# *Socio-Legal Dimensions of DNA Technology: It's Interface with Indian Legal System*

A Thesis

Submitted for the award of the Degree of

Doctor of Philosophy in Law


Submitted By:

*Harita Shinde*

Department of Law, Faculty of Law
The Maharaja Sayajirao University of Baroda
Vadodara

Guided By:

*Prof. (Dr.) Syed Maswood*

Department of Law, Faculty of Law
The Maharaja Sayajirao University of Baroda
Vadodara

# Certificate

*Certified that the thesis entitled "Socio-Legal Dimensions of DNA Technology: It's Interface with Indian Legal System" has been prepared by Ms. Harita Krishnarao Shinde under my supervision and guidance. The thesis is her original work completed after careful research and analysis of data available in previous works and various judicial pronouncements. The thesis is of the standard expected of a candidate for the Degree of Doctor of Philosophy in Law and I recommend that it be sent for evaluation.*


*Prof. P.M.Patel*
*O.S.D.*
*Faculty of Law*
*M.S.University of Baroda*
*Vadodara*

*Prof. (Dr.) Syed Maswood*
*Guide*
*Faculty of Law*
*M.S.University of Baroda*
*Vadodara*

# DECLARATION

I declare that the thesis entitled "**Socio-Legal Dimensions of DNA Technology: It's Interface with Indian Legal System**" which is submitted for the award of Degree of Doctor of Philosophy in Law has not been submitted by me in any other University for any degree or diploma.

Date: Harita Shinde

Vadodara

# AKNOWLEDGEMENT

***"Sa vidya ya vimuktaye"***

Ideas basically rule the world and also the minds of the man. They contribute to continuing changes, shape as well as determine the destiny of human beings. And contribute to the growth of the whole society. Very grant and great accomplishment whether relating to religion, science, Law or any other field is in the first instance a mere idea in the mind of the human begin. These ideas can only be converted in to action only by the grace of God. Thus, I express my pious gratitude to almighty.

I would like to express my gratitude to my guide Dr. Syed Maswood, who has, since the beginning of the Dissertation work, been guiding me as a polar star.

I must also thank to teachers, administrative staff and my friends for always being with me and providing moral support and kind co-operation in accomplishment of my Thesis.

I find no word to express my deep gratitude to my family members, especially my mother Mrs. Usha Krishnarao Shinde for providing me the moral boost during all ups and downs of my Ph.D. work.

This whole experience has been an overwhelming, inspiring elevating one for me.

Date: Harita K. Shinde,

Place: Vadodara

**Table of Cases**


- Abdul Salam v. Chalil Sajid And Others, 2003,1 DMC 774
- Alika Khosala v. Thomas Mathew, 2000 Cr.L.J. 1208(Ker), Manu/De/2001
- Arukumar v. Turaka Kondalal Rao,1998 Cr.L. J.4279
- Ananth Kumar v. State of A.P., 1977 CR.L.J. 1797
- Anil Kumar v. Turaka Kondala Rao And Other,1998 Cr.L.J. 4279 (AP)
- Ammathyee v. Kumar Sain, AIR 1967 SC 549
- Baldev Raj Mighani v. Urmila Meghani, AIR 1979 SC 879
- Banarsi Das v. Mrs. Teeku Dutta and Others, 2005 (52) A Cri C 481 SC
- Bharu Raj v. Sumesh Sachdeo, AIR 1986 All 259
- Bipin Chandra Shantilal Bhatt v. Madhuri Ben Bhatt, AIR 1963 Guj. 250
- Bommi And Others v. Munirathinam, 2004 (2) HLR 517 9 (Mad)
- CBI v. Santosh Kumar Singh, AIR 1994 SC 786
- Chandan Pannala Jaiswal v. State Of Gujarat-2004 Cri.LJ 2992 (Guj)
- Chandradevi and others v. State of Tamilnadu, Manu/TN/2335/2002
- D. Rajeswari v. State Of Tamilnadu and Others, 1996, Cri. L J3795(Mad)
- Dakhlae Jhan v. Frooq, AIR 1987 SC 1049
- Dharma Deo Yadav v. State of U.P.,2005 (2) DNR(HC)675
- Dwarika Prasad Satpathy v. Bidyut Prava Dixit- 2000 Cri LJ 1 : AIR 1999 SC 3348
- Geeta Daha v. NCT of Delhi (DB 200) 1997(1) JCC 101
- Goutam Kundu v. State of West Bengal , AIR 1993 SC 2295
- Hargovinda Soni v. Ram Dularey, AIR 1986 MP 57
- Haribhai Chanabhai Vora and Others v. Keshubhai Haribhai Vora, AIR 2005 Guj. 157
- Jamshed v. State of U.P., 1976 Cr. L. J.1680
- Jothi Ammal v. K.Anjan, (2007) DMC 756 (DB)
- Karpaya Servai v. Mayandi, AIR 1934 SC 49
- K. Selvaraj v. P. Jayakumari, 2000 Cr.L.J. 4748 (Kerala) 201

- Kamalnath and others v. State of Tamilnadu, 2005 (2) SCC (cr.) 1121
- Kanchan Bedi v. Gurpreet Singh Bedi v. Shri Gurpreet Singh Bedi, 2003 (103) Delhi LT 165, AIR 2003 Delhi 446
- Kamti Devi v. Poshi Ram, AIR 2001 SC 2226
- krish Murthi Aiyer v. Govind Swami Palley, AIR 1966 Mad.443
- M.Karthika v. R.Manohar, C.R.P.(PD)No.1528 of 2008,M.P.No.1 of 2008
- Mathew v. Annamma Mathew,1994 (1) DMC 524 (ker.)
- Mir Muzzafarruddin v. Sayed Ariffuddin Khan, 1971 (3)SCC 810
- M. V. Mahesh v. State of Karnataka 1996 Cr.L.J.221 (Kant.)
- Mr. X v. Hospital, AIR 1999 SC 495, 1998 SCW 3662
- Ms. X v. Mr. Z, AIR 2002 Delhi 217
- Najabhai v. State of Gujarat, 1972 Cr. L.J. 1605
- Narinder Singh Bogarh v. State Of Punjab, 2004 Cr.L.J. 1446 SC
- Patangi Balrama Venkata Ganesh And Others v. State of A.P, 2003 Cr.L.J. 4508(A.P.)
- Polavarrappuvenkatasvarallu and Others v. Polavarrappu Subbaiya, AIR 1995 Madras
- Perumal Nadir v. Ponnuswami, AIR 1971 SC 2352
- R.P. Uloganambi v. K. C. Loganayaki, 1986 Cr.L.J. 1522.
- Rajesh Chaudhary v. Nirmala Chaudhary, 205(2) Divorce and Matrimonial Cases Delhi 814
- Raghunath v. Shardabai, AIR 1986 Bombay 386
- S. Thangavelu v. Kannammal, 2005 (25)AIC 496
- Sadashiv Mallikarjun Khedarkar v. Nandini Sadashiv Khedkar, 1995 Cr.L.J. (Bom) 4090
- Sharda v. Dharampal, 194 AIR 2003 SC 3450
- Shailesh Munjal And Others v. All India Institute of Medical Science and Others, 2004 Consumer Protection Reporter 27(NC) (Del).
- State of UP v. Amarmani Tripathy 2002 Cr.L.J. 396
- State v. Sheshappa Dudhappa Tambade, AIR 1964 Bom. 253

- Sharad v. Dharmapal, AIR 2003 SC 3450
- Sajeera v. P.K. Salim, 2000 Cr L J 1208 (Ker)
- Sajitha v. State of Kerala,2003 (1) DMC 222 ker
- State v. Sheshappa Dudhappa Tambade, AIR 1964 Bom 253
- Smt. Dukhlar Jahan v. Mohammad Farooq, AIR 1987 SC 1049,
- Sunil Eknath Trambake v. Leelavati Sunil Tambake, AIR 2006 Bombay 140
- Syed Mohammad Ghouse v. Noorunnissa Begum, 2001 CrLJ 2028
- State of Bombay v. Khthikalu, CR.L.J. 1961(2) 856
- Subayya Gounder v. Bhoopala Subramaniam, AIR 1959 Madras 396
- V.K.Bhuvaneswari v. N.Venugopal, Dated: 15/12/2006, C.R.P.PD.No.776 of 2006
- Vasu v. Santha, 1975 Ker LT 533
- Vishal Motising Vasava v. State Of Gujarat, 2004 Cr.L.J. 3086 (Guj.)

# CONTENT


| | | |
|---|---|---|
| Declaration | | iii |
| Acknowledgement | | iv |
| Table of cases | | v |


# INDEX

## Chapter-I

## Introduction


| | | |
|---|---|---|
| 1. | Introduction | 1 |
| 2. | Objectives of the study | 15 |
| 3. | Nature and Scope of the Study | 17 |
| 4. | Rational of the Study | 18 |
| 5. | Hypothesis of the Study | 23 |
| 6. | Utility of the Study | 24 |
| 7. | Research Methodology | 25 |
| 8. | Review of Literature | 26 |
| 9. | Limitation of the study | 27 |
| 10. | Scheme of study | 28 |


## Chapter-II

## Concept, Nature and Scope of DNA Technology –Scientific, Social and Legal Study


| | | |
|---|---|---|
| 1. | Introduction | 31 |
| | 1.1 Basic Biology of DNA | 31 |
| 2. | DNA Fingerprinting | 37 |

| | | | |
|---|---|---|---|
| 3. | Various Techniques of DNA Fingerprinting: | | 38 |
| | 3.1 | Restriction Fragment Length Polymorphism Testing (RFLPT) | 39 |
| | 3.2 | VNTR Typing (Variable number Tandem Repeats) | 39 |
| | 3.3 | PCR-Polymerase Chain Reaction Testing-Nuclear DNA | 41 |
| | | a. Steps of PCR Analysis | 42 |
| | | b. Methods of PCR | 42 |
| | | c. Difference between PCR and VNTR | 43 |
| | | d. Disadvantages of PCR Method | 44 |
| | 3.4 | STR Analysis | 44 |
| | 3.5 | Polymerase Chain Reaction Testing – Mitochondrial DNA | 45 |
| 4. | Sources of DNA Evidence: | | 46 |
| 5. | How DNA Fingerprinting is done | | 46 |
| | 5.1 | Gathering DNA Evidence | 46 |
| | 5.2 | Identifying DNA Evidence | 47 |
| | 5.3 | Crime Scene Integrity | 47 |
| | 5.4 | Chain of Custody | 48 |
| | 5.5 | Transportation and Storage | 48 |
| | 5.6 | Analyzing DNA Evidence | 49 |
| 6. | DNA Samples | | 50 |
| | 6.1 | Bayes Theorem | 50 |
| | 6.2 | Steps in DNA Sample Processing | 51 |
| | 6.3 | Possible Results from DNA Tests | 55 |
| 7. | Forensic Science | | 57 |
| 8. | Forensic Evidence: | | 58 |
| 9. | Scope, Purpose, Use, application of DNA Fingerprinting: | | 58 |
| 10. | Nature and Scope | | 59 |
| 11. | Use of DNA Technology in Legal Systems | | 60 |
| | (a)The Frye Test | | 61 |
| | (b) The ‘Helpless’ Standard | | 62 |
| | 11.1 | Position in India- | 65 |
| 12. | Services for Laboratories | | 66 |

13. DNA Data Bank 66
13.1 Forensic DNA Databases: 67
13.2 Combined DNA Index System 68
13.3 Basics of How CODIS Works 68
13.4 Capabilities of CODIS Software 69
13.5 Levels of the Database. 70
13.6 NDIS Procedures and Administration in U.S.A. 71
13.7 Forensic databases 72
14. DNA Laboratories 77

## Chapter-III

## Historical Development and Evolution of DNA Technology – Religious & Ethical Perspectives

1. History of Forensic DNA Analysis 94

1.1 Introduction: 84
1.2 Identification of Individuals 85
i Identification Of Individuals Through Fingerprints- 85
ii Through Blood Grouping test 86
iii Through DNA fingerprinting 88
1.3 First time uses of DNA Evidence for the purpose of Law. 89
2. Social-Ethical-Economic-Religious perspective of DNA 90
2.1 Ethical Aspects 90
2.2 Bioethics 91
2.3 Non monetary Costs and Benefits 92
2.4 Genetic testing 94

a. Ethical, Legal, and Social Concerns about DNA Data banking 95
3. Universal Declaration on the Human Genome and Human Rights and Ethics 95

4. Moral Rights 98
5. Religious issue 100
(i) Jews
(ii) Protestant Christians
(iii) Buddhists
(iv) Islam philosophy
(v) Hindu Vedanta philosophy
(vi) Greek philosophy
6. Economic Aspects 103

## Chapter-IV

## Various Socio-Legal Aspects of DNA Technology

1. Introduction: 105
1.1 Impact and application of DNA Technology on Society at large 105
2. Use of DNA Information in the Legal System 106
2.1 Investigation stage: In Criminal cases 106
2.2 Criminal Investigation: 107
3. DNA and Criminal Cases 115
4. The Admissibility of DNA Evidence 116
5. Role of Expert 120
a. DNA and Probability – Some Issues: - 121
b. Presentation of DNA Evidence in Court121 121
c. DNA Evidence is not infallible 121
d. Expert Evidence and the Prosecutor's Fallacy121 122
e. Post- conviction DNA Testing 123

6 Use of DNA Technology in civil cases 126
6.1 Law Relating To Parentage Related Issues- Paternity And Maternity*:* 126
a. Parentage Testing 126

b. Evidentiary Aspects of DNA and Cases relating to Paternity Disputes 130
c. Parentage Identification: 131

7. Adultery 131
8. Inheritance and Succession 132
9. Maintenance 132
10. DNA and Right to Privacy/Information 133
10.1. Concept of right to privacy 133
a. Meaning of Privacy 133
b. UDHR on Right to privacy 133
c. ICCPR and Right to Privacy 133
d. European Convention on Human Rights 133
e. Concept of right to privacy in United States 134
f. Concept of right to privacy in India 134
g. The National Commission's review 135
11. Genetic Privacy 135
12. DNA Database and Constitutional Concerns 138
13. Genetic Discrimination 144
14. The Human Genome Project, 1990 – 2003 145
15. Protection of Human Genetic Information 147
16. Human Enhancement 149
17. Genetic Weapons 150
18. Gene Patents 155
18.1 Background to biotechnology and Intellectual Property 155
18.2 How the Patent system works 156
18.3 Gene patenting 157
18.4 Why are genes being patented 160
18.5 Legal protection given to biotechnology 162
18.6 Patenting of Transgenic Animals 166
a. Ethical-Moral Issues 166

18.7 Why say NO to Life patenting 170
18.8 Whether Patent Law Protects Biotechnological Inventions 171
18.9 Factors determining the question of patentability 171
18.10 Dangers involved 172
18.11 Benefits 172
18.12 Conclusion 173
19. Biotechnology 174
20. Genetic engineering 174
20.1 Concept definition 174
20.2 Fundamentals of Genetic Engineering 175
20.3 Current Recombinant Cloning Technology 176
20.4 Human Disorders and Gene Therapy 176
21 Human Genome Project 177
21.1. Legal and Ethical Considerations 178

## Chapter-V

## Legal Perspective of DNA Technology

1 Legislations In India 180
1.1 Constitutional Provisions 180
1.2 The Indian Evidence Act, 1872 183
a. Evidence of Expert 184
b. Evidentiary Aspects of DNA and Cases relating to Paternity Disputes 185
c. Direction to Give Sample and Adverse Inferences 188
1.3 Criminal Procedure Code, 1973 191
1.4 Code Of Civil Procedure, 1909 192
1.5 The Indian Penal Code 1973 193
1.6 Identification Of Prisoner's Act, 1920 194
1.7 Transplantation of The Human Organs Act 1994 194
1.8 Patenting Laws 195
1.9 Indian succession Act, 1925 200
1.10 Family Laws 201

1.11 Medical Termination of Pregnancy (Amendment-2004) Act 1971 201

2. DNA Legislations in Other Countries (An Overview)

2.1 Laws In New Zealand 201

2.2 Laws in China 203

2.3 Laws In Canada 204

2.4 Law In United Kingdom/England 205

2.5 Law In United States 209

a. Admissibility 210

**i**. The Frye Test 211

ii. Helpfulness Standard 213

iii. Cases on Admissibility of DNA Evidence Under the Federal Rules 213

2.6 The Australian Law 216

3. Indian Legal Scene: A Comparative-study/Analytical Study 219

3.1 Position in Civil Law 220

3.2 Position in Criminal Law 222

3.3 Legislative Responsibilities 224

**Chapter-VI**

## Judicial Response & DNA Technology

1. Judgment delivered by Supreme Court of India 225

2. Judgment delivered by different High Courts of India 235

## Chapter-VII

# Conclusion


1. Introduction
   - 1.1 DNA Databank: An Over View 260
   - 1.2 Forensic Laboratories 261
   - 1.3 DNA Profiling Board 263
   - 1.4 Use of DNA Data Base 264
   - 1.5 Comparison of DNA Profiles and Latent Fingerprints 266
   - 1.6 Confidentiality and Security 268
   - 1.7 Methodological Standardization 270
   - 1.8 Cost versus Benefit 271
   - 1.9 Whose samples should be included 272
   - 1.10 Information to Be Included and Maintained In a Databank 275
   - 1.11 Rules on Accessibility 275
   - 1.12 Status of Databank Development 276
   - 1.13 Summary of Recommendations 277
2. Advantage of DNA 279
3. Reliability on the technique 279
4. Challenges for DNA investigators 280
5. Barriers to Realizing the Potential of DNA Evidences 285
6. Overcoming the Barriers (Suggestions) 287
7. Amendments in Law -Some suggestions 288
   - 7.1 Drastic changes required in India 290
   - 7.2 The Need for Judicial Education 293
   - 7.3 Social awareness about the issue 295
   - 7.4 Transportation and Storage 295

8. DNA evidence and the various parties in the legal system-
   Role of various agencies 296
   - 8.1 Role and Duties of DNA Forensic Laboratories 296

8.2 Crime Laboratory Managers 298
8.3 Forensic Scientists 300
8.4 Role of Expert 300
8.5 Researchers 301
8.6 Officers and Investigator 302
8.7 role/duties of judges Crime Scene Integrity-
Duty of Investigating Agency 302
8.8 Law Enforcement and Officers of the Court 304
8.9 Victim's Advocates 305
8.10 The Prosecutor 306
8.11 The Defense 307
8.12 Policymakers and Lawmakers 309
8.13 Data Bank Related Conclusion-Suggestions 310
8.14 Other Suggestions Recommendations 311
a. Eliminating Backlogs 311
b. Effect of Clearing the Backlog 311
c. Strengthening Crime Laboratory Capacity 312
d. Increasing the Analysis Capacity of Public Crime Labs 312
e. Funding the Forensic Analysis Programs 313
f. Stimulating Research and Development 313
g. Improving DNA Technology 314
h. Establishing DNA Demonstration Projects 314
i. Creating a National Forensic Science Commission 315
8.15 Training to various agencies 316
a. Training the Criminal Justice Community 316
b. Law Enforcement Training 317
c. Training Prosecutors, Defense Attorneys, and Judges 317
d. Training for Probation and Parole Officers 318
e. Training for Forensic Scientists 318
f. Training for Medical Personnel 318
g. Training for Victim Service Providers 318

| | | |
|---|---|---|
| 8.16 | Accountability and Public Security | 319 |
| 8.17 | Expectations | 320 |
| 8.18 | International Exchange | 322 |
| 8.19 | Universal Declaration on the Human Genome and Human Rights (UDHR), 1997 | 323 |
| | Conclusion | 326 |

| | |
|---|---|
| Bibliography | i |
| Appendix-I | vii |
| Appendix-II | xiii |
| Appendix-III | xvi |

# Chapter-I

## Introduction

*"DNA Is the Micro Compact Hard Disc of Nature Which Reveals the Biological History, Chemical History and Inheritance of an Individual"*

"Science" is a term which has something to do with inventions in various fields of human life which include observation, experiments conclusion; and application of science with various tools and techniques is known as "Technology".

Science and Technology has made the human life so comfortable, easy and dependent that we cannot imagine our survival without it. It is Science with Technology which differentiates human beings from other creatures on the earth.

Directly or indirectly in a way we are living the life of science without consciously knowing its actual concept and importance. There are infinite aspects related with science, one of which is "science of study of human cell". In scientific language it is known as "Deoxyribonucleic acid" and DNA fingerprinting is an indispensable part of the same.

'DNA fingerprinting' or DNA typing (profiling) as it is now known, was first described in 1985 by an English geneticist named Alec Jeffreys. Dr. Jeffrey found that certain regions of DNA contained DNA sequences that were repeated over and over again next to each other. He also discovered that the number of repeated sections present in a sample could differ from individual to individual. By developing a technique to examine the length variation of these DNA repeat sequences, Dr. Jeffrey created the ability to perform human identity tests.

Before that the identification of an individual was carried on through Fingerprints, which was considered as one of the most reliable physical evidence used in the determination of the identification of the person. But later it was found that even fingerprints can be altered by surgery. Also the problem with the fingerprints is that the two individuals can have the same fingerprints although the chances are very-very low.

After that the identification was begun to be determined through Blood Grouping test, but the limitation was they may exclude a certain individual as the possible father of the child but cannot possibly establish paternity. And at last DNA Technology was invented which has been proved a benediction for everlasting generations. The said subject has been chosen with a purpose to understand and convey its use and application with relation to society, science and focusing on Law.

DNA Technology is mainly used for identification and establishing blood relations with the use of legal evidence to resolve the legal issues of inheritance, maintenance, maternity and paternity, for criminal investigation to solve various crimes, Identify endangered and protected species, for medical use and biotechnological research purpose, to identify and cure diseases etc. The list is infinite.

DNA[1] or Deoxyribo Nucleic Acid is the fundamental Building block for an individual's entire genetic make-up. It is a component of virtually every cell in the human body, a person's DNA is the same in every cell. DNA profiling is a new technique to identify a person on the bases of his genes as no two persons have the same identical sub-genetic structure. It is also known as genetically fingerprinting and is not concerned with the conventional process of finger printing. This technique detects and displays a DNA pattern, which is unique to every person as simple tracks of bands like a bar code found on food packing. DNA is the powerful tool because each person's DNA is different from every other individual, except for identical twins, DNA fingerprinting works on the principle that every individual in this word can be differentiated and identified at molecular level on the basis of DNA the genetically material which inherits from his parents and which is identical in every cell.

The application of DNA profiling spreads far and wide across both civil and criminal process of operation. Over the years this technique has undergone rapid changes. There are many rapid scientific doubts regarding the veracity of this process, which requires a detailed scientific study, but it is too technical to be discussed.

[1]See, Article "Advancing Justice through DNA Technology", Available at http://www.dna.gov/audiences/investigators/know/whatisdna (Last accessed on: 2nd Jan., 2007)

The DNA technology has been expanded to the horizons of various fields like genetic weapons, human expansion, patenting and inventions, bio-technology and genetic engineering, diseases; other than having its importance in the civil and criminal investigation; and still on the way of developments.

In this research work the efforts have been made to explain the various socio-legal dimensions of DNA Technology and its interface with Indian Legal System. For example; as compared to the other countries of the world, how far the Indian legislations, judiciary and society have been proved successful in using, applying and accepting the DNA technology. The question is; whether any efforts have been made to modify the existing laws to contribute in these directions? There are many more other questions which require reasonable, rational, analytical answers. Hence, this research work is prepared with the same purpose and object.

## 1.1 Understanding Genetic and Molecular Basis for DNA Testing:

Some principles of genetics and molecular biology are necessary to understand the two principal kinds of genetic systems used in forensic DNA typing. Efforts have been made to describe some basic concepts about DNA, chromosomes and genes

Each human body is composed of an enormous number of cells. Most of these cells contain a nucleus (or inner part), which in turn contains the person's genetic material (the *genome*). All the cells in every human body descend by successive divisions from a single fertilized egg[2].

## 1.2 What is DNA?

Chromosomal DNA is the chemical storehouse of genetic information. The DNA molecule itself resembles a twisted ladder or double helix. The molecule is composed of four chemical subunits called *bases*: Guanine (G), Adenine (A), Thymine (T) and Cytosine (C). These bases pair between strands: A on one strand with T on the other, and C with G. The sequences of base pairs in turn are arranged in long chains of

[2] Ibid 1

varying lengths that form the DNA double helix. Each person has about 3.3 billion base pairs[3].

### 1.3 DNA Resides in the Chromosomes:

Virtually the entire complement of a person's genetic material resides in the *chromosomes*. A chromosome is a very thin thread of DNA, surrounded by other materials, mainly protein. Chromosomes are located in the cell's nucleus.

Almost all cells in the human body contain 23 pairs of chromosomes (for a total of 46 chromosomes). The two members of a chromosome pair are said to be *homologous*. One member of each homologous pair is inherited from the mother (the egg) and one from the father (the sperm). Because of the way DNA in the original fertilized egg replicates itself, virtually every cell in the body has the same chromosomal make-up. An important exception is found in sperm and egg cells, which have only half as many chromosomes (a total of 23) as the rest of the body's cells. The full number, 46, is restored by fertilization[4].

### 1.4 Genes and Chromosomes:

Integral to the chromosomes is the genes. Structurally, a gene is "*a stretch of DNA, ranging from a few thousand to tens of thousands of base pairs, that produces a specific product, usually a protein.*[5]" Functionally, genes are the basic units of heredity. The gene's function is determined by the order of the four kinds of bases within it. The specific base sequence acts as an encoded message, each specifying an amino acid (a protein building block).

Genes are interspersed among the rest of the DNA and actually compose only a small fraction of the total DNA. Genes differ from the rest of the DNA on the chromosome only in having a specific sequence of bases, which enable them to encode a specific protein. Most of the rest of the DNA has no known function.

---

[3] Ibid 1

[4] See, article on Human Genome Project, available at http://www.answers.com/topic/human-genome-project (Last accessed on: 2nd Jan., 2007)

[5] Ibid 1

The position that the gene occupies along the chromosome (or DNA thread) is its *locus.* Each chromosome contains many different loci, arranged in a specific linear order. The order is the same for every human. For example, the locus for the gene responsible for cystic fibrosis is on chromosome. Everyone has this gene at the same position on chromosome, although only some people have the alteration in the gene that causes it to be defective and produce cystic fibrosis.

Genes are passed on from parents to their offspring via egg and sperm cells. During *meiosis*, the process that results in the development of sperm or egg cells, two partner chromosomes in a chromosome pair line up side-by-side and randomly exchange parts. The result is that genes formerly located on the same chromosome can move to the *homologous chromosome*, and genes formerly located on homologous chromosomes can move to the same chromosome. Genes that are very close to one another on the same chromosome might remain associated for many generations before they are separated. Genes on the same chromosome are said to be *linked*; that is, they tend to be inherited together. Genes residing on *no homologous* chromosomes are inherited independently, as are genes far apart on the same chromosome.

### 1.5 Most Genes Are the Same for All Humans:

Most loci contain the same gene in every human being, while some (like the cystic fibrosis example) can vary among individuals. It is thought that about 3 million of the total 3.3 billion base pairs differ between any two individuals. In other words, most of our genetic material is the same. This fact is not surprising when we think of how many characteristics all humans share: one head, two eyes, two legs, etc.

### 1.6 Some Genes Differ Among Individuals:

At each genetic locus reside two genes, one inherited from the mother and one from the father. The form of the gene inherited from the mother can differ from the one inherited from the father. An *allele* is an alternative form of a gene (for example, those producing normal and sickle cell haemoglobin). If the mother and father have different alleles, then their child will inherit one allele from the father and one from the mother. In other words, while only two genes reside at each locus, multiple different alleles are possible at each locus.

An example is the gene responsible for determining blood type. Three possible variants or alleles exist for this gene: A, B, and O. which combination of the three a person has depends on which she inherited from her parents. So if the father passed on the A allele and the mother passed on the B allele, the child is blood type AB. Someone who got the O *allele* from one parent and the O from the other would be type O. In a more generic example, if there are two possible alleles at a locus, A and a, then there are three *genotypes:* AA, Aa, and aa. The word *genotype* refers generally to the genetic makeup of an organism; however, it also can be used to describe the genetic makeup at a number of loci, from one to the total number[6].

DNA testing concerns itself with those loci at which genes can differ among individuals. Obviously, it would do no good to test one of the loci for which no genetic variation is possible, because the test would show a complete match for every human being. Forensic DNA tests also typically examine alleles from four or five different loci. The tests compare DNA sequences at these loci between different individuals.

### 1.7 Description of Forensic DNA Testing:

As of 1995 or so, most DNA testing involved one of two basic techniques: analysis of *variable-number tandem repeats* (VNTR), and polymerase chain reaction-based (PCR) methods. PCR is the newer of the two technologies.

**Use of the DNA testing:**

i. Identification of Parentage, paternity, maternity can be identified; to identify, decide and establish the blood relation between two persons, whether they are real brother or sisters and about their ancestors.

ii. Acceptance of parentage: Once identified can't be denied the parentage-paternity/maternity, conclusively solve the question of maternity in case where no one is ready to accept the child as their biological child.

[6]See Article on DNA Technology Available at http://www.ornl.gov/sci/techresources/Human_Genome/elsi/forensics.html (Last (accessed on: 2nd Jan., 2007)

iii. Succession right: biological parents cannot lie to their child, to court, to law then they are not parents of the infant or child to get the succession right.

iv. For criminal investigation of murder where deceased is unidentified and body is very much mutilated- for identification of person and determination of the sex of the deceased.

v. Used against suspects in solving various crimes. (E.g.or Forensic Identification)

vi. Identify potential suspects whose DNA may match evidence left at crime scenes

vii. Exonerate persons wrongly accused of crimes

viii. Identify crime and catastrophe victims

ix. Identify endangered and protected species as an aid to wildlife officials (could be used for prosecuting poachers)

x. Detect bacteria and other organisms that may pollute air, water, soil, and food

xi. Match organ donors with recipients in transplant programs

xii. Determine pedigree for seed or livestock breeds

xiii. Authenticate consumables such as caviar and wine

The list is not exhaustive.

We can say that no area of human life has been left untouched by use and application of DNA Technology. It has become indispensable Part of our life. And hence the in-depth study of the same is required by taking into consideration the social, scientific, moral-ethical perspective of DNA technology by studying it's relation with law.[7]

[7] Interpretation and analysis are discussed further in chapter 2 of the Research work.

**Explanation of the Title of the Doctrinal Work with the Help the Charts:**

**(a) Multi-Dimensional Features of DNA Technology –Chart-1**

DNA Technology carries the multidimensional features though contains very small portion of the animate inanimate things. DNA Technology has expanded it's horizons to various areas such as health and diseases, human genome project, genetic engineering, intellectual property, bio-ethics human enhancement, forensic science and what not. And still has scope of further expansion on the bases of scientific and technological applications covering various aspects of the human life.

But at one side DNA Technology has facilitated the human life, and on the other side it is subjected to criticisms and required a thorough discussion and analysis and created a number of problems for the spheres related with human concerns such as –

1. Society;
2. Science;
3. Law;
4. Ethics;
5. Religion;
6. Jurisprudence Etc.

There is a specific nexus between DNA Technology and all above mentioned aspects of life.

**Chart-1: Multi-Dimensional Features of DNA Technology**

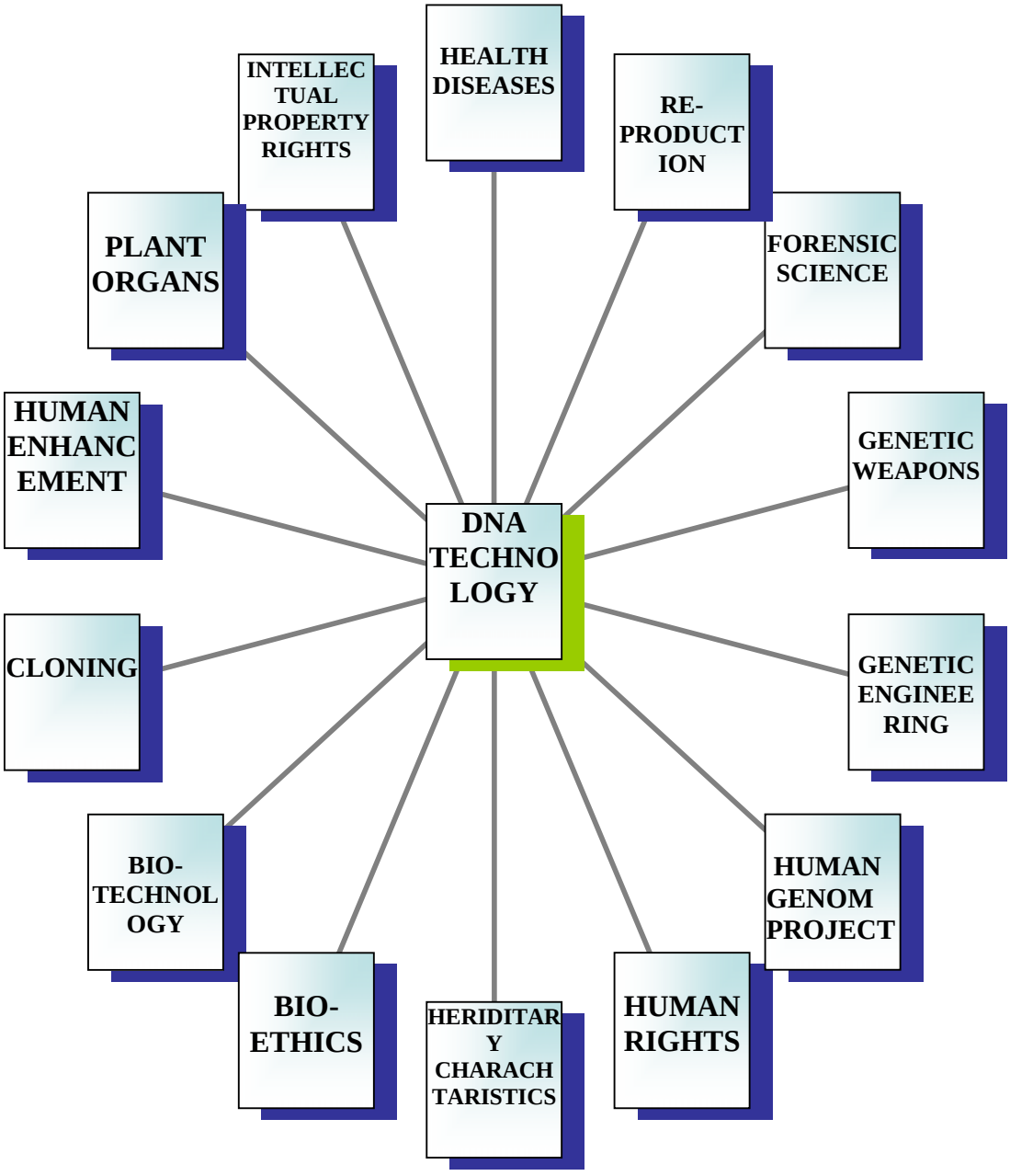


**Chart-2**

(b) Interdependence-Interrelationship of Various Social, Legal and Scientific Aspects/ Dimensions with DNA Technology. This can be explained with the help of Chart -2.

**Relation between Science and Society:**

In this Van-Diagram of the DNA Technology the over-lapping field of science and society indicate the area of ethics, morals and religion. There has always been a war between the science and religious ideology, morals and ethics in society.

**Relation between Law and Society:**

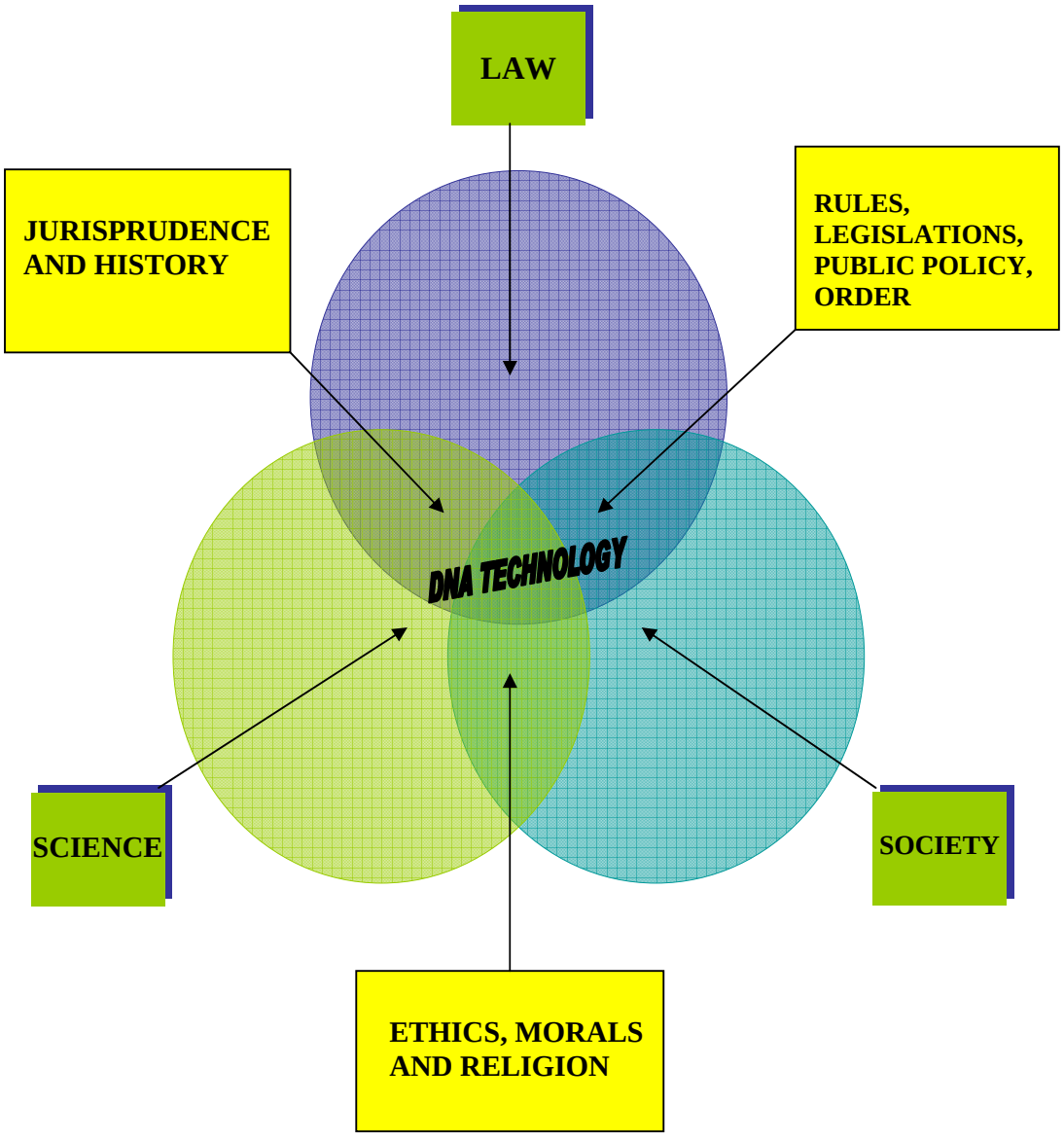
The overlapping fields are of law and society indicated the rules, regulations, public policy, law and order etc. As per the 'Social Engineering' theory of Roscoe Pond law is the creation of society. It is managed, controlled by Law in society only. No society means no law in Existence.

**Relation between Science and Law:**

Again in case of overlapping of science and law there has always been a conflict between these both on issues as explained in the chart. That means the Jurisprudence which is considered as philosophy of law also includes science in it which is explained in various theories under Jurisprudence. Among all these three areas the DNA Technology can be seen falling in centre as it has relation with all three aspects viz. Law, Science and Society.

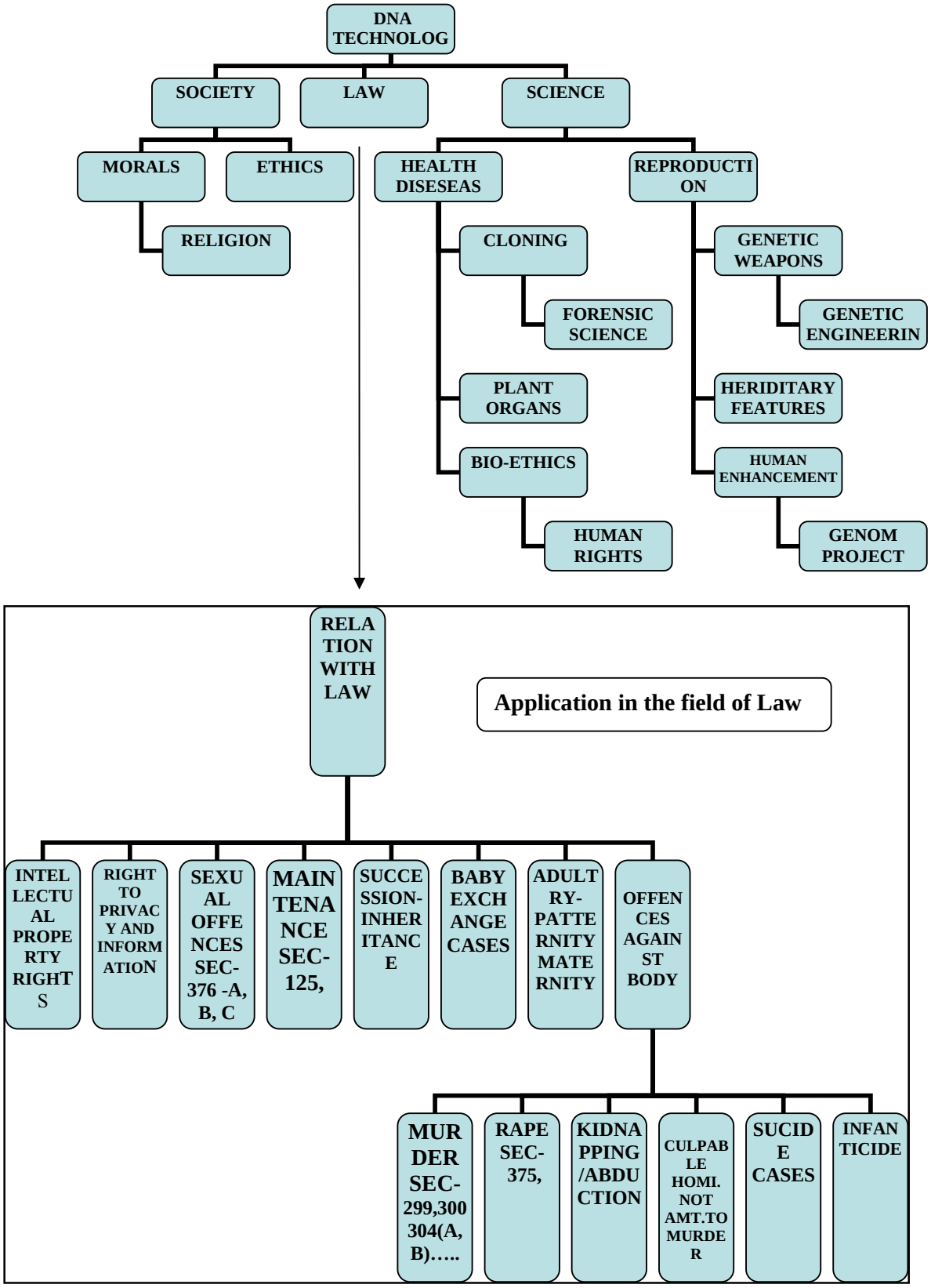
Thus, the vary title of the Research can be explained with the help of the explanation of inter-dependence and interrelation of DNA Technology with various social, legal and scientific aspects or dimensions.

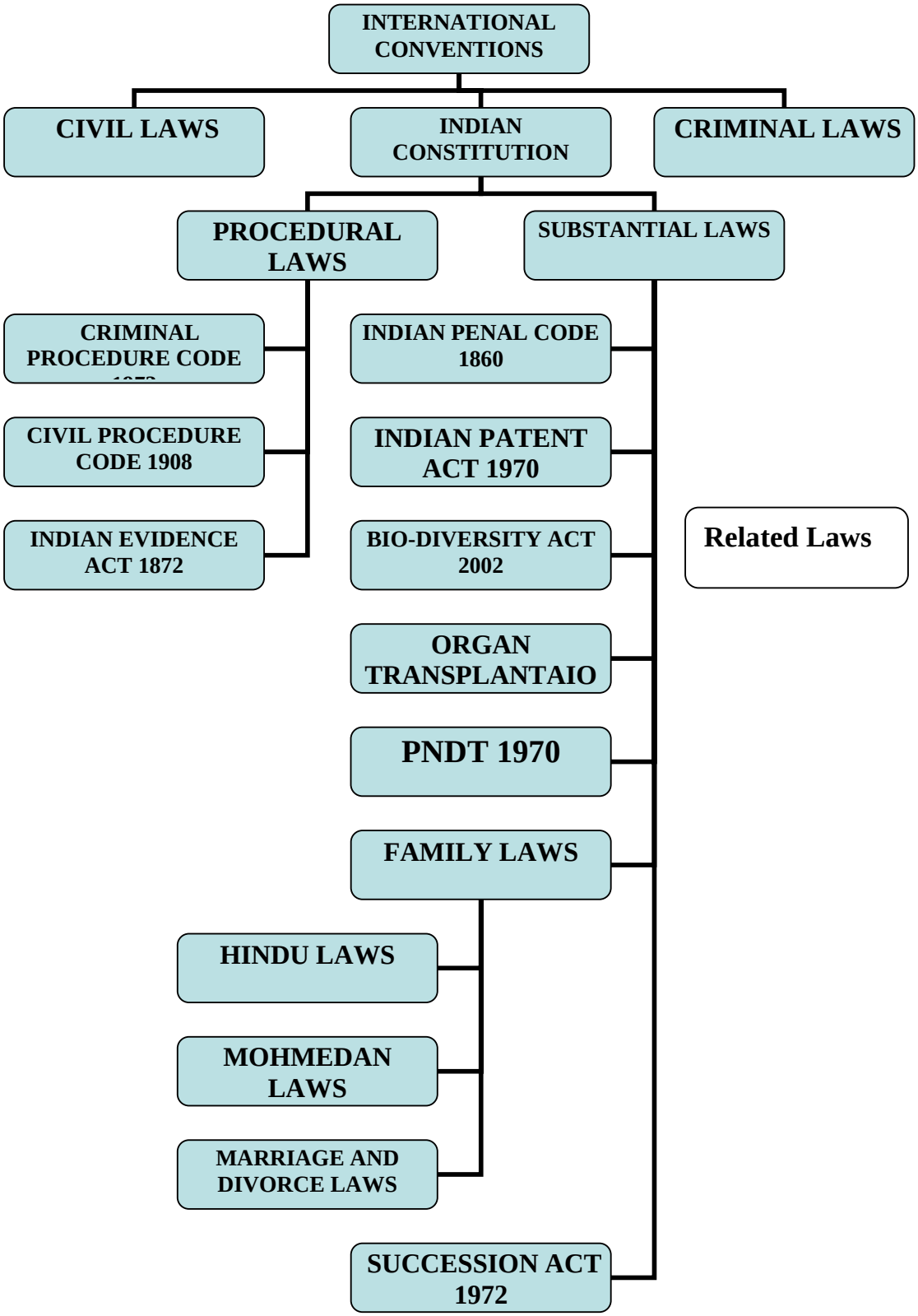
**Chart-2**




Interdependence-Interrelationship of Various Social, Legal and Scientific Aspects/ Dimensions with DNA Technology

**Chart-3: Socio-Legal Dimensions of DNA Technology:**




INTERNATIONAL CONVENTIONS
CIVIL LAWS
INDIAN CONSTITUTION
CRIMINAL LAWS
PROCEDURAL LAWS
SUBSTANTIAL LAWS
CRIMINAL PROCEDURE CODE
CIVIL PROCEDURE CODE 1908
INDIAN EVIDENCE ACT 1872
INDIAN PENAL CODE 1860
INDIAN PATENT ACT 1970
BIO-DIVERSITY ACT 2002
Related Laws
ORGAN TRANSPLANTAIO
PNDT 1970
FAMILY LAWS
HINDU LAWS
MOHMEDAN LAWS
MARRIAGE AND DIVORCE LAWS
SUCCESSION ACT 1972

**(d) Chart- 3 and 4**

The Central Idea of the research work and the Title of the research work i.e. "*The* Socio-Legal Dimensions of DNA Technology: Its Interface with Indian Legal System" can be explained with the help of Chart-3 and 4.

Thus this chapter gives the brief idea and explanation of the topic of the research work. This has been discussed in next chapters in detail.

## 2. Objectives of the Study:

The Constitution of India, by Article 51A (h) and (j), declares that, it shall be the duty of every citizen of India "to develop the scientific temper, humanism and the spirit of inquiry and reform"; and "to strive towards excellence in all spheres of individual and collective activity so that the Nation constantly rises to higher levels of Endeavour and achievement." The Parliament is legislatively competent to make laws with respect to the Union agencies and institutions for professional, vocational or technical training, promotion of special studies or research, or scientific or technical assistance in the investigation or detection of crime and with respect to coordination and determination of standards in institutions for higher education or research and scientific and technical institutions[8]. The constitutional provisions take care of the scientific developments that may take place and may be put to use for the benefit of the people. The Constitution provides efficient scales for balancing between public and private interests and the Courts have put to use its provisions for an effective social engineering to protect both the cherished human rights recognized by the Constitution and the paramount public interest in a welfare State.

The study on "Socio-legal dimensions of DNA technology and its reflection on Indian legal system" has been carried out by taking into consideration the following objectives.

i. To understand the meaning, nature, scope and concept of the various terminologies relating to DNA Technology.

ii. To find out the application of DNA technology in Indian legal system i.e. both civil and criminal judicial system. To establish the relationship between the law and science-modern technology.

iii. To discover the effect, success and failure of use/application of DNA Technology in Indian context. I.e. How far the Indian judiciary has been proved successful in dealing with the cases where the DNA technology has been used directly or indirectly.

[8] J.N. Pandey *: The Constitution Law of India*, 44th Edition, 2006 ,65 and 66 of the Union List in the Constitution of India

iv. To understand and analyze various social-scientific-legal dimensions/aspects, their impact, effect, causes, reasons for/of the use and application of the DNA technology as far as the law, society, science, ethics and jurisprudence are concerned.

v. To establish the relation between the mythological history and use of science of DNA technology in modern era.

vi. To decide the legal position and carry a comparative study of the Indian legal system from international point of view as far as DNA legislations are concerned, to provide suggestions in this the laws and legislations relating to DNA technology, to study use and application of the same. To justify the study by analyzing facts from Social-Judicial-Legislative Perspective.

vii. To analyze and decide the advantages and disadvantages, reliability, limitations of DNA technology in Indian legislative and judicial system and to bring suggestions for the modification of prevailing procedural and substantial laws.

## 3. Nature and Scope of the Study:

We are living in 21st century- a century of science and technology. The changes occurring in science bring changes in society, and through which changes in the various laws of the country become possible, or we can say that they are bound to be changed. Scientific developments resulting from advancement in molecular genetics provides the scope for diagnostic, predictive and unfolding inherently locked –in biological secrets of life and behavioural patterns. The genetic profile generated by molecular genetics and biotechnology coupled with information technology has great potential for revolutionizing applications in all paradigms of life and living style. Along with developmental applications they are creped in contra indications having legal bearings peculiar of Genetic Information System. Nonetheless, the justice administration system needs to assimilate the scientific advancement of genetic profiling and develop the procedural techniques of harnessing the emerging judicial challenges.

Thus, the scope of the study has extended not only to the scientific inventions but also has created direct and indirect impact on society and on law and is still on the way of development.

The nature of the study is very basic and explanatory based on theoretical, experimental work in the field of law and science as well as society. The pure nature of the present study is of exploring the possible impact of the adaptation of DNA Technology in the socio-legal dimensions in the Indian Legal System.

## 4. Rationale of the Study:

For the solution of a problem there is a need to know the actual problem and to find out the material facts/reasons/root of problem to come to conclusion and to bring the effective solution.

Circular motion of the DNA Technology and its relationship with the various fields of human concern. This can be explained with the help of chart-5

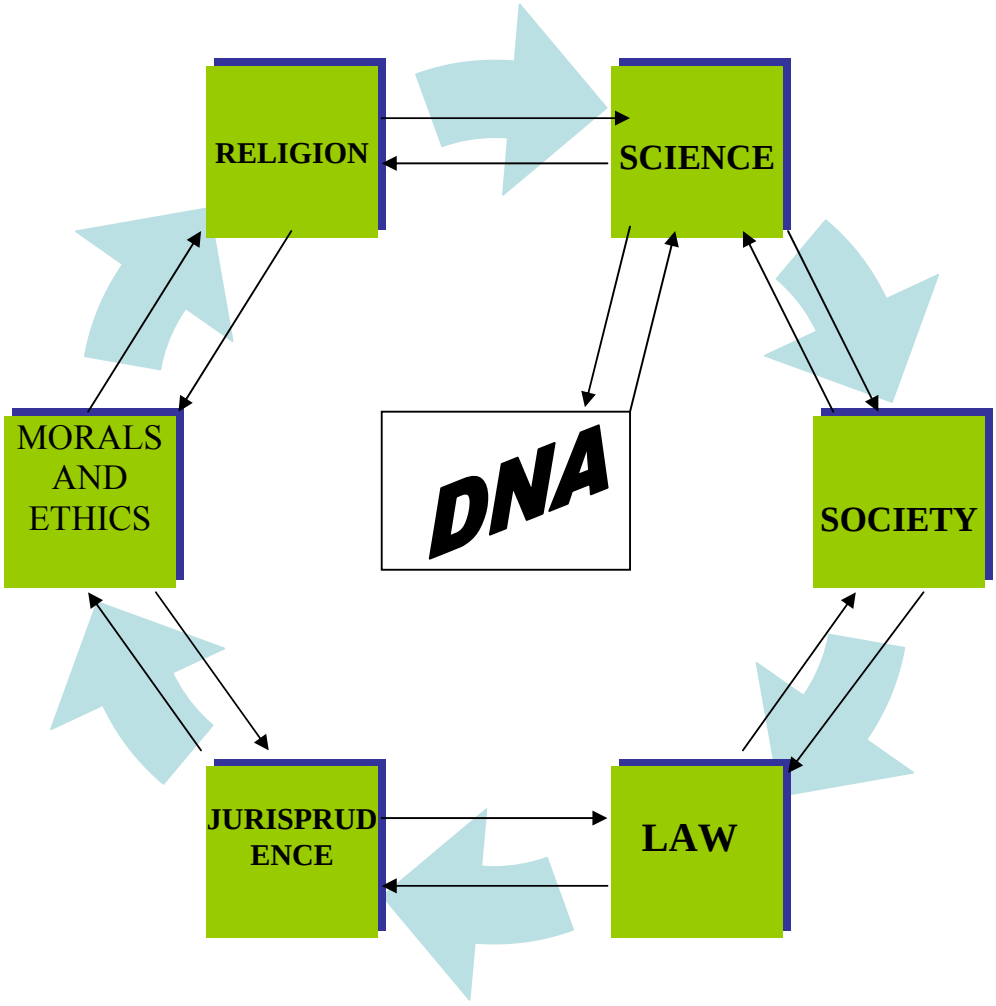
(1) DNA Technology is the scientific invention.

(2) Scientific inventions are carried out by the human beings in the society.

(3) The conduct of human beings is regulated by the laws, enactments and legislations etc. (The social engineering theory of roscoe pound)

(4) When law comes Jurisprudence comes which explains the philosophical bases relating to law with legal, social, philosophical, historical, sociological analytical and natural schools of law.

**Chart-5: Circular Motion of DNA Technology-Interdependence of Various Aspects**



Jurisprudence explains how the morals and ethics create an everlasting effect on religion. I.e. every religion is based on morals and rules of ethics and vice-versa. And when we go for the scientific inventions it also requires the consideration for religious values and morals, and morals take into consideration the ethics.

This shows the clockwise motion of the DNA Technology. The Anti-clockwise motion of the DNA technology can be explained as under.

Ethics have been given a valuable place in Jurisprudence. -When Jurisprudence comes again comes law-again the law is the created by and in society, where the human beings by experiments try to invent something under he name of science to facilities the human life as DNA technology.

Thus this clock wise and anti-clockwise circular motion or direction of DNA Technology show or indicates the interrelationship of various socio-legal fields /aspects of life. The DNA Technology falls in the centre of all.

Thus the vary title of the research work can be explained with the help of the explanation of inter-dependence and interrelation of DNA Technology with various social, legal and scientific aspects or dimensions.

*"Nova Constitio Futuris Forman Imponere Debet, Non Proteritis",* which means; new Laws Are Prospective Not Retrospective and therefore there is a need of new laws and legislation providing directions for the use of the DNA Technology.

Law of a country is bound to change due to revolutionary changes in science and technology. The modern invention of science has the serious impact on the law and the administration of the justice system. For example the introduction of the Information Technology Act 2000 has also influenced the Indian Evidence Act 1872 and IPC, 1860. These Acts have also been amended.

The advent of DNA technology has the serious impact on the administration of justice. Investigation in criminal cases has been much easier with the advent of DNA Technology. A circumstantial evidence is much stronger than the eyewitness oriented criminal administration of justice system. DNA Technology has made a drastic change improvement proving different types of disputes both civil and

criminal. But the traditional procedural laws and Evidence Act have not been amended. These Acts should be amended by keeping pace with new scientific inventions. The rigidity of proving the case with the help of the eyewitness should be replaced by scientific evidence. In all the developed countries scientific evidence has been prominent and administration of justice has been enriched with wide application of Forensic Technology.

i. The dangers of the eyewitness-oriented system are as under.

ii. Administration of justice system in India depends heavily on eyewitness, particularly on the administration of the criminal justice.

iii. Courts access the entire evidence of the cases on the performance of eyewitness. But this system of justice has some disadvantages. Because in all situations the eyewitnesses are not available.

iv. If available due to ear of cross-examination they do not attend court.

v. In many situations these eyewitnesses are purchased by the influential opposite party by money.

vi. In many cases, eye witness become hostile they become reluctant to say anything on behalf of prosecution.

vii. If eyewitnesses are available, there is no protection for him.

viii. In many situations eyewitness are harassed.

ix. No, sufficient diet money is given to them. They are afraid of attending the courts

x. Due to long pending of the cases the eyewitnesses go somewhere. Their Whereabouts Become Unknown To Prosecution.

In the same way there are other social areas where there is the need to take in account the use, applicability advantages and disadvantages of DNA technology to modify the laws, both substantial and procedural, of country. i.e. making favorable changes in legislations as and when there is the introduction of new inventions in science such as DNA technology.

## 5. Hypothesis of the Study:

The hypothesis of the study is as under.

i. DNA Technology has direct and indirect relation with law, society and science.

ii. In Indian Legal System it is necessary to understand when to use and when not to use DNA Technology.

iii. The study of the socio-legal dimensions of DNA technology is indispensable in Indian Legal System.

iv. The role and responsibilities of various agencies using DNA Technology are important factors to understand the relativity in Indian Legal System.

v. The Social, legal, religious and moral areas always get affected directly or indirectly by DNA technology, in Indian context.

## 6. Utility of the study:

In the light of the developments taking place in the field of DNA Technology, this doctrinal research is useful to number of agencies:

In the absence of any concrete legislation on the use of the DNA Technology in India, the investigating agencies- the police force and the central and state laboratories will be the primary groups and classes of people who are having first hand on the DNA Technology. The forensic experts will be benefited by the current study to gauge their role in the providing the evidences in the court of law and in the process of administration of justice. The governmental agencies like CBI, RAW, IB and other intelligence wings will get a vital outlook towards the use of DNA Technology from the investigation and legal point of view from the present study.

Through the present study the scholars of evidence law, lawyers, and judges, students of law, the press media, the government agencies and the entire society will be getting the vital inputs regarding how the existing laws of the country and the regulatory framework will operate in India if the DNA Technology is accepted in our legal system.

## 7. Research Methodology:

This study on DNA Technology has been carried on the bases of primary and secondary data prepared by various authors, researchers scholars, relevant material collected from the books, articles, journals websites, news papers and efforts have been made to interpret, analyze, and to conclude the same by giving the rational and reasonable suggestions.

And thus, the research is purely Doctrinal in nature.

## 7. Review of Literature

**1. "*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Yashpal Singh and Mohammad Zaidi ,Alia Law Agency, Allahabad, 2006**

This book deals with the almost all aspects of DNA Technology. Initially it discusses about various legal and scientific terms. It also provides for the information of historical development of DNA technology. The DNA related important issues like Right to privacy and Right to information, DNA Test in paternity disputes, Expert Evidence and criminal Investigation are some of the important topics which have been discussed thoroughly in this book.Various Legislative aspects and judicial pronouncement is the important feature of this book.

The major reason for adopting this book for review is that this book contains the analysis of the DNA technology legislations of most of the developed and developing countries including that of USA, UK, Newzealand, Canada, China, and Australia.

**2. *"An International DNA Database: Balancing Hope, Privacy, and Scientific Error,"* Allison Puri, Allahabad Law Agency, 2003**

This is another important book discussing the international aspects of DNA Data base. Emphases have been given on administration, moral ethical aspects, right to privacy and other related issues of DNA Data Bank.

By studying this book wee can make out how can the administration and legislations relating to DNA Data bank can be introduced, adopted and improved in India.

This book is relied upon by the researcher for the purpose of understanding the difference in existing legislation in different countries relating to DNA Data Bank.

Apart from the above mentioned books, the researcher can refer to many other primary and secondary resources like Indian constitution, Indian evidence Act, DNA and patent issues, Medico-Legal Jurisprudence and other such books which cover various legislative aspects of DNA Technology in India.

The other resources have been mentioned in the footnotes and bibliography. Articles from various journals and resources based on websites have been added separately in the bibliography.

## 9. Limitation of the Study:

The study has been kept limited to Indian society and Indian legal system taking into consideration the international development in various countries as far as the Socio-legal dimensions of DNA Technology are concerned.

For the purpose of understanding the impact of DNA Technology, the comparative approach is adopted by the researcher by comparing the existing legal system in India with that of UK, USA, Canada, Australia, China and New Zealand. But this comparison is consequential in nature and not a complete comparison.

The other limitation of the present study is that there are day to day innovations and developments in the field of DNA Technology. All the technological changes and developments during the span of researcher have not been totally included in the present study as this research is purely based on the legal aspects.

## 10. Scheme of the Study

**Chapter-I** deals with the Methodology of research work carried out for the study of the subject. It includes the Introduction part which is the narrow introduction of the term DNA Technology, its legal and scientific explanations, and the Title of research work is explained with the help of the charts. The general objective/purpose for undertaking this study has been described in Objectives of the study. The nature and Scope of explains to whom and how and what are the areas /spheres where the DNA technology is applicable.

Rationale of study justifies the research work by quoting actual problems and their solution by giving the tentative testable statements for presumed questions of research in its Hypothesis.

Utility of the Study provides to whom, when and how this research be useful and in what manner. Thus, Research Methodology is purely Doctrinal and also includes the Limitations of the study.

The Scheme of the Study is the main part of the Doctrinal work describing various chapters as under:

**Chapter-II** deals with the Concept, Nature and the Scope of the DNA Technology. The areas covered under this chapter are scientific terms, DNA Technology application in judicial system in India, Use and application of DNA Data Banking and Evidential aspects.

**Chapter-III** deals with Historical Development and Evolution of DNA Technology In both India as well as in foreign countries like U.S.A. and also focuses on religious and ethical perspectives of DNA technology including Hindu Philosophy, Jainism, Catholic ideology, Islam, Jew's views regarding cloning and DNA Technology.

**Chapter–IV** is the heart of the Doctrinal work dealing with various Socio-Legal Dimensions and Aspects of DNA Technology such as, Criminal Investigation and DNA technology, Admissibility and Role of Expert and the admissibility of expert evidence and many more issues relating to the same. Use of DNA Technology in Post Conviction DNA testing; Paternity-Maternity Disputes Inheritance and Succession,

some issues relating to Right to Privacy v/s and Right to Information and DNA are some of the are other important points of discussion in this chapter.

The main focus area in this chapter is DNA Data Banking, Human Genome Project and DNA Patenting which discusses the impact of the same on law, society science, religion and ethics and morality.

**Chapter-V** explains the Legislative Approach of different countries towards DNA Technology. This chapter deals with the various legislations covering all or some of its sections, directly or indirectly having relation with it and takes into consideration the use of the DNA Technology, both in foreign and Indian legislations. Especially this chapter evaluates and discusses the relevant articles of India Constitution, The Indian Evidence Act, the procedural laws such as Criminal Procedure Code, Civil Procedure Cod., the substantial laws such as The Indian Patent Act 1970, succession laws, family laws Transplantation of human Organ's Act etc. At the same time the comparative study of the foreign legislations of various country such as U.S.A., U.K., Canada, Australia, New Zealand have been carried out as far as the DNA Technology is concerned. A detailed discussion on universal Declaration on Human Genome Project has been included in the same chapter.

**Chapter-VI** focuses on the DNA Technology and Judicial Response in India. This chapter focuses on the stand and role of Indian Judiciary and discusses the efforts made by the Indian Judiciary to give directions, guidelines as to the admissibility of the DNA evidence, paternity[9] and maternity[10] disputes, Divorce proceedings[11], maintenance, succession, adultery and other cases relating to both the civil and criminal proceedings[12]. And also focuses on how far the Indian judiciary has been proved successful to accept- apply this DNA Technology in administration of civil and criminal justice.

[9] Goutam Kundu v. State of West Bengal[9] AIR 1993 SC 2295
[10] Kamti Devi v. Poshi Ram AIR 2001 SC 2266
[11] Sharad v. Dharmapal, Ms. X v. Mr. Z and others AIR 2003 SC 3450
[12] Kamalnath and others v. St. Of Tamilnadu2005 (2) SCC (cri.) 1121

**Chapter-VII** provides for Conclusion and Suggestions

Efforts have been made to analyse the advantages, disadvantages, utility and limitation, use and application of DNA Technology, by giving the rational and reasonable suggestions as to the duties, role, and responsibilities, of the judges, investigation agencies, forensic expert and the society as a whole and other related agencies which have direct or indirect relationship with the application of DNA Technology.

# Chapter-II

## Concept, Nature and Scope of DNA Technology –Scientific, Social and Legal Study

### 1. Introduction:

This chapter deals with definitions and meaning of legal and scientific terms and their use and importance in today's parlance.

### 1.1 Basic Biology of DNA

DNA is the abbreviation for deoxyribonucleic acid, which is the genetic material present in the cells of all living organisms. DNA is the fundamental building block for an individual's entire genetic makeup. A person's DNA is the same in every cell (with a nucleus). The DNA in a person's blood is the same as the DNA in their skin cells, semen, and saliva.

DNA is comprised of four building blocks called bases. The building blocks are: Cytosine, Guanine, Thymine, and Adenine. These are commonly referred to as C, G, T, A. It is the order (sequence) of these building blocks that determines each person's genetic characteristics[13].

DNA is contained in blood, semen, skin cells, tissue, organs, muscle, brain cells, bone, teeth, hair, saliva, mucus, perspiration, fingernails, urine, feces, etc.

**Formation of DNA:**

Every cell in the human body contains a nucleus, with the exception of red blood cells, which lose this structure as they mature. Within the nucleus are tightly coiled threadlike structures known as chromosomes. Humans normally have 23 pairs of chromosomes, one member of each pair derived from the mother and one from the father. One of those pairs consists of the sex chromosomes – with two X

[13]See, Article on DNA Technology, Available at http://www.dna.gov/basics/biology (Last accessed on: 3rd Jan., 2007)

chromosomes determining femaleness, and one X and one Y determining maleness. The other 22 chromosomes are known as autosomes.

Each chromosome has within it, arranged end-to-end, hundreds or thousands of genes, each with a specific location, consisting of the inherited genetic material known as deoxyribonucleic acid (DNA). Scientists have numbered these autosomes from 1 – 22 in size order, with chromosome 1 being the largest (containing nearly 3,000 genes).

DNA contains a code that directs the `expression' or production of proteins, which form much of the structure of the cell and control the chemical reactions within them. The DNA of each gene is characterized by a unique sequence of bases that form the `genetic code'. These bases are arranged in groups of three, known as codons or phrases[14].

The base sequence is the crucial feature of the gene. It is this sequence that carries the genetic information essential for the synthesis of an RNA molecule that may subsequently direct the synthesis of a protein molecule or may itself be functional in the cell. This process is called gene expression; it has two stages. The first stage in gene expression is transcription (the process by which RNA directs the synthesis of a protein). Proteins are composed of amino acids and are the molecules that carry out the work of the cell[15].

There are four basic building blocks (referred to as bases or nucleotides) for DNA: Adenine (A) and Guanine (G), which is known as Purines; and Thymine (T) and Cytosine (C), which are known as Pyramids.

These nucleotides link together to form long polynucleotide chains, having a defined sequence of nucleotides.

[14]See, Article on DNA Technology, Available at http://www.dna.gov/basics/biology (Last accessed on: 3rd Jan., 2007)

[15]See, Article "The Ethics of Patenting DNA, a Discussion" , Presented in Nuffield Council on Bioethics 2002, Available at http://www.nuffieldbioethics.org/patenting-dna (Last accessed on: 13th Jan., 2007)

A DNA molecule consists of two of these chains, linked together by hydrogen bonds, running in opposite directions. The two chains link together in a ladder-like shape, twisted into the now famous double helix [16].

Linkage of the chains follows a strict rule, known as complementary base pairing, so that the base A can only pair with the base T, and vice versa; and the base G can only pair with the base C, and vice versa. The human genome is comprised of about 3.2 billion of these base pairs.

A genome is an organism's entire genetic material. All living organisms contain genetic material or genomes. One of the most commonly accepted definitions of gene is that a gene contains all of the information required to determine the expression of a specific protein or chain of amino acid (a polypeptide). Sometimes a polypeptide can form a complete protein on its own (as in the case of insulin), but in most cases a number of polypeptides combine to create a single protein (as in the case of collagen and globin)[17].

Proteins are critical components of all cells, determining color, shape and function. Proteins can have a structural role (such as keratin, from which hair is made), or a functional role in regulating the chemical reactions that occur within each cell (such as the enzymes involved in producing energy for the cell). Proteins are themselves made up of a chain of amino acids. Within the DNA there is a code that determines which amino acids will come together to form that particular protein.

The genetic code for each amino acid, consisting of three bases, is virtually identical across all living organisms. Different genes are switched on and off in different cells, leading to different proteins being made or expressed with varying structures, appearances and functions – leading to the production of brain cells, nerve cells, blood cells, and so on. Contemporary stem cell research is based on the idea that it should be possible to learn how to use gene switches to coax stem cells into developing into the specialized cells or tissue needed for therapeutic purposes. When

[16] first described by James Watson and Francis Crick in 1953, who were awarded the Nobel Prize for their work "`A Structure for Deoxyribose Nucleic Acid' (1953) 171 Nature 737

[17] See Article on DNA Technology, Available at http://www.dna.gov/basics/biology (Last accessed on: 3rd Jan., 2007)

the instructions in a gene are to be read, the DNA comprising that gene unwinds and the two strands of the double helix separate.

An enzyme called RNA polymerase allows a complementary copy of one strand of the DNA to be made. This copy is made from RNA nucleotides, and is called messenger RNA (or mRNA) because it carries the coded genetic information to the protein-producing units in the cell, called ribosomes.

This process of reading the message in the DNA is called transcription. In the ribosome, the amino acids are assembled in the precise order coded for in the mRNA. The process of converting the message encoded in the RNA (mRNA) to protein using the ribosome is called translation. When the whole message has been translated, the long chain of amino acids folds itself up into a distinctive shape that depends upon its sequence – and is then known as a protein. In humans, genes comprise only a small proportion of the DNA in a cell. Up to 98% of DNA consists of `non-coding' regions – popularly, but incorrectly, referred to as `junk DNA' – which are full of repeat sequences (micro-satellites), pseudogenes and retroviruses. By way of contrast, there are no non-coding portions of DNA in bacteria – there are only genes, each one expressing a specific protein[18].

In recent years, genetic scientists increasingly have come to believe that non-coding DNA may be the basis for the complexity and sophistication of the human genome, which permits only 30,000 or so genes to produce about 200,000 proteins. A leader in this field, Professor John Mattick, Director of the Institute for Molecular Biology at the University of Queensland, has surmised that non-coding DNA forms a massive parallel processing system producing secondary signals that integrate and regulate the activity of genes and proteins.

In effect, they co-ordinate complex programs involved in the development of complex organisms. According to recent estimates , all humans have the same basic set of about 30,000 – 35,000 genes, which is far lower than the early estimates of 200,000 (based on the number of proteins), and even the relatively recent estimates of 100,000 used at the start of Human Genome Project.

[18]Ibid 1

Genes may come in different versions, known as alleles. These alleles arise when there is a change in the ordering of the bases (nucleotides) described above – in effect, a `typographical error' in the code, involving the change of a single letter, the inversion of two letters, the deletion or insertion of a codon, or the repetition of a codon. This change in the sequence (a mutation) may cause no harm, merely resulting in a polymorphism, or it may make the gene faulty in the way it directs (expresses) the production of protein. In a very few cases the mutation is beneficial. Although any two human beings are at least 99.9% genetically identical, the precise DNA sequence of about 3.2 billion base pairs will differ slightly in each person's genetic code. The 0.1% of difference is thought to compromise more than 10 million common single letter genetic variations (single nucleotide polymorphisms, or SNPs) as well as a larger number of rare variants. The rate of variation is very low in humans (one SNP per 1,300 bases) compared with other species, including other primates – suggesting a population that has descended from a small `starter population'. This explains both the striking similarities among all people, which are the result of our common inheritance, and the many individual differences found even within a nuclear family.

Mutations are permanent and inheritable changes in the ability of a gene to encode its protein. Much like typographical errors, which can change the meaning of a word, or even render a sentence as gibberish, such changes in gene structure can have severe effects on the ability of a gene to encode its protein. Some mutations prevent any protein from being produced, some produce a non-functional or only partially functional protein, and some produce a faulty or poisonous version of the protein.

The unique combination of alleles found in a particular individual's genetic make-up is said to constitute that person's genotype. The observable physical characteristics of this genotype, as determined by the interaction of both genetic makeup and environmental factors, is said to constitute that person's phenotype. This includes features such as color of eye and hair, determined genetically, as well as height and weight – determined by genetic factors as well as by diet, access to proper healthcare and other environmental influences.

Because mutations can affect the functioning and expression of the alleles of genes, resulting in particular traits or characteristics, it is possible to follow the pattern of

inheritance of the different alleles of a gene in a family. For most genes, two copies are found in an individual.

If the two copies are the same allele, the individual is said to be homozygous. If two different alleles for that gene are present, the individual is referred to as heterozygous for that gene – except for those traits coded for by genes that are found on the X chromosome. A dominant trait is one that is manifested when a person has only one mutated allele in a particular gene pair. An affected person may have inherited the mutated allele from either parent or, as the result of a new mutation, may be the first person in the family to have it. There is one-in-two chance that a child will inherit a genetic trait if one parent has a dominant mutated allele[19].

Examples of autosomal dominant traits include HD, myotonic dystrophy, hereditary non-polyposis colorectal cancer, Marfan syndrome, familial adenomatous polyposis, and early onset familial Alzheimer's disease.

Medical conditions or diseases linked to genes can be classified in a number of ways, including: monogenic (or single gene) disorders; polygenic (or multi-gene) disorders; and multifactorial disorders. A monogenic disorder is one in which a mutation in one or both alleles of a single gene is the main factor in causing a genetic disease. Much of our early understanding about genetic influences on health is derived from the observation and study of monogenic disorders such as Huntington's disease (a neurodegenerative disease which is inherited in an autosomal dominant pattern) – although such diseases are relatively rare.

The vast majority of medical conditions with some genetic link involve either the complex interaction of a number of genes (polygenic) or the complex interaction between genes and the environment (multifactor disorders). In the case of multifactor disorders, inheriting a mutated allele for a particular condition means that a person is susceptible or predisposed to develop the condition. Other factors such as diet or exposure to certain environmental factors are necessary to bring about the expression of the trait or condition.

[19] Ibid 1

Most of the important and common medical problems in humans are multifactor, including heart disease, hypertension, psychiatric illness (such as schizophrenia), dementia, diabetes, and cancers. According to the Human Genome Database, as on 29 December 2002, 14,014 genes had been mapped to individual chromosomes, of which 1,639 had been identified as being involved in a genetic disorder. It may be that most of the simple linkages have already been made, since the rate of discovery has slowed dramatically despite better technology; of the last 3,783 genes to be mapped, only 17 have been identified with a genetic disorder.

## 2. DNA Fingerprinting:

DNA Fingerprinting is a method where, a person's genetic traits, genes, are used to make specific strings of DNA letters that are cut into patterns of shorter strings separated by length these banding patterns can identify a unique human being.

Forensic scientists are able to "read" the DNA sequences and find differences among species. They reduce the base names down to letters, namely "a", "c", "t" and "g". Then scientists read the sequence of these letters by looking at one-half of the ladder. Although the majority, 99.9% of the letter sequence on a human DNA strand is identical, there are portions of each strand that differ from individual to individual. Thus, in a DNA strand with three billion letters, one tenth of one percent difference translates into three million separate spelling differences. These are differences that scientists examine in the process known as DNA fingerprinting to determine identity and heritage.

Unfortunately, for purposes of forensic DNA fingerprinting, scientists do not read all three billion letters. Instead, to save time and money, scientists look at a very small handful of sites of variation. Along the DNA strand, or genome, there are regions where the base pair sequences repeat themselves. For instance, one person could have the sequence of "t-a-c-t-g" repeat three times and another person could have that same sequence repeat twice or appear only once. Thus, these normally biologically insignificant sequence repetitions create spelling difference in particular areas. In general, forensic scientists cut the DNA strands with an enzyme at these points of repetition. They then record the repetition variations by reducing the data into a bar code type expression. When comparing DNA samples from crime scene evidence to a

suspect's DNA sample, scientists will compare the "bar code" information from each site of variation. If the bar code differs between the evidence and the suspect's DNA at any point, that particular suspect is usually ruled out as a possible source of the DNA evidence. However, if the bar codes are the same along all points of variation tested, the suspect is considered more likely to have left the evidence. It is important to note, however, that this does not mean the suspect committed the crime or even left the DNA evidence. Because scientists do not read the entire DNA, looking for any and all variations, two samples conceivably could appear as exact matches but actually may differ in some other portion of the strand.

Some courts have rejected the use of the term "DNA Fingerprinting". Because-

(1) It tends to trivialize the intricacies of the processes by which information for DNA comparisons is obtained to the process of fingerprinting, and

(2) The word fingerprinting tends to suggest erroneously that DNA testing of the type involved in this case will identify conclusively, like real fingerprinting, the one person in the world who could have left the identifying evidence at the crime scene.

DNA profiles differ from conventional fingerprints in the following respects:

- DNA holds vastly more information than fingerprints.
- DNA profile can be used in establishing kinship relations.
- The sample from which the profile was obtained may hold predictive health and other information of a sensitive nature.
- As genetic information is shared with biological relatives, an individual's profile might indirectly implicate a relative in an offence.
- DNA can be amplified from tiny and aged samples and may be recovered from almost any cell or tissue unlike fingerprinting.

### 3. Various Techniques of DNA Fingerprinting:

DNA testing technology has developed three main types of DNA testing that are widely used for both science and legal identification purposes. The circumstances,

such as the age, size, and handling of the sample, determine what type of testing is to be used[20].

### 3.1 Restriction Fragment Length Polymorphism Testing (RFLPT)

It is widely used for legal identification purposes by forensic scientists. This procedure was developed by Professor Sir Alec Jeffreys and is generally accepted by the courts in the Unites States and has resulted in a number of post-conviction exonerations. This testing process does not actually "read" the sequence repetitions, but it isolates certain areas of repetition and essentially measures the length of these sections, which are then recorded as bar codes and compared between samples.

RFLP Testing is best used on large, unadulterated or untarnished samples and when it is possible; it is very discriminate, leading to statistically strong exclusions and inclusions even when only testing a few DNA regions.

### 3.2 VNTR Typing (Variable number Tandem Repeats)

Certain regions of DNA, known as *variable number tandem repeats* (VNTRs), have no known function and show great variability among individuals. These are the regions of the DNA used in VNTR typing. The VNTR loci used in forensic tests reside on different chromosomes (or sometimes very far apart on the same chromosome), so they are independently inherited.

In VNTR regions, usually ranging from 500 to 10,000 nucleotide pairs, a core sequence of some 15-35 base pairs repeats many times consecutively along the chromosome. The number of repeats varies from person to person. (Sequences with different numbers of repeated units are called *alleles*, even though the word originally applied to functional genes.

Several features of VNTR regions make them useful for forensic testing and identification. First, VNTR loci have a very large number of alleles (often a hundred or more), and none of the alleles is very common, so great variation exists among individuals. Second, because VNTR regions have no known function, they are less

[20] Yashpal Singh and Mohammad Zaidi "*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 59

likely than functional genes to be influenced by natural selection and thus less likely to vary in the frequency with which they appear in different populations. Finally, the variable number of base sequence repeats makes VNTR regions identifiable by their lengths, so they can be readily sorted by laboratory procedures.

Although details vary somewhat among labs, the basic steps of VNTR typing are uniform. In VNTR typing, the lab first excises fragments of chromosomes that begin and end with certain sequences of DNA base pairs from DNA at the crime scene and DNA from the suspect(s). The tester then measures the lengths of the DNA fragments in the samples by seeing how far they move through a slab of gelatinous material when attracted by an electric charge. The tester compares how far the sample fragments moved relative to how far fragments of known lengths moved. The analyst then applies a *"probe"* or genetic marker to make visible the genetic patterns at each locus. Commonly, labs examine four or five VNTR loci for each sample[21].

The following steps compose the typical VNTR analysis:

1) Isolate the DNA from the specimen to be examined;
2) Cut the DNA into discrete pieces using a bacterial enzyme (called a restriction enzyme);
3) Separate the different-sized DNA pieces using a process called gel electrophoresis;
4) Transfer the DNA from a gel to a nylon membrane to make it easier to work with;
5) Apply (or hybridize) a DNA probe to the membrane (the probe usually is radioactively labelled, although some labs are beginning to use luminescent molecules); and
6) Show the location of the probe, usually by exposing the membrane to x-ray film (autoradiography), or if luminescent probes are used, to light-sensitive film.

If a radioactive marker is used, the entire process for four or five probes takes several weeks.

After the film is developed, the analyst must examine the images and interpret the results of the test. The film typically shows a number of parallel bands running across it, like lanes on a highway. The position of each radioactively labelled band on the

[21] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 64

membrane indicates the size of the VNTR. Because of measurement uncertainty, however, the test does not reveal the exact size of a band. The analyst must account for this uncertainty when analyzing autorads.

Because the most common DNA tests for measuring the lengths of the VNTR fragments are not sensitive enough to distinguish between fragments that are extremely close in size, laboratories group bands of similar size into *bins*. The analyst then treats the alleles within a bin as though they are a single allele. The usual width of a bin is about 10% of the mean (average) size of the VNTR segment at the centre of the bin. After binning, the analyst compares the number and location of the various bands in the lanes on the autorad. A person whose DNA falls into the same bin is said to be *homozygous*; while a person whose DNA falls into different bins is said to be *heterozygous*[22].

### 3.3. PCR-Polymerase Chain Reaction Testing-Nuclear DNA:

This elegant and simple process was developed by Kary B. Mullis-a Nobel Prize winner. PCR requires four nucleotide building blocks, inorganic chemicals, and a device to rapidly and accurately change and maintain the temperature for short period of time.- known as the thermal cycle.

In this process one or more specific small regions of the DNA are copied using DNA polymerase enzymes that a sufficient amount of DNA is generated from analysis. Very small or degraded specimens/biological samples are enough to under go the PCR technique. PCR technique is widely used for forensic identity purpose. This technique is generally used and relied upon by the scientific community and hence admissible in and accepted by court of laws.

This type of testing has become most widely used technique in the field of molecular biology and was first developed by Dr. Kary Mullis in 1984. PCR is also accepted by the courts and has led to a number of post-conviction exonerations. PCR testing can be done on smaller and less pristine samples. Small samples can be subjected to PCR testing because sample amplification is part of the process. Essentially, specific

[22] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 66

regions of DNA are copied using an enzyme called Taq polymerase and then are compared in a type of bar code format. Like RFLP testing, exclusion is generally considered dispositive; however an inclusion is less discriminate. Therefore, in order to have a more statistically strong inclusion, PCR testing needs to be conducted at a number of sites along the DNA strand[23].

**a. Steps of PCR Analysis:**

In this three-step process, the lab first heats the double-stranded DNA segments to separate them into two strands. Second, the lab hybridizes the single-stranded segments with *primers*, short DNA segments that complement and define the target sequence to be amplified. Each primer serves as the starting point for replicating the target sequence when mixed with the enzyme DNA polymerase and the four-nucleotide building blocks (A, C, G and T). The process copies the complement of each of the separated stands, resulting in two double-stranded DNA segments. The lab then repeats the three-step cycle, usually twenty to thirty-five times[24].

Once the DNA is amplified, analysis precedes the same as with VNTR methods, with a few modifications. Like VNTR analysis, PCR-based methods rely on the principle of identifying different-sized fragments by their migration rates in an electric field.

**b. Methods of PCR:**

i. PCR-based methods are used on a number of different classes of DNA fragments and genes. One class of repeated DNA units labs analyze using PCR is *short tandem repeats* (STRs). These repeats of a few nucleotide units are very common and are distributed widely throughout the genome. While STRs have fewer alleles per locus than VNTRs, a very large number of loci are potentially usable.

ii. Another PCR application uses the DQA locus. Unlike VNTRs, the eight alleles at DQA code for a protein. Specific probes can distinguish six of the

[23] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006,p. 69

[24] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 78

eight alleles identified at this locus. The DQA system can be used, along with other markers, as part of a more detailed DNA profile.

iii. A third PCR system is the *Amplitype polymarker (PM*). This system analyzes six loci simultaneously: DQA, *LDLR* (low-density lipoprotein receptor), *GYPA* (glycophorin A, the MN blood-groups), *HBGG (*hemoglobin gamma globin), D7S8 (an anonymous genetic marker on chromosome 7), and *GC* (group-specific component). Two or three distinguishable alleles exist at each locus. However, polymarker loci vary more among races than do VNTRs.

iv. Another PCR-based technique involves D1S80, a VNTR in which the largest allele is less than 1,000 base pairs long. The locus has a sixteen-base unit repeated a variable number of times. More than 30 distinguishable alleles exist at the locus, and the size classes are discrete. The analysis is complicated, however, by insertion or deletion of a single base.

v. Finally, another class of genetic marker is mitochondrial DNA. Unlike most DNA, which is found in the cell's nucleus, mitochondrial DNA is found outside the nucleus in the cell's mitochondria. Also unlike other DNA, mitochondrial DNA passes only from mother to child, so that all the children of one woman have identical mitochondrial DNA. Certain regions of the mitochondrial DNA are highly variable and thus have been used for forensic analysis. Because each person inherits mtDNA from his or her mother, the technique cannot distinguish siblings or other maternally related relatives[25].

**c. Difference between PCR and VNTR:**

PCR-based methods differ from VNTR analysis in several respects. First, PCR-based analyses usually permit exact identification of each allele, avoiding the problem of measurement uncertainty. Second, results of PCR-based analyses normally are available within about 24 hours, much sooner than VNTR results. Finally, PCR analysis is better suited than VNTR typing for smaller samples for which very little DNA are available.

[25] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p., Alia Law Agency, Allahabad, 2006, p. 89

### d. Disadvantages of PCR Method:

PCR analysis presents at least three disadvantages not present in VNTR analysis. First, a sample that is contaminated can make multiple copies of the wrong DNA. The amplification process is so efficient that a few stray molecules of contaminating DNA could affect the band pattern enough to cause an analyst to declare a no match when a match actually exists, or to declare a match when the evidence DNA actually does not match the suspect's DNA. Second, most markers used in PCR-based typing have fewer alleles than VNTRs, and the distribution of allele frequencies is not as flat. The lab therefore must analyze more loci to get the same amount of information about the likelihood that two people share a profile. Finally, some of the loci used in PCR-based analysis are functional genes; some are linked to important disease-producing genes. Recall that functional genes are more likely than non-functional markers to be influenced by natural selection and thus appear with different frequencies in different segments of the population (the sickle-cell example).

## 3.4 STR Analysis:

Short tandem repeat (STR) technology is a forensic analysis that evaluates specific regions (loci) that are found on nuclear DNA. The variable (polymorphic) nature of the STR regions that are analyzed for forensic testing intensifies the discrimination between one DNA profile and another. For example, the likelihood that any two individuals (except identical twins) will have the same 13-loci DNA profile can be as high as 1 in 1 billion or greater. [26]

Several genetic markers have been identified on the Y chromosome that can be used in forensic applications. Y-chromosome markers target only the male fraction of a biological sample. Therefore, this technique can be very valuable if the laboratory detects complex mixtures (multiple male contributors) within a biological evidence sample. Because the Y chromosome is transmitted directly from a father to all of his

[26] The Federal Bureau of Investigation (FBI)in U.S.A. has chosen 13 specific STR loci to serve as the standard for CODIS. The purpose of establishing a core set of STR loci is to ensure that all forensic laboratories can establish uniform DNA databases and, more importantly, share valuable forensic information. If the forensic or convicted offender CODIS index is to be used in the investigative stages of unsolved cases, DNA profiles must be generated by using STR technology and the specific 13 core STR loci selected by the FBI.

sons, it can also be used to trace family relationships among males. Advancements in Y-chromosome testing may eventually eliminate the need for laboratories to extract and separate semen and vaginal cells (for example, from a vaginal swab of a rape kit) prior to analysis.

### 3.5 Polymerase Chain Reaction Testing – Mitochondrial DNA:

Usually, MtDNA testing is used to link a sample to a particular family since mitochondria is passed from a mother to her offspring. This type of testing can be used on extremely old or damaged samples. It can be done on samples from dried bones, teeth, hair shafts, or any other sample that contains little or highly degraded nuclear DNA . Plus which is a megaplex system developed by Perkin Elmer enabling the inspection of 10 loci and upto 36 different samples .There was a sufficient (mtDNA) analysis allows forensic laboratories to develop DNA profiles from evidence that may not be suitable for RFLP or STR analysis.

While RFLP and PCR techniques analyze DNA extracted from the nucleus of a cell, mtDNA technology analyzes DNA found in a different part of the cell, the mitochondrion .Old remains and evidence lacking nucleated cells--such as hair shafts, bones, and teeth--that are unamenable to STR and RFLP testing may yield results if mtDNA analysis is performed[27].

For this reason, mtDNA testing can be very valuable to the investigation of an unsolved case. For example, A cold case log may show that biological evidence in the form of blood, semen, and hair was collected in a particular case, but that all were improperly stored for a long period of time.

Although PCR analysis sometimes enables the crime laboratory to generate a DNA profile from very degraded evidence, it is possible that the blood and semen would be so highly degraded that nuclear DNA analysis would not yield a DNA profile. However, the hair shaft could be subjected to mtDNA analysis and thus be the key to solving the case. Finally, it is important to note that all maternal relatives (for example, a person's mother or maternal grandmother) have identical mtDNA. This

[27] See, Article on DNA Technology , Available at http://www.dna.gov/solving-crimes/cold-cases/longandshort/typesofanalysis (accessed on 12th Jan. 2007)

enables unidentified remains to be analyzed and compared to the mtDNA profile of any maternal relative for the purpose of aiding missing persons or unidentified remains investigations. Although mtDNA analysis can be very valuable to the investigation of criminal cases, laboratory personnel should always be involved in the process.

## 4. Sources of DNA Evidence:

Trace Evidence includes items such as hair, fibbers, paint chips, glass shards, shoe prints, gunshot residue, arson- explosives and physical matches, Baseball bat or similar weapon Handle end Sweat, skin, blood-tissue Hat, banana or mask Inside Sweat, hair, Dandruff Eyeglasses Nose or ear pieces, lens Sweat, ski Facial Tissue, Cotton swab Surface area Mucus, blood, sweat, semen, ear wax Dirty laundry Surface area Blood, Tooth-pick Tips Saliva Used cigarette Cigarette-butt Saliva Tape or ligature Inside/outside surface Skin, sweat Bottle, can, glass Sides, mouth pieces Saliva, sweat Used condoms Inside/outside surface Semen, vaginal rectal-cells Blanket, pillow, sheet Surface area Sweat, hair,, urine saliva, etc. The list is endless. Using this type of evidence, forensic scientists have been able to identify the source, only on the basis of its general appearance and structural features.

Unlike DNA, trace evidence rarely provides definitive identification. As a result, trace evidence is primarily useful only in cases that don't have DNA evidence, otherwise substantial resources can be wasted by Crime Laboratories screening for trace evidence that will not be analyzed. So, DNA evidence is more fool proof and is more reliable than trace evidence and DNA evidence can be said to produce conclusive evidence.

An investigator may collect clues for DNA test from some sources of evidences shown in the list where possibilities of existence of human cells may be there.

## 5. How DNA Fingerprinting is done?

### 5.1 Gathering DNA Evidence:

Physical evidence is any tangible object that can connect an offender to a crime scene. Biological evidence, which contains DNA, is a type of physical evidence. However,

biological evidence is not always visible to the naked eye. DNA testing has expanded the types of useful biological evidence. All biological evidence found at crime scenes can be subjected to DNA testing. Samples such as faces and vomit can be tested, but may not be routinely accepted by laboratories for testing.

### 5.2 Identifying DNA Evidence:

Since only a few cells can be sufficient to obtain useful DNA information to help your case, the list below identifies some common items of evidence that you may need to collect, the possible location of the DNA on the evidence, and the biological source containing the cells. Remember that just because you cannot see a stain does not mean there are not enough cells for DNA typing. Further, DNA does more than just identify the source of the sample; it can place a known individual at a crime scene, in a home, or in a room where the suspect claimed not to have been. It can refute a claim of self-defense and put a weapon in the suspect's hand. It can change a story from an alibi to one of consent. The more officers know how to use DNA, the more powerful a tool it becomes

### 5.3 Crime Scene Integrity:

Protection of the crime scene is essential to the protection of evidence. Safeguarding and preserving evidence is fundamental to the successful solution of a crime. Remember, while documenting evidence at the crime scene, to include descriptions of whether evidence was found wet or dry. An example of this documentation would include blood spatters.

The risk of contamination of any crime scene can be reduced by limiting incidental activity. It is important for all law enforcement personnel at the crime scene to make a conscious effort to refrain from smoking, eating, drinking, littering or any other actions which could compromise the crime scene. Because DNA evidence is more sensitive than other types of evidence, law enforcement personnel should be especially aware of their actions at the scene to prevent inadvertent contamination of evidence.

## 5.4 Chain of Custody:

The chain of custody of evidence is a record of individuals who have had physical possession of the evidence. Documentation is critical to maintaining the integrity of the chain of custody. Maintaining the chain of custody is vital for any type of evidence. In addition, if laboratory analysis reveals that DNA evidence was contaminated, it may be necessary to identify persons who have handled that evidence.

In processing the evidence, the fewer people handling the evidence, the better it is. There is less chance of contamination and a shorter chain of custody for court admissibility hearings.

Contamination because extremely small samples of DNA can be used as evidence, greater attention to contamination issues is necessary when identifying, collecting, and preserving DNA evidence. DNA evidence can be contaminated when DNA from another source gets mixed with DNA relevant to the case.

## 5.5 Transportation and Storage:

The first responding officer may be called upon to transport evidence from a crime scene. As with any evidence, the officer should ensure that the chain of custody is maintained. In addition, they should be aware that direct sunlight and warmer conditions may degrade DNA, and avoid storing evidence in places that may get hot, such as the trunk of the police car. To best preserve DNA evidence, store in a cold environment.

Any probative biological sample that has been stored dry or frozen, regardless of age, may be considered for DNA analysis. Nuclear DNA from blood and semen stains more than 20 years old has been analyzed successfully using polymerase chain reaction (PCR). Samples that have been stored wet for an extended period of time should be considered for testing only using PCR and may be unsuitable for DNA analysis. Mitochondrial DNA analysis has been performed on very old bones, teeth, and hair samples.

Samples generally considered unsuitable for testing with current techniques include embalmed bodies (with the possible exception of bone or plucked hairs), pathology or fetal tissue samples that have been immersed in formaldehyde or formalin for more than a few hours (with the notable exception of pathology paraffin blocks and slides), and urine stains. Other samples such as feces, fecal stains, and vomit can potentially be tested, but are not routinely accepted by most laboratories for testing.

### 5.6 Analyzing DNA Evidence:

Several basic steps are performed during DNA testing regardless of the type of test being done. The general procedure includes:

1) The isolation of the DNA from an evidence sample containing DNA of unknown origin, and generally at a later time, the isolation of DNA from a sample (e.g., blood) from a known individual;

2) The processing of the DNA so that test results may be obtained;

3) The determination of the DNA test results (or types), from specific regions of the DNA; and 4) the comparison and interpretation of the test results from the unknown and known samples to determine whether the known individual is not the source of the DNA or is included as a possible source of the DNA.

Any probative biological sample that has been stored dry or frozen, regardless of age, may be considered for DNA analysis.

Each additional test at a previously untested locus (location or site) in the DNA provides another opportunity for the result of "exclusion" if the known individual being used for comparison is not the source of the DNA from an evidence sample of unknown origin. If, however, the known individual is the source of the DNA on the evidence sample, additional testing will continue only to include that individual as a possible source of the DNA. When a sufficient number of tests have been performed in which an individual cannot be excluded as the source of the DNA by any of the tests, a point is reached at which the tests have excluded virtually the world's population and the unique identification of that individual as the source of the DNA has been achieved.

## 6. DNA Samples:

In the genetic finger printing technique, for carrying out DNA-test, various types of samples are used such as blood, semen, vaginal smear, body tissue, hair roots, and nasal fluid, and bone, teeth of disputes both in the civil and in the criminal justice administration. In paternity, maternity, dispute cases, rape cases, murder cases DNA test has enormous applications.

These samples are carefully collected, lawfully preserved, and properly sealed and sent to DNA Laboratory for DNA-test. Forwarding of such samples can be done in appropriate cases by the (a) learned District and Sessions Judges, Subordinate Judges, Judicial Magistrate (b) S.P., D.S.P., O/c. of Police Stations, S.I. of such Police Stations (C) Medical officers of Government Hospitals.

### 6.1 Bayes Theorem:

Before going further it is important to mention how exactly DNA match probabilities are represented. A statistical theorem known as Bayes Theorem is widely in use in courts and it can be represented as follows:

(Prior ODDS) x (Likelihood Ration): (Posterior Odds) which is explained in Chapter 4 with Expert Evidence[28].

In DNA profiling process firstly, the DNA is isolated from cells or tissues of the body in which the amounts of DNA found at the root of one hair is sufficient. After chemically extracting the intact DNA from the sample restriction enzymes are used to cut DNA at specific places. The DNA pieces are then sorted out according to size by sieving technique called electrophoresis in an agarose gel. The DNA fragments are blotted from the gel into a nylon membrane. This process is known as Southern Blotting. On addition of radioactive or colored probe to the nylon sheet a pattern called the DNA fingerprint is produced. The final DNA fingerprint is build by using several probes or more simultaneously.

[28] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 91

Where the samples are inadequate and the quality poor, this technique has been found to be less satisfactory. Therefore, a new technology was developed to replicate the inadequate sample, by synthesizing new DNA from the existing one to obtain sufficient quantities for analysis. This technique is called Polymerase Chain Reaction (PCR) and the testing PCR is known as PCR-STR (Short Tandem Repeat). It can produce quick, valuable results with degraded specimens In India this technique is in its infancy. Centre for DNA fingerprinting and Diagnostics (CDFD), Andhra Pradesh Forensic Science Laboratory (APFSL), Centre for Cellular and Molecular Biology (CCMB), Rajiv Gandhi Centre for Biotechnology (RGCB) are the major institutes where DNA fingerprinting is done.

## 6.2 Steps in DNA Sample Processing:

Each method of DNA typing has its own advantages and limitations, and each is at a different state of technical development. However, the use of each method involves three steps:-

i. Laboratory analysis of samples to determine their genetic-marker types at multiple sites of potential variation.
ii. Comparison of the genetic-marker types of the samples to determine whether the types match and thus whether the samples could have come from the same source.
iii. If the types match, statistical analysis of the population frequencies of the types to determine the probability that a match would have been observed by chance in a comparison of samples from different persons.

Before any particular DNA typing method is used for forensic purposes, precise and scientifically reliable procedures for performing all three steps must be established. It is meaningless to speak of the reliability of DNA typing in general—i.e., without specifying a particular method.

Following is a review of the steps involved in processing forensic DNA samples with STR markers. STRs are a smaller version of the VNTR sequences first described by Dr. Jeffreys. Samples obtained from crime scenes or paternity investigations are subjected to defined processes involving biology, technology, and genetics.

**a. Biology:**

Following collection of biological material from a crime scene or paternity investigation, the DNA is first extracted from its biological source material and then measured to evaluate the quantity of DNA recovered. After isolating the DNA from its cells, specific regions are copied with a technique known as the polymerase chain reaction, or PCR. PCR produces millions of copies for each DNA segment of interest and thus permits very minute amounts of DNA to be examined. Multiple STR regions can be examined simultaneously to increase the informativeness of the DNA test. See also Basic Biology of DNA.

**b. Technology:**

The resulting PCR products are then separated and detected in order to characterize the STR region being examined. The separation methods used today include slab gel and capillary electrophoresis (CE). Fluorescence detection methods have greatly aided the sensitivity and ease of measuring PCR-amplified STR alleles. After detecting the STR alleles, the number of repeats in a DNA sequence is determined, a process known as sample genotyping.

The specific methods used for DNA typing are validated by individual laboratories to ensure that reliable results are obtained and before new technologies are implemented. DNA databases, such as the one described earlier in this chapter to match Montaret Davis to his crime scene, are valuable tools and will continue to play an important role in law enforcement efforts.

**c. Genetics;**

The resulting DNA profile for a sample, which is a combination of individual STR genotypes, is compared to other samples. In the case of a forensic investigation, these other samples would include known reference samples such as the victim or suspects that are compared to the crime scene evidence. With paternity investigations, a child's genotype would be compared to his or her mother's and the alleged father(s) under investigation. If there is not a match between the questioned sample and the known

sample, then the samples may be considered to have originated from different sources. The term used for failure to match between two DNA profiles is 'exclusion.'

If a match or 'inclusion' results, then a comparison of the DNA profile is made to a population database, which is a collection of DNA profiles obtained from unrelated individuals of a particular ethnic group. For example, due to genetic variation between the groups, African-Americans and Caucasians have different population databases for comparison purposes.

Finally a case report or paternity test result is generated. This report typically includes the random match probability for the match in question. This random match probability is the chance that a randomly selected individual from a population will have an identical STR profile or combination of genotypes at the DNA markers tested.

**i. Questioned or Unknown Samples:**

Questioned or unknown samples collected from the crime scene can be any biological sample including: liquid blood or bloodstains, liquid saliva or saliva stains, and liquid semen or dried semen stains (including from vasectomies males) deposited on virtually any surface; genital/vaginal/cervical samples collected on swabs or gauze, or as aspirates; rectal/anal swabs; penile swabs; pieces of tissue/skin; fingernails; plucked and shed hairs (e.g., head, pubic, body); skin cells on drinking vessels, clothing (e.g., neck collars, waistbands, hat linings); slides containing tissue, semen, etc.; and liquid urine[29].

**Samples from Unidentified Bodies:**

Samples collected from unidentified bodies can include: blood, buccal swabs, hairs, bone, teeth, and fingernails, tissues from internal organs (including brain), muscle, and skin.

[29] Yashpal Singh and Mohammad Zaidi "*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006

**ii. Reference Samples from Known Individuals:**

The most common reference samples collected from known individuals are blood, oral/buccal swabs, and/or plucked hairs (e.g., head, pubic).

**iii. Samples to Use When No Conventional Reference Samples Are Available:**

Other samples that may be considered when individuals are unavailable or are reluctant to provide samples include clothing where biological fluids may be deposited (e.g., women's panty crotches or blood-, saliva-, or semen-stained items) and other clothing in close contact with the body where skin cells may have rubbed off (e.g., collars, waistbands, hats), bedding (with vaginal/semen stains or rubbed off skin cells), fingernail clippings, cigarette butts, toothbrushes, hairs in razors and hairbrushes, discarded facial tissues or handkerchiefs with nasal secretions, condoms, gum, feminine products, pathology paraffin blocks or slides from previous surgery or from autopsy, and teeth[30].

**iv. Reference Samples from Individuals Who Have Been Transfused:**

If an individual has received transfusions shortly before the collection of a blood sample (e.g., homicide victim), the DNA test results may indicate the presence of DNA from two or more sources. Generally the predominant DNA types reflect the types from the individual. However, other sources of reference samples for individuals who have received transfusions may need to be collected. These would include: blood-stained clothing or other material (bedding, etc.) and oral, vaginal, and other swabs in addition to the items listed above.

**v. Use of Samples from Relatives for Testing:**

Because a child inherits half of its DNA from each parent, it is possible to use reference samples collected from close relatives (e.g., biological father, mother, and/or full siblings or the individual's spouse and their children) to identify or confirm

[30] Yashpal Singh and Mohammad Zaidi "*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 98

the identity of bodies that have not been identified through other means. It is also possible to use reference samples collected from close relatives for comparison to crime scene samples, for example, in missing body cases where a bloodstain or tissue sample from a possible crime scene can be tested to demonstrate a biological relationship to known individuals.

**vi. Determination of Paternity or Maternity of a Child or Foetus:**

Aborted fetal tissue can be analyzed for determining paternity, for example, in sexual assault and/or incest cases where conception occurred. Paternity and/or maternity of a child can be confirmed using blood or other samples listed above from the child and the alleged parent(s).

### 6.3 Possible Results from DNA Tests:

In criminal investigations, the police collect biological evidence left at a crime scene to identify the perpetrator (and to exclude those falsely associated with an evidentiary sample). DNA typing is a powerful tool for assisting in the inculpation or exculpation of an individual as the source of biological evidence collected at the crime scene. There are three interpretations of DNA profile comparison between a known sample (e.g. a suspect) and evidentiary sample (e.g., a virginal swab continuing semen) viz.

a) Inconclusive – there is insufficient information to arrive at a conclusion.
b) Exclusive – the two DNA profiles are sufficiently different such that the sample did not originate from the same source; and,
c) Inclusive (or match) – the two DNA profiles are similar operationally and potentially could have originated from the same source.

**Inclusions;**

When the results obtained from the standard sample from a known individual are all consistent with or are all present in the results from the unknown crime scene sample, then the results are considered an inclusion or nonexclusion. The term "match" is also commonly used when the test results are consistent with the results from a known individual. That individual is included (cannot be excluded) as a possible source of the DNA found in the sample. Often, statistical frequencies regarding the rarity of the

particular set of genetic information observed in the unknown evidence sample and for a known individual are provided for various population groups.

It is possible for a falsely accused individual to be included as a source of a sample, particularly if the test system used only tests at one or a few loci (e.g., the DQa). In this situation, additional testing at more loci should be performed with the remaining evidence and/or DNA.

In some cases where inclusions are reported, the results are not meaningful or are inconclusive for that particular case from a legal perspective. Situations where this might apply are when the results obtained are all consistent with the individual from whom the samples were collected. [31]

**Exclusion:**

When the results obtained from the standard sample from a known individual are not all present in the results from the unknown crime scene sample, the results are considered exclusion, a no match, or no inclusion. With limited exceptions, an exclusion of an individual at any one genetic region eliminates that individual as a source of the DNA found in the sample.

In some cases where exclusion is reported, it may be necessary to do additional testing for that exclusion to be meaningful to the case or to provide evidence for exoneration. A situation where this might apply is when the defendant is excluded as a donor of the DNA in a sexual assault case, but no samples are available from the victim and/or consensual partners.

**Inconclusive Results:**

Results may be interpreted as inconclusive for several reasons. These include situations where no results or only partial results are obtained from the sample due to the limited amount of suitable human DNA or where results are obtained from an unknown crime scene sample but there are no samples from known individuals

[31] For Example. victim's results only on vaginal swabs taken from the victim, defendant's results only on a bloodstain on defendant's clothing.

available for comparison. In the latter case, the results would be suitable for comparison once an appropriate sample for comparison is tested.

Despite the challenges of forensic DNA typing, it is possible to develop reliable forensic DNA typing systems, provided that adequate scientific care is taken to define and characterize the methods.

An estimation of frequency of occurrence of a DNA profile in a general population group or groups does not arrive with the first two interpretations. However, with an 'inclusion', it is desirable to convey a valid estimate as a guideline of how common or rare the DNA profile is in the general population of potential perpetrators. To assess the rarity of a DNA profile (which ultimately assist the justice system), general population databases are generated. DNA samples from anonymous individuals from major population groups or geopolitical groups are typed for various genetic markers. The number of various forms of each marker whether they are fragment sizes, the presence or absence of dots, or specific DNA sequences, is tallied and these tallies provide a basis for estimating the rarity of DNA profiles in the various population groups.

**7. Forensic Science:**

According to dictionary "Forensic Science " means " relating to court or law" or "relating to court of law" in general. Forensic science includes those things or matters which are dealt with by both legal practitioners and scientists for achieving the goals of justice and for scientific inventions respectively.

The word "Forensic is taken from the Latin word "Forensic" which means something relating to court of laws or of public debate or discussion. we can say that in other word it is concerned with legal proceedings, used in judicial system for evidential purpose. In court of laws it is recognised as persuasive evidence to prove guilt or innocence of a person.

According to "Oxford companion to law Various branches of forensic science are (chemistry, physics and biology as main branch) ballistic,, blood and other biological

material, documents, photographics, serology, geology, DNA fingerprinting, brain fingerprinting, narco analysis….etc.

According to David M. walker forensic science means a branch of science concerned with the application of those bodies of knowledge for legal purpose particularly to eliciting and interpreting facts which may be of significance in legal inquiries.

It is that discipline which is directed to the recognition , identification, individualization and evaluation of physical evidence by application of the principls and methods of natural sciences for the purpose of administration of the criminal justice.

In America known as 'Public science", in France 'criminalistique", in Germany "Kriminalistik"[32].

## 8. Forensic Evidence:

The evidence which is accepted by scientific community and acceptable to court of laws is forensic evidence. Such evidence must pass the test of admissibility in the court according to The Indian Evidence act 1872.

## 9. Purpose, Use, application of DNA Fingerprinting:

- Identification of parentage: Parentage, paternity, maternity can be identified, paternity disputes
- Acceptance of parentage. : Once identified can't be denied the parentage-paternity/maternity, conclusively solve the question of maternity in case where no one ready accept the child as their biological child. Establish paternity and other family relationships
- To decide, identify, and establish the blood relation between two persons, whether they are real brother or sisters and about their grandparents.
- Where deceased is unidentified,

[32] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006, p. 122

- For criminal investigation of murder where body is very much mutilated for identification of person and determination of the sex of the deceased.
- Used against suspects in solving various crimes…. Such as…
- Useful in mass disaster
- Identify potential suspects whose DNA may match evidence left at crime scenes
- Post conviction DNA testing - Exonerate persons wrongly accused of crimes
- Identify crime and catastrophe victims, for Criminal investigations
- Identify endangered and protected species as an aid to wildlife officials
- Could be used for prosecuting poachers
- Detect bacteria and other organisms that may pollute air, water, soil, and food
- Match organ donors with recipients in transplant programs
- Determine pedigree for seed or livestock breeds
- Authenticate consumables such as caviar and wine
- Population genetics
- Animal genetics
- Medical uses- establishing the biological relation ship of two or more persons, Organ transplantation (in medical science)
- Identifying missing children in child swapping cases, baby exchange cases
- Plant genetics
- Immigration Cases
- Identifying remains of the dead persons
- To control terrorism through preservation of genetic data in DNA data banks
- Certification and authentificaton of various food products.
- To resolve legal issues. For example, In the case of succession, inheritance of property, maintenance and adoption of minor.

**10. Nature and Scope :**

- DNA collection and analysis gives the criminal justice field a powerful tool for convicting the guilty and exonerating the innocent
- Only one-tenth of a single percent of DNA (about 3 million bases) differs from one person to the next. Scientists can use these variable regions to

generate a DNA profile of an individual, using samples from blood, bone, hair, and other body tissues and products.

- In criminal cases, this generally involves obtaining samples from crime-scene evidence and a suspect, extracting the DNA, and analyzing it for the presence of a set of specific DNA regions (markers).
- If the sample profiles don't match, the person did not contribute the DNA at the crime scene.
- If the patterns match, the suspect may have contributed the evidence sample.
- DNA from crime scenes also can be compared to profiles stored in a database
- DNA analysis is a powerful tool because each person's DNA is unique (with the exception of identical twins). Therefore, DNA evidence collected from a crime scene can implicate or eliminate a suspect, similar to the use of fingerprints. It also can analyze unidentified remains through comparisons with DNA from relatives. Additionally, when evidence from one crime scene is compared with evidence from other using CODIS, those crime scenes can be linked to the same perpetrator locally, statewide, and nationally.
- DNA is also a powerful tool because when biological evidence from crime scenes is collected and stored properly, forensically valuable DNA can be found on evidence that may be decades old. Therefore, old cases that were previously thought unsolvable may contain valuable DNA evidence capable of identifying the perpetrator.
- Forensic DNA typing often involves samples that are degraded, contaminated, or from multiple unknown sources. Its procedures sometimes cannot be repeated, because there is too little sample. It often involves matching of samples from a wide range of alternatives in the population and thus lacks built-in consistency checks. Except in cases where the DNA evidence excludes a suspect, assessing the significance of a result requires statistical analysis of population frequencies.

## 11. Use of DNA Technology in Legal Systems:

This section provides an overview of how DNA Evidence might be used in the investigation and prosecution of crimes and civil litigations. The techniques and principles behind DNA profiling are discussed in this earlier chapter. A discussion on

the issue of admissibility, in the United States and, in India in order to provide a comparative perspective is indispensable which has been discussed in the chapter of legislations. The discussion of case law is intended mainly to highlight specific issues and is not intended to be comprehensive.

In the United States there are two main tests for admissibility of scientific information from experts. One is the Frye test, enunciated in Frye v. United States[33]. The other is a 'helpfulness' standard found in the Federal Rules of Evidence and many of its State counterparts. In addition, several States in the United States have enacted laws, which essentially mandate the admission of DNA profiling evidence.

**(a) The Frye Test-**

The test for the admissibility of novel scientific evidence enunciated in Frye v. United States has been the most frequently invoked one in American case law. Frye lays down that the admissibility of novel scientific evidence on its general acceptance in a particular scientific field: "While Courts will go a long way in admitting expert testimony deducted from a 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. It should conduct a hearing to determine whether the scientific theory underlying the evidence is generally accepted in the relevant scientific community and to determine that the specific techniques used are reliable for their intended purpose.

In People of the State of New York v. Joseph Castro[34] the Court noted that a three-pronged test needed to be followed in determining whether the DNA evidence adduced should be admitted:

1. Is there a theory, which is generally accepted in the scientific community, which supports the conclusion that DNA forensic testing can produce reliable results?

2. Are there techniques of experiments that currently exist that are capable to producing reliable results in DNA identification and which are generally accepted in the scientific community?

[33] 293 F2d 1013 (DC Cir. 1923)
[34] 545 NYS 2d 985 Supp. Ct. 1989

3. Did the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in the case?

**(b) The 'Helpless' Standard**

The Federal Rules of Evidence, without specifically repudiating the Frye rule, adopt a more flexible approach, Rule 702 states that:

"If science, technical or other specialized knowledge will assist the tier 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."

Rule 702 should be read with Rule 403, which requires the court to determine the admissibility of evidence by balancing its probative force against its potential for misapplication by the jury. The Federal Rule encompasses Frye by making general acceptance of scientific principles by experts a factor, and in some cases a decisive factor, in determining probative force. A Court can also consider the qualifications of experts testifying about the news scientific principle; the use of which the new technique has been put, the technique's potential for error, the existence for specialized literature discussing the technique and its novel

The decision in Daubert v. Merrell Dow Pharmaceuticals[35] was a path breaking judgment since it modified the test laid down in Frye v. United States[36]. The scientific basis and validity of a well-known medicine for causing deformation of twins due to the consumption of his drug by the mother during pregnancy this drug was challenged. Incorporating the "helpfulness" standard in the Frye test, the following modified test was laid down:

- Has the science been tested?
- Has the science been peer reviewed and published?
- Is the science accurate?
- Is the science well accepted in the scientific community?

[35] 509 US 579 (1993)
[36] 293 F2d 1013 (DC Cir. 1923)

To produce biological evidence that is admissible in court in criminal cases, forensic investigators must be well trained in the collection and handling of biological samples for DNA analysis. They should take care to minimize the risk of contamination and ensure that possible sources of DNA are well preserved and properly identified. As in any forensic work, they must attend to the essentials of preserving specimens, labeling, and the chain of custody and must observe constitutional and statutory requirements that regulate the collection and handling of samples.[37]

**In civil cases** such as paternity, custody, and proof-of-death cases—the standards for admissibility must also be high, because DNA evidence might be dispositive. The relevant federal rules (Rules 403 and 702-706) and most state rules of evidence do not distinguish between civil and criminal cases in determining the admissibility of scientific data. In a civil case, however, if the results of a DNA analysis are not conclusive, it will usually be possible to obtain new samples for study.

The advent of DNA typing technology raises two key issues for judges determining admissibility and explaining to jurors the appropriate standards for weighing evidence. A host of subsidiary questions with respect to how expert evidence should be handled before and during a trial to ensure prompt and effective adjudication apply to all evidence and all experts.

In practice, the court is much more involved. The court must determine the scientific fields from which experts should be drawn. Complexities arise with DNA typing, because the full typing process rests on theories and findings that pertain to various scientific fields. For example, the underlying theory of detecting polymorphisms is accepted by human geneticists and molecular biologists, but population geneticists and other statisticians might differ as to the appropriate method for determining the population frequency of a genotype in the general population or in a particular geographic, ethnic, or other group. The courts often let experts on a process, such as DNA typing, testify to the various scientific theories and assumptions on which the process rests, even though the experts' knowledge of some of the underlying theories is likely to be at best that of a generalist, rather than a specialist.

[37] Fourth Amendment provides much of the legal framework for the gathering of DNA samples from suspects or private places, and court orders are sometimes needed in this connection.

The Frye test sometimes prevents scientific evidence from being presented to a jury unless it has sufficient history to be accepted by some subspecialty of science. Under Frye, potentially helpful evidence may be excluded until consensus has developed. By 1991, DNA evidence had been considered in hundreds of Frye hearings involving felony prosecutions in more than 40 states. The overwhelming majority of trial courts ruled that such evidence was admissible, but there have been some important exceptions.

With the helpfulness approach, the court should also consider factors that might prejudice the judge. One of the most serious concerns about scientific evidence, novel or not, is that it possesses an aura of infallibility that could overwhelm a judge's critical faculties. The likelihood that the jury would abdicate its role as critical fact-finder is believed by some to be greater if the science underlying an expert's conclusion is beyond its intellectual grasp. The judges might feel compelled to accept or reject a conclusion absolutely or to ignore evidence altogether. However, some experience indicates that jurors tend not to be overwhelmed by scientific proof and that they prefer experiential data based on traditional forms of evidence. Moreover, the presence of opposing experts might prevent a judge from being unduly impressed with one expert or the other. Conversely, the absence of an opposing expert might cause a judge to give too much weight to expert testimony, on the grounds that, if the science were truly controversial, it would have heard the opposing view. Nevertheless, if the scientific evidence is valid, the solution to those possible problems is not to exclude the evidence, but to ensure through instructions and testimony that the judge is equipped to consider rationally whatever evidence is presented.

In determining admissibility with the helpfulness approach, the court should consider a number of factors in addition to reliability. First is the significance of the issue to which the evidence is directed. If the issue is tangential to the case, the court should be more reluctant to allow a time-consuming presentation of scientific evidence that might itself confuse the judge. Second, the availability and sufficiency of other evidence might make expert testimony about DNA superfluous. And third, the court should be mindful of the need to instruct and advise the judge so as to eliminate the risk of prejudice.

### 11.1 Position in India:

In the Indian context, the awareness of the strength and potential of this technique is still lacking. One of the major inadequacies in this regard in this context is that this technique has not yet become a part of the Evidence Act. It is the fundamental principle of law of evidence that witnesses should state facts, which are within their knowledge, and forming of an opinion on any matter under enquiry is within the domain of the Court. However, there are situations when the Court is not in a position of form its Judgment on certain issues without the aid of persons who have acquired special skill or experience or knowledge in certain areas that are beyond the common experiences of men. When a situation like this arises, the rule is relaxed and conclusions drawn from a set of facts by especially skilled persons are admitted in evidence under the provisions of Section 45 of the Evidence Act. The judiciary looks at DNA typing as an expert witness and allows it to be admitted only under Section 45 of the Evidence Act. The present scenario in India is oscillating between two facets. The members of the forensic agencies as well as the scientific community claim that DNA fingerprinting provides a quantum leap in crime detection, while the legal fraternity on the other hand, is confused about its admissibility and application under the provisions of the Indian Evidence Act of 1872. The question of whether a suspect, or for that matter anybody, can be forced to give a blood sample for testing. The uncertainty also prevails about whether possible testing would be considered a violation of Article 20(3) of the Constitution, which protects every citizen from providing self-incriminating evidence. It has become evident in recent years, through the ruling in at least couple of important cases, that no individual can be forced to give blood samples under the existing laws. During a trial, the proponent of the evidence meets the burden of establishing that the DNA analysis performed in the present case provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material.

- The following burden lies on party.
- The acquisition of the sample.
- The chain of the custody of the sample and test result.
- The proper labelling of the sample.

- The interpretation of the test results by scientist's properly qualified to read and interpret the test results.

## 12. Services for Laboratories:

Forensic Laboratories are the base for testing DNA evidence. The crime lab system in operation across the country varies in structure. Public crime labs may be Federal-, State-, county-, or city-sponsored. In foreign countries many public labs are associated with a law enforcement entity; some are associated with a district attorney's office, while others are independent government entities. Some forensic laboratories are privately held companies.

Not all laboratories are capable of providing comprehensive and complete forensic services. Some do not have the capability to conduct DNA testing and may need to contract out their DNA cases to other agencies or private corporations.

The functionality of each laboratory differs from the functionality of other Laboratories. The Dos and Don'ts are discussed at length in the last chapter of Thesis.

## 13. DNA Data Bank:

The door is opened to the possibility that this technology could be applied to forensic evidence massively. The forensic DNA analyze can be stored in a databank. It can lead to unique and unimaginable results as one can change his name, even his looks, but it is impossible to alter the DNA profile. It will confirm or deny a person's association after police investigation. In the absence of other evidence police can determine or eliminate suspects, with the help of DNA evidence. DNA databank can help in crime prevention by giving the information of potential criminals. DNA databank can be used to link crimes committed by serial offenders if both are found in a case gives a strong proof of the person's involvement. The person suspected for an unsolved crime can avoid hassle from police if voluntarily gives sample and found negative. It can apprehend the criminals just acting as eyewitness and crime recorder

of the offence, hence referred. in the offender from criminal activity. DNA data bank will reduce the time and expenditure[38].

In U.S.A. a rape and murder was solved by a match between DNA from blood and semen found at the crime scene and a databank samples from a person imprisoned for burglary. There were also various instances where some alleged persons were acquitted and proved their innocence only by the DNA test. This could not be possible without this data bank and the wonderful technique with us. Now U.S.A. and U.K. have DNA data bank legislation.

In India it is not possible to preserve DNA data of each and every person. It also violates the human rights and privacy concern. Hence it must be confined to those who are convicted in sexual offence, theft, and murder and in habit of committing these types of offences. Privacy advocates fear that samples from DNA database will be used in research aimed at identifying criminal gene. Utmost care should be taken to prevent the manipulation of the preserved data. In order to withstand the challenges of Court and to be viable in long run DNA data bank requires legislation without any human rights and privacy violation. India should come forward to draft a legislation in this regard to use DNA test as evidence under guidance of a committee of scientists, jurists, representative from the rights bodies, and security organizations such as the police and defence forces.

### 13.1 Forensic DNA Databases:

The development and expansion of databases that contain DNA profiles at the local, State, and national levels have greatly enhanced law enforcement's ability to solve cases with DNA. Convicted offender databases store hundreds of thousands of potential suspect DNA profiles, against which DNA profiles developed from crime scene evidence can be compared.

Given the recidivistic nature of many crimes a likelihood exists that the individual who committed the crime being investigated was convicted of a similar crime and already has his or her DNA profile in a DNA database that can be searched by the

[38] Read more in Chapter-VII about DNA Data Bank

Combined DNA Index System (CODIS) software. Moreover, CODIS also permits the cross-comparison of DNA profiles developed from biological evidence found at crime scenes. Even if a perpetrator is not identified through the database, crimes may be linked to each other, thereby aiding an investigation, which may eventually lead to the identification of a suspect.

## 13.2 Combined DNA Index System

CODIS[39] stands for Combined DNA Index System. It is the core of the national DNA database, established and funded by the Federal Bureau of Investigation (FBI) in U.S.A. and other countries, and developed specifically to enable public forensic DNA laboratories to create searchable DNA databases of authorized DNA profiles. The CODIS software permits laboratories throughout the country to share and compare DNA data. In addition, it provides a central database of the DNA profiles from all user laboratories. A search is conducted of the DNA profiles in this national database, known as the National DNA Index System (NDIS), and resulting matches are automatically returned by the software to the laboratory that originally submitted the DNA profile.

The term "CODIS" is often misused by law-enforcement officers, prosecutors and even practitioners of the forensic sciences when they intend to refer to a "DNA database." The index system has three levels of operation. The term "DNA database" is sometimes used without specific reference to the level, which may lead to misunderstandings. For example, some categories of profiles are allowed in a State's database but not in the National database. The term "CODIS lab" is also misused in reference to a state laboratory that does the analysis of convicted offender samples. That is a misnomer since CODIS also contain other profiles such as forensic profiles.

## 13.3 Basics of How CODIS Works:

CODIS uses two indexes to generate investigative leads in crimes for which biological evidence is recovered from a crime scene. The convicted offender index contains DNA profiles of individuals convicted of certain crimes ranging from certain misdemeanors to sexual assault and murder. Each State has different "qualifying

[39] CODIS is restricted DATA base, access to it and training on its use is handled by FBI, in USA.

offenses" for which persons convicted of them must submit a biological sample for inclusion in the DNA database. The forensic index contains DNA profiles obtained from crime scene evidence, such as semen, saliva, or blood. CODIS uses computer software to automatically search across these indexes for a potential match.

A match made between profiles in the forensic index can link crime scenes to each other, possibly identifying serial offenders. Based on these "forensic hits," police in multiple jurisdictions or States can coordinate their respective investigations and share leads they have developed independent of each other. Matches made between the forensic and convicted offender indexes can provide investigators with the identity of a suspect(s). It is important to note that if an "offender hit" is obtained, that information typically is used as probable cause to obtain a new DNA sample from that suspect so the match can be confirmed by the crime laboratory before an arrest is made.

### 13.4 Capabilities of CODIS Software

In U.S.A. The CODIS software is designed for the storage and searching of short tandem repeat (STR) profiles. The same version of the software is used by all participating laboratories at the local, state, and federal levels. Although the main version of CODIS is for handling STR results, a separate version exists for the entry and searching of mitochondrial DNA (mtDNA) profiles.

**The four primary functions of the CODIS software are:**

- DNA profile entry and management: the function dealng with the database DNA profiles.
- Searching: the function allowing a search of database DNA profiles.
- Match management: the function managing search results. For example, it allows a laboratory to record and distinguish whether a particular match is an offender hit or a forensic hit, and whether the match is within or outside of the state.
- Statistical calculations: the function enabling laboratory personnel to calculate profile statistics, based on the laboratory's or FBI's population frequency data.

- The FBI in U.S.A. provides CODIS software40 to all public forensic laboratories at no cost. However, the cost of the computer hardware and all support software is the laboratory's responsibility. Upgrades and technical support of the software is also provided free to all laboratories. Copies of CODIS software provided to some foreign countries are stand-alone copies not connected to the CODIS network in the United States.

### 13.5 Levels of the Database:

**The National DNA Index** System (NDIS) is a system of DNA profile records input by criminal justice agencies (including State and local law enforcement agencies). The Combined DNA Index System (CODIS) is the automated DNA information processing and telecommunication system that supports NDIS.

**i. Local:**

A local laboratory can maintain its own local database of forensic profiles—local DNA index system (LDIS)—and upload approved profiles to SDIS**.**

**ii. State:**

The state database, or State DNA index system (SDIS), contains forensic profiles from local laboratories in that state, plus forensic profiles analyzed by the state laboratory itself. The state database also contains DNA profiles of convicted offenders. States may have their own regulations regarding which profile types can be maintained at SDIS.

**iii. National:**

Profiles from the states (including the FBI) are uploaded into the National DNA Index System (NDIS). In accordance with Federal law, specific rules govern whether a profile can or cannot be uploaded to NDIS Some categories of samples, as well as DNA profiles that do not meet minimum number of DNA loci, are not eligible for entry into NDIS. Approved analysts should familiarize themselves with NDIS Board procedures.

[40] See relevant sections of the Federal Law of U.S.A.,"Justice For All Act 2004", relating to CODIS

### 13.6 NDIS Procedures and Administration in U.S.A.:

(In India we can adopt under mentioned mechanism for formulating the CODIS at state and central level.)

Each state is responsible for determining its own policies regarding samples allowed in the state's DNA database, primarily via legislation regarding the creation and use of DNA databases. Each state can set its own policies, data entry, and/or search schedules, and other activities on CODIS within that state. However, there is still an expectation of reasonable uniformity amongst states about the use of CODIS.

The NDIS Procedures Board is responsible for development and modification of policy regarding NDIS use. Board membership comprises representatives of Central, state, and local laboratories. State or local laboratories that contribute DNA profiles to NDIS must comply with NDIS procedures, posted on the CJIS-WAN CODIS website. NDIS procedures provide details regarding acceptance of DNA profiles at the national level. One requirement, for example, is that a forensic evidence DNA profile must have results at 10 or more of specific CODIS core loci.

Each laboratory is required to designate a CODIS Administrator, who is responsible for CODIS data and serves as the primary point of contact for CODIS issues in that laboratory. Each state has a designated CODIS State Administrator, who serves as the state's CODIS point of contact and is responsible for coordinating and communicating with all CODIS administrators in the state's local laboratories regarding CODIS issues. CODIS state administrators also serve as gatekeepers for entering data from states into NDIS. While preparing CODIS following things are required to be considered[41].

- Legal developments and procedures.
- CODIS software upgrades and modifications.
- Exchange of information and CODIS experiences.
- Formulation and clarification of CODIS policies and NDIS procedures.
- CODIS software modification and improvements.

[41] Yashpal Singh and Mohammad Zaidi, *"DNA Test in Criminal Investigation, Trial and Paternity Disputes"*, Alia Law Agency, Allahabad, 2006, p. 59

- Issues relating to CODIS and DNA databases.

The working group also addresses CODIS issues directed to its attention by the NDIS Procedures Board or the SWGDAM chairman. The board and working group comprises members who are CODIS users at the local, state, or national level.

### 13.7 Forensic databases:

Forensic databases are organized bodies of information that can be accessed on certain criteria. Forensic databases consist of:

a) A convicted offender database
b) An unsolved cases (or not available suspect cases)
c) Population frequency databases, and
d) Missing person database.

The DNA database contains information about DNA profile, identifiers for the laboratory examiner, case sample and population statistics.

### (a) Convicted Offender Database:

It consists of DNA profiles from known individuals convicted of crimes for which the deposition of biological materials by a suspect is likely (e.g., example homicide, attempted homicide, sexual assault, kidnapping assault). A biological sample, which may be a liquid blood or buckle sample, is collected at the time of incarceration or before the convicted offender is released. Dried replicate specimens are prepared and frozen in a restricted access facility in case future analysis is required. A portion of each donors sample is subjected to analyses against genetic loci known to be forensically informative. Typing information (e.g., ban size, numerical type designation) is then determined and entered into the database with the appropriate identifying information (e.g., sample numbers) to permit only simple identification and retrieval.

**(b) Unsolved Cases Database:**

DNA profile that can be contained in forensic database may include there from semen left behind at an unsolved rape, blood typed on knife found at the scene of a homicide that did not come from victim, or hair not originating from a victim other known person who had access to this scene.

**(c) Population Database:**

This is a depository of population statistics information often used to study on how frequently forensically, important genetic markers occur among various geographic areas or community and ethnic groups. Population databases are necessary to validate an estimate of how rare a DNA profile is. The identity of donor of individual samples is not carried within the population databases; generally the source of each sample is anonymous.

**(d) Missing Person Database and Unidentified Decedents:**

The information includes the DNA profiled derived from body parts whose origin is unknown and profiles from parents or children of missing persons.

**For criminal investigation purpose we can further bifurcate profiles as under:**

**(e) Forensic Profiles:**

Significant numbers of forensic profiles entered by states into CODIS are probative profiles from cases where the perpetrator is not known, commonly referred to as unsolved cases. Additionally, states also enter forensic evidence profiles that match the reference profile of the suspect in that case (solved cases). Forensic profiles are entered into CODIS in the hope that a match will result from a search of the database, and an investigative lead generated.

**(f) Arrestee Profiles:**

States can collect DNA samples from individuals arrested for certain offences and maintain those DNA profiles in an arrestee database. In those states, specific laws

require individuals arrested for qualifying offenses to provide a DNA sample for the database. States may upload these profiles to NDIS.

**(g) Suspect Profiles:**

The states can also maintain a suspect database, containing suspects' reference profiles lawfully collected in connection with criminal cases. These profiles are ineligible for upload into NDIS.

**(h) DNA Identification in Mass Fatality Incidents[42]**

DNA analysis is the gold standard for identification of human remains from mass disasters. Particularly in the absence of traditional anthropological and other physical characteristics, forensic DNA typing allows for identification of any biological sample and the association of body parts, as long as sufficient DNA can be recovered from the samples. This is true even when the victim's remains are fragmented and the DNA is degraded.

Unidentified Human remains, missing persons and relative of missing person Profiles:[43] Some states in United States also enters unidentified human remains, missing person or remains of missing persons profile into CODIS. It includes results from mtDNA analysis as well as STR profiles.

It is advocated for a comprehensive statute legalizing the DNA profiling system is necessary and needs to provide for –

1. The Authority to establish databases
2. The declared purpose of the use of databases
3. Who can and cannot be subjected to sample collections
4. What offences are covered?
5. The types of samples so collected and by whom

[42] The examples of mass disaster are : 9/11 attacks of the World Trade Centere,Hurrican Katrina,,South East Tsunami, killari and Gujarat 2001 earth quack

[43] See,details discussion of all these issues in "lesson learned from 9/11:DNA identification in mass Fatality accident .An excessive overview of forensic identification beyond DNA analysis can be found in Mass fatality incidents. A guide for human forensic identification,U.S. Department of Justice, National Institute of Justice, June 2005

6. The assignment of responsibility for the collection, maintenance and administration of the database records
7. Unauthorized use of DNA databases and penalties for that unauthorized use
8. Provisions for the impingement DNA data from such an archive an
9. Specifications for the unauthorized disclosure of DNA records

**Evidentiary Perspective:**

- All profile data can be digitally and numerically stored in a computer.
- The database can be readily retrieved and compared with evidentiary profiles. Although comparisons of DNA profile can be made within a case or among profiles a database, the quality issues are slightly different. In a particular case, when comparing, for example, a suspect's profile with that of evidence sample, one is more concerned with the false-positive scenario (i.e., that one or both of the samples have been typed incorrectly and a match has resulted when the samples are genetically different at those markers).
- Laboratories practice standards protocols to minimize the occurrence of false positive, samples can usually be reanalyzed. A false-negative scenario is more tolerated in a particular case because it would not result in wrongly inculpating an individual. In contrast, for a database search for potential matching profiles to be effective, a false – negative result is less tolerated. If matches cannot be made in a database, where matches exist, then there would be no need to generate databases for identifying repeat offenders or serial perpetrators.
- A false positive can be eliminated in database search by requiring re-analysis of the known samples by the querying laboratory. Establishing validated and robust protocols and establishing proper guidelines for quality assurance and control can minimize a false negative.

In USA, DNA typing standards were created by DNA Advisory Board (DAB) by the DNA Identification Act of 1994. DAB is responsible for promulgating national standards of forensic data analysis.

**DAB addressed issues as:**

1) laboratory organizations,
2) personal qualification, (3)documentation,
3) materials and equipments
4) validation of analytical procedures,
5) generation and validation of genetic marker frequency databases
6) evidence handling procedures,
7) internal controls and standards,
8) Data analysis and reporting,
9) proficiency testing,
10) Quality audit and safety.
11) Training and Assistance
12) Educational Materials for Families
13) Research, Development, and Testing
14) Funding for Crime Laboratories

Since the inception of forensic DNA profiling considerable benefits have been gained from integrating information management and communication technologies with the data derived from forensic DNA analysis. The Establishment of various forensically useful databases, for both population and forensic data was also recognized as pivotal to the process of resolving crimes where there is no suspect or multiple crimes that may be committed by the same individual. N 1989, the FBI created 'Combined DNA Index System' (CODIS), since then CODIS is serving a powerful tool for the use in forensic DNA profiling in generating investigative leads. Most forensic DNA laboratories have built their respective DNA analysis programmes in four areas:-

1. Case Work;
2. Research and Development of Technology;
3. Technology and Data Sharing; and
4. A computerized indexing system.

In USA, NDIS is statutorily authorized to disclose information to criminal justice agencies participating in investigation in respect of an identification match only[44].

1. To criminal justice agencies for purposes of law enforcement identification.
2. In judicial proceedings, if otherwise admissible pursuant to applicable statute and rules.
3. For Criminal defence purposes to a defendant who shall have access to sample and analyses performed in connection with the case in which the defendant is charged.
4. If personally identifiable information is removed; for a population statistics database, for identification research and protocol development, or for quality control purposes.

**14. DNA Laboratories:**

DNA Laboratory is a place where DNA evidence is collected, stored, preserve, labbeled and administered by the government Authorities, especially in U.S.A, U.K. and other countries enforced by law and legislative force. In India there are some Labs working on the same guidelines, but still there is a need of formulating laws to introduce nation wide centrally controlled laboratory system with uniformity.

Reliable and accurate results are a national concern for crime laboratories. Decisions about guilt or innocence are made based on a laboratory's analysis of evidence. Additionally, demands on crime laboratories change consistently with new technologies, legislation, and needs of the criminal justice field. Laboratory Services include

- Lab Audits
- Grant Progress Assessments
- Sample Analysis
- Accreditation Assistance And Quality Documentation
- DNA Sample Analysis
- DNA Laboratory Audits And Accreditation
- DNA Sample Collection Kits

[44] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes"* , Alia Law Agency, Allahabad, 2006, p. 51

- Quality Documents
- Expert Systems Tested Project
- Sequencing Unusual Str Alleles
- Validation Information For Labs
- Us Y-Str Database DNA Sample Analysis
- Quality Assurance Standards For Forensic DNA Testing Laboratories (FBI)

In U.S.A. the crime lab systems in operation across the country vary in structure. Public crime labs may be Federal-, State-, county-, or city-sponsored. Many public labs are associated with a law enforcement entity; some are associated with a district attorney's office, while others are independent government entities. Some forensic laboratories are privately held companies.

Not all laboratories are capable of providing comprehensive and complete forensic services. Some do not have the capability to conduct DNA testing and may need to contract out their DNA cases to other agencies or private corporations.

Not all laboratories are capable of the same DNA testing either. Most DNA labs have the capability to conduct testing on nuclear DNA, which is the single copy of DNA that exists in every cell nucleus. A select few specialize in Y-STR testing, which is DNA conducted on the Y-chromosome, which is found only in males. Others specialize in testing mitochondrial DNA (or mtDNA), which is found in every cell of the body regardless of the presence of a nucleus.

**Concerns over the Privacy and Confidentiality of Forensic and Medical Genetic Data Banking:**

Confidentiality and security of DNA-related information are especially important and difficult issues, because we are in the midst of two extraordinary technological revolutions that show no signs of abating.

Forensically DNA Profiling has more efficient scientific usage, but there is an imminent need to balance the benefits of genetic information to society particularly medical and forensic realms, with the right of individuals to control information about them and prevent its use for information about them and prevent its use for purposes

other than those for which it was created. Balancing between molecular biology, which is yielding an explosion of information about human genetics, and in computer technology, which is moving toward national and international networks connecting growing information resources is also very important

- The potential sensitivity of DNA information and the digital information management system for storage of large number of data and quick retrieval calls for effective interlocking and control measures by the system users.
- Forensic applications of DNA technology revolving with stringent privacy consideration of controls in mind and the forensic community have addressed a number of potential privacy issues.
- The predisposition of a donor to no one or more genetically induced conditions is generally not retrievable from forensic genetic data; only the potential for the individualization of donor to the exclusion of all others (or an exclusion as the source of the evidence sample) by the genetic information can be obtained.
- Medically sensitive information cannot be derived from forensic DNA analysis. The genetic information used in forensic DNA typing is well established and known by the scientifically forensic and legal community.
- The limited dissemination of forensic DNA information to authorized recipients during Court proceedings or pre-trial activities has no medical or other values.
- Investigative information as to the nature of the crime is often provided to the forensic analyst so that the proper analysis can be performed and information and conclusion about leads can be derived; but the information is not directly associated with the samples themselves and therefore would not be a part of the database.
- Sensitive identifying information about a donor (e.g., social security number) has no bearing on a value to the forensic analytical process. Submissions of evidence are usually identified by a unique sequential number (e.g., year, month, date and order issued) or alphanumeric generated by the laboratory and, perhaps contributing agency. Simple designator (often alphanumeric) are assigned to individual specimens and used for efficiency during the analysis.

- Forensic laboratories and police are subject to strict legal and procedural requirement, as to the chain of custody of the physical evidence (i.e., source of genetic information) and the release of information to unauthorized, personnel. Forensic laboratories are restricted access facilities, making unauthorized access difficult.
- The authorizations to collect, preserve, and analyze sample to be contained with such a database, and the restrictions and limitation of such uses including privacy and confidentiality issues and penalties for violation, are created by a legislative body with associated legal review, scientific comment and recommendations. This becomes part of the public record.
- The computer technology required for an automated fingerprint identification system is sophisticated and complex.
- Fingerprints are complicated geometric patterns, and the computer must store, recognize, and search for complex and variable patterns of ridges and minutiae in the millions of prints on file. Several commercially available but expensive computer systems are in use around the world.
- In contrast, the computer technology required for DNA databanks is relatively simple. Because DNA profiles can be reduced to a list of genetic types (hence, a list of numbers), DNA profile repositories can use relatively simple and inexpensive software and hardware. Consequently, computer requirements should not pose a serious problem in the development of DNA profile databanks. Confidentiality and security of DNA related information are especially difficult and important issues, because we are in the mids of two extraordinary technological revolutions that shows n o sings of abating: in molecular biology , which is yielding an explosion of information about human genetics, and in computer technology, which is moving towards national and international networks connecting growing information resources.
- Even simple information about identity requires confidentiality. Just as fingerprint files can be misused, DNA profile information could be misused to search and correlate criminal-record databanks or medical-record databanks.
- Computer storage of information increases the possibilities for misuse. For example, addresses, telephone numbers, social security numbers, credit ratings, range of incomes, demographic categories, and information on

hobbies are currently available for many of our citizens in various distributed computerized data sources. Such data can be obtained directly through access to specific sources, such as credit-rating services, or through statistical disclosure, which refers to the ability of a user to derive an estimate of a desired statistic or feature from a databank or a collection of databanks.

- Disclosure can be achieved through one query or a series of queries to one or more databanks. With DNA information, queries might be directed at obtaining numerical estimates of values or at deducing the state of an attribute of an individual through a series of Boolean (yes-no) queries to multiple distributed databanks.
- Several private laboratories in U.S.A. already offer a DNA-banking service (sample storage in freezers) to physicians, genetic counsellors, and, in some cases, anyone who pays for the service. Typically, such information as name, address, birth date, diagnosis, family history, physician's name and address, and genetic counsellor's name and address is stored with samples. That information is useful for local, independent bookkeeping and record management. But it is also ripe for statistical or correlative disclosure. Just the existence in a databank of a sample from a person, independent of any DNA-related information, may be prejudicial to the person.
- In some laboratories, the donor cannot legally prevent outsiders' access to the samples, but can request its withdrawal. A request for withdrawal might take a month or more to process. In most cases, only physicians with signed permission of the donor have access to samples, but typically no safeguards are taken to verify individual requests independently. That is not to say that the laboratories intend to violate donors' rights; they are simply offering a service for which there is a recognized market and attempting to provide services as well as they can.

Following are few suggestions to avoid all above mentioned problems:

- In the future, if pilot studies confirm its value, a national DNA profile databank should be created that contains information on felons convicted of particular violent crimes. Among crimes with high rates of recidivism, the case is strongest for rape, because perpetrators typically leave biological

evidence (semen) that could allow them to be identified. Rape is the crime for which the databank will be of primary use. The case is somewhat weaker for violent offenders who are most likely to commit homicide as a recidivist offence, because killers leave biological evidence only in a minority of cases.

- The databank should also contain DNA profiles of unidentified persons made from biological samples found at crime scenes. These would be samples known to be of human origin, but not matched with any known persons.
- Databanks containing DNA profiles of members of the general population (as exist for ordinary fingerprints for identification purposes) are not appropriate, for reasons of both privacy and economics.
- DNA profile databanks should be accessible only to legally authorized persons and should be stored in a secure information resource.
- Legal policy concerning access and use of both DNA samples and DNA databank information should be established before widespread proliferation of samples and information repositories. Interim protection and sanctions against misuse and abuse of information derived from DNA typing should be established immediately. Policies should explicitly define authorized uses and should provide for criminal penalties for abuses.
- Although the committee endorses the concept of a limited national DNA profile databank, it doubts that existing RFLP-based technology provides an appropriate wise long-term foundation for such a databank. We expect current methods to be replaced soon with techniques that are simpler, easier to automate, and less expensive—but incompatible with existing DNA profiles. Accordingly, the committee does not recommend establishing a comprehensive DNA profile databank yet.
- For the short term, we recommend the establishment of pilot projects that involve prototype databanks based on RFLP technology and consisting primarily of profiles of violent sex offenders. Such pilot projects could be worthwhile for identifying problems and issues in the creation of databanks. However, in the intermediate term, more efficient methods will replace the current one, and the forensic community should not allow itself to become locked into an outdated method.

- State and federal laboratories, which have a long tradition and much experience in the management of other types of basic evidence, should be given primary responsibility, authority, and additional resources to handle forensic DNA testing and all the associated sample-handling and data-handling requirements.
- Private-sector firms should not be discouraged from continuing to prepare and analyze DNA samples for specific cases or for databank samples, but they must be held accountable for misuse and abuse to the same extent as government-funded laboratories and government authorities.
- In U.S.A. the partner agencies of the DNA Initiative are working to help ensure that DNA forensic technology is used to its full potential to identify missing persons by providing:
- Nihil Simul Inventum Est Et Perfactum – A Thing Invented Takes Time To Be Perfected

Thus it can be concluded that because of the reasons such as Discrimination potential, Sensitivity, Reliability, Ease of interpretation, Speed of analysis and Cost effectiveness the DNA Technology shall be utilised in various fields, especially investigation.

# Chapter-III

## Historical Development and Evolution of DNA Technology – Religious & Ethical Perspectives

### 1. History of Forensic DNA Analysis

### 1.1 Introduction:

DNA typing, since it was introduced in the mid-1980s, has revolutionized forensic science and the ability of law enforcement to match perpetrators with crime scenes. Thousands of cases have been closed and innocent suspects freed with guilty ones punished because of the power of a silent biological witness at the crime scene.

'DNA fingerprinting' or DNA typing (profiling) as it is now known, was first described in 1985 by an English geneticist named Alec Jeffreys. Dr. Jeffreys found that certain regions of DNA contained DNA sequences that were repeated over and over again next to each other. He also discovered that the number of repeated sections present in a sample could differ from individual to individual. By developing a technique to examine the length variation of these DNA repeat sequences, Dr. Jeffreys created the ability to perform human identity tests.

These DNA repeat regions became known as VNTRs, which stands for variable number of tandem repeats. The technique used by Dr. Jeffreys to examine the VNTRs was called restriction fragment length polymorphism (RFLP) because it involved the use of a restriction enzyme to cut the regions of DNA surrounding the VNTRs. This RFLP method was first used to help in an English immigration case and shortly thereafter to solve a double homicide case[45].

Since that time, human identity testing using DNA typing methods has been widespread. The past 20 years have seen tremendous growth in the use of DNA evidence in crime scene investigations as well as paternity testing. In addition, most countries in Europe and Asia have forensic DNA programs. The number of

[45] Yashpal Singh and Mohammad Zaidi ,"*DNA Test in Criminal Investigation, Trial and Paternity Disputes"* , Alia Law Agency, Allahabad, 2006, p. 101

laboratories around the world conducting DNA testing will continue to grow as the technique gains in popularity within the law enforcement community. In India there are 24 central laboratories working to preserve, protect and maintain the record of DNA evidence.

**Historical perspective of discovery of individual's identifying techniques:**

## 1.2 Identification of Individuals

### i. Identification of Individuals through Fingerprints-

Fingerprints were considered as one of the most reliable physical evidence used in the determination of the identification of the person. In 17th century English Botanist Dr. Nehemiah Grew, fellow of the college of Physicians and of the Royal Society was the first person to documents his findings about the ridges on the hands in his paper published in 1684.[46]

In 1880, Scotish physician Dr.Henry Faulds and British administrator sir William Herschel described that every individual has a different fingerprinting. Scientist Sir Fransis Galton approved there research and conclusion. In 1973 Sir Edward Henry, A British Indian Civil servant in India had described about fingerprinting classification system in his book "Classification and uses of fingerprints" based on Francis Galton's book "Fingerprint" and subsequently it was adopted in British India. The exhaustive comprehensive study and research work on fingerprinting was carried out by Galton in 1892 for the purpose of criminal investigation. In 1896, Henry fingerprint classification system was first used by the police of Argentina to solve a murder mystery of a child by comparing the fingerprints of suspect and fingerprints found on crime scene[47].

In 1860, it was first time introduced in India and was used for identification of an illiterate British soldier for the payment of military pension. In India, science of finger printing is widely used, whereas in western countries it is rarely used as there is almost no use of thumb impression due to high percentage of literacy.

---

[46]See, Article on "History of the Metropolitan Police Fingerprint Bureau ,Available at http://www.met.police.uk/history/fingerprints.htm (Last accessed on 24th Jan., 2007)
[47] Ibid

**Limitations:**

This for 150 years was the primary source for identification of individuals. But later it was found that even fingerprints can be altered by surgery. Also the problem with the fingerprints is that the two individuals can have the same fingerprints although the chances are very-very low. There are conflicting opinions of various experts in case if the fingerprints are blurred.

**ii. Through Blood Grouping test:**

Karl Land Steiner[48], who was given a noble prize in 1930 for dividing blood into four distinct groups, and this also, formed the basis for identification of an individual.

1901- Karl Landsteiner discovered the methods by which blood could be grouped into different categories.

1915-Italian scientist Dr. Leone Latters developed procedure for determining blood groups of blood stains.

1940 –Rhesus (IRh) system was discovered for solving paternity disputes by Landsteiner and wiener.

1947- 5 groups were discovered.

The human blood can be genetically transmitted as it holds certain characteristics. The blood groups which were earlier used for paternity testing were 'ABO', 'MNS' and Rh.

**Limitations of blood group system:**

They may exclude a certain individual as the possible father of the child but cannot possibly establish paternity. Blood test can't be used positively to establish paternity, but they can increase the denial of possibility of the paternity. i.e a person can or cannot be the father of a child. Even in case of the conflict between two persons with

[48] See, Article on DNA Technology, Available on notable twentieth-century scientists. gale research, 1995.reprinted by permission of The Gale Group.Link: http://www.galegroup.com http://www.pbs.org. /wnet/redgold/innovators/bio_landsteiner.html (Last accessed on 6th February, 2007)

whom the mother of the child had the intercourse, if they undergo a blood test that there is 80% chance the test will show that one of them is or both of theme are not the father/fathers of that child.

Today more than 100 different factors in human blood are known which may vary in different individuals. Thus there had been clearly a need of another marker, which is conclusive in exclusion so as to minimize the high increase in the error rate in wrongful convictions and acquittals

This need was fulfilled by Alec Jeffrey's method by which individual specific polymorphism can be detected. DNA fingerprinting/profiling was developed in 1985 by Alec Jeffrey and his colleagues at Leicester University (England) who named the process for isolating and reading DNA markets as "DNA Fingerprinting".

Forensic use of DNA technology in criminal cases began in 1986 when police asked Dr. Alec J. Jeffrey to verify a suspect's confession that he was responsible for two rape-murders in the English Midlands[49]. Tests proved that the suspect had not committed the crimes. Police then began obtaining blood samples from several thousand male inhabitants in the area to identify a new suspect.[50]

In a 1987 case in England Robert Melias became the first person convicted of a crime (rape) on the basis of DNA evidence.[51] In one of the first uses of DNA in a criminal case in the United States, in November 1987, the Circuit Court in Orange Country, Florida, convicted Tommy Lee Andrews of rape after DNA tests matched his DNA from a blood sample with that of semen traces found in a rape victim[52].

[49]The first reported use of DNA identification was in a no criminal setting to provem a familiar relationship. A Canadian boy was refused entry in U.K. for the lack of the proof that he was son of women who had the right to settlement in U.K. immigration authorities contained that the boy could be the nephew of the women, not her son. The DNA testing showed the mother-son relatioship. The U.K. Government accepted the test findings and admitted the boy See "Methods and application of DNA fingerprinting; A guide for the non-scientists' Criminal Law Review 1987 p.105.

[50]See, Article written by Gill Peter Alec Jeffery and David J. Werret "Forensic application of DN fingerprinting" Available at http:/www.pbs.org./wgbh/pages/frontlineshows/case/revolution /wars.html. (Last accessed on: 9th February,2007)

[51] See, Article , Available at http://web.utk.edu/ (Last accessed on: 12th February, 2007)

[52]Admissibility of DNA evidence was upheld by the intermediate appeals court, which cited the uncontroverted testimony of the state's expert witness. Ibid 51.

Two other important early cases involving DNA testing are State v. Woodall[53] and Spencer v. Commonwealth. In Woodall, the West Virginia Supreme Court was the first State High court to rule on the admissibility of DNA evidence. The court accepted DNA testing by the defendant, but inconclusive results failed to exculpate Woodall. The court upheld the defendant's conviction for rape, kidnapping, and robbery of two women. Subsequent DNA testing determined that Woodal was innocent, and he was released from prison.

The multiple murder trials in Virginia of Timothy Wilson Spencer were the first cases in the United States where the admission of DNA evidence led to guilty verdicts resulting in a death penalty. The Virginia Supreme Court upheld the murder and rape convictions of Spencer, who had been convicted on the basis of DNA testing that, matched his DNA with what of semen fond in several victims.[54]

The first paternity dispute in India[55] which was solved by DNA fingerprinting test was the case no. M.C. 17 of 1988 in the court of Chief Judicial Magistrate of Telicherry .The Chief Judicial MAGISTRATE held that "The evidence of expert is held admissible under sec 45 of the Indian evidence Act. And it is also relevant under sec-51 of The Indian Evidence Act." Dr. Lalji Singh is known as the founder of the DNA technology used in Indian Legal system.

**iii. Through DNA fingerprinting:**

Following is the chronological development in DNA fingerprinting[56]:

1. DNA Fingerprinting by doctor Alec Jaffrey (U.K.) -1985
2. DNA profiling –by FBI (RFLP) -1988
3. PCR DQalpha and Polymarker tm-1990
4. PCR STRs-1993
5. Mitochondrial DNA -1996

---

[53] See, Missisippi Court Opinion, Fifth Circuit, Available at http://www.mslawyer.com. (Last accessed on: 12th February, 2007 )

[54] See,Case Discussion,http:pbs.org/wgbh/pages /frontline/shows/cases/revolution/wars.html.(Last accessed on: 13th February, 2007)

[55] M. W. Pandit and Dr. Lalji Singh 'DNA testing, Evidence Act and Witness testing' *The Indian Police Journal*, Dec. 2000 p.100 (Cr.L.J. 2004)

[56] Yashpal Singh and Mohammad Zaidi "*DNA Tests in Criminal Investigation, Trial and Paternity Disputes"*, Alia Law Agency, Alahabad, 2006 p. 95

6. Multi-Plex STRs-1997
7. Y-CHROMOSOMS Analysis-
8. SNPs
9. CHIPS

### 1.3 First time uses of DNA Evidence

Following is the chronology of the use of DNA for the purpose of Legal proceedings or investigation[57]:

- 1986- Prof. Alec Jeffreys innovated and applied first DNA test of two teenaged girls rape and murder case in U.K.
- 1986-First exoneration through post –conviction test in U.K.
- 1987- Robert melias was the first person got conviction on the basis of DNA evidence in U.K.
- 1987- DNA evidence produced first time in U.S.A.
- 1987- DNA test first used in Tommy Lee Andrew of U.S.A. in a rape case.
- 1989- DNA evidence got legal validity in India.[58]
- 1989- DNA evidence was first time produced in court in India.[59]
- 1994- Crime of century case of O. J. Simpson produced in the court.
- 1996, Mitochondrial DNA analysis was first used in the case of Tennessee in U.S.A.
- 1998Canada has passed "DNA Identification Act, 1998"and was assented in 2000
- 2003, U.S.A. passed 'Advancing Justice through DNA Technology Act, 2003"
- 2003, U.S.A has passed "Justice for all Act, 2004.'
- 2005, provisions for DNA profiling are included in the Code of Criminal Procedure by passing The Code of Criminal Procedure (Amendment) Act 2005 in India.

[57]Yashpal Singh and Mohammad Zaidi "*DNA Tests in Criminal Investigation, Trial and Paternity Disputes"*, Alia Law Agency, Alahabad, 2006 p.97
[58] Kunhiraman v. Manoj, (1991) 3 Crimes 860 (Ker.)

**Social, Ethical, Economic and Religious perspective of DNA Technology:**[60]

The introduction of any new technology is likely to raise concerns about its impact on society. Financial costs, potential harm to the interests of individuals, and threats to liberty or privacy are only a few of the worries typically voiced when a new technology is on the horizon.

## 2.1 Ethical Aspects:

Ethical considerations regarding the use of DNA technology in forensic science overlap with various issues addressed in social and legal analyses including substantive and procedural rights of people and overall no monetary costs and benefits likely to result from establishing the use of the new technology in courtroom proceedings.

A threshold question for any ethical inquiry is whether the action or practice under discussion is intrinsically wrong. An action or practice is intrinsically wrong if it violates fundamental ethical principles. These have traditionally been held to include prohibitions against enslavement, torture, gratuitous infliction of harm on human beings, and modes of exploitation that use humans as merely a means (usually without their knowledge or consent) to serve the ends of others. To hold that such actions or practices are intrinsically wrong is not to claim that they can never be justified. For example, if torturing a terrorist who knows the location of a bomb planted to kill a million people is the only way to avert the tragedy, then torture might be justified. That would not yield the conclusion that torture is ethically right, but rather would show that evil acts can sometimes—albeit rarely—be justified as a means of preventing much greater harm.

DNA technology in forensic science is unlikely to violate any fundamental ethical principle of the type described above. Although DNA technology involves new scientific techniques for identifying or excluding people, the techniques are

[60] See, 22 1977 Cr.L.J 1797 (AP)
And 1985 Cr.L.J 974 (Guj)
And Sec 4 of Indian Evidence Act, 1872.
Sec 112 read with Sec4 of Indian Evidence Act, 1872.
Also see AIR 1993 SC 2295

extensions and analogues of techniques long used in forensic science, such as serological and fingerprint examinations, handwriting analyses, photography, and examination of teeth. Ethical questions can be raised about other aspects of this new technology, but it cannot be seen as violating a fundamental ethical principle.

A new practice or technology can be subjected to further ethical analysis by using two leading ethical perspectives. The first examines the action or practice in terms of the rights of people who are affected; the second explores the potential positive and negative consequences (nonmonetary costs and benefits) of the action or practice, in an attempt to determine whether the potential good consequences outweigh the bad.

## 2.2 Bioethics:

Summa Ratio Est Equae Pro Religion Facit-The Best Reason Is That Which Is In Favour Of Religion.

Science, Law, and Religion have been continuously remaining in conflict with each other. The questions of the social use of genetic information gained through DNA testing also arise and must be debated at an ethical level also.

- Is it now open to parents to choose the kind of children they will have and if so, what are the consequences of such choices?

- Stem cells research also raises serious ethical issues. Nobody wants to know how he will die and when and would rather live without that knowledge. Such a dilemma might only be expected to face characters in a science fiction novel or film until now. Genetic test, which promises to foretell our medical future, are being sold in growing numbers, thus causing ethical problems.

By far the biggest public concern recently has come with new developments in the life sciences, - Some of the ethical issues relating to cloning and genetically modified organism have been exaggerated, some of which are as under[61]:

[61]See, Article on Bioethics, *The National Academic Press*, Available at http://www.nap.edu/openbook.php (Last accessed on: 27th February, 2007)

- The potential to misuse genetic information about individuals
- The question of who owns genes and genetic code
- The implications of patenting knowledge that traditionally has been shared
- The acceptability of cloning human beings for reproductive or other purposes
- The acceptability of transferring genes from one animal species to another
- The safety of genetically-modified organisms, both in terms of the environment and the consumer, including reduced biodiversity.

### 2.3 Non monetary Costs and Benefits:

The ethical perspective by which actions or practices are evaluated in terms of their good and bad consequences is fundamentally sound. Nevertheless, it suffers from both theoretical and practical difficulties. Not only is it difficult to predict good and bad results in advance of gathering sufficient evidence about projected consequences, but it is also sometimes hard to weigh consequences, even if they have already come about. For example, how is it possible to weigh the good consequences of enabling positive identifications to be made with greater certainty by using DNA technology against the bad consequences of drawing mistaken conclusions in particular cases where laboratory techniques or personnel are substandard? Even well-done tests can yield false positives. In approximately 35% of cases performed by the FBI to date, the primary suspect was excluded by DNA (tests on persons who had been prescreened). However, that observation does not resolve the problem of weighing good consequences against bad ones, although it does provide some information that could be used in such weighing.

Another factor to be weighed in a consequential and ethical analysis is whose interests are to count and whether some people's interests should be given greater weight than others'. For example, there are the interests of the Accused, the interests of victims of crime or their families in apprehending and convicting perpetrators, and the interests of society. Whether the interests of society in seeing that justice is done should count as much as the interest of the accused or the victim is open to question?

Here there is an obvious overlap with an ethical analysis from the perspective of rights, and assessment of the consequences of instituting a new practice should include the effects of the new practice on the rights of the people involved.

Especially when a practice is new and information on projected consequences is scanty, there are problems with relying on balancing the good and bad consequences as a mode of ethical analysis. People who favor one policy or practice predict a balance of good consequences over bad ones, and detractors do the opposite.

One important factor contributing to uncertainty about the use of DNA typing technology is the existence of disagreement among scientific experts. When experts disagree about the use of techniques or statistical methods (such as extrapolations based on population genetics) or about the interpretation of data, the uncertainty is of a different sort from uncertainty that stems simply from scanty evidence drawn from actual consequences. The latter uncertainty can be remedied by gathering more data before a technology is introduced as an accepted standard. If controversy among experts persists, disagreements can erupt whenever empirical evidence is analyzed and specific conclusions and questions are to be addressed or answered, which can be as follows:

- DNA typing technology has the potential for uncovering and revealing a great deal of information that most people consider to be intensely private.
- DNA patterns may not be neutral
- Fairness in the use of genetic information in the database by insurers, employers, courts, schools, adoption agencies, and the military among others.
- "Who should have access to personal genetic information, and how will it be used? "
- Privacy and confidentiality of genetic information.
- Who owns and controls genetic information?
- Parameters of privacy and confidentiality of the genetic information along with its controls have to be suitably defined.
- Psychological impact/ trauma and stigmatization due to an individual's genetic differences.

- How does personal genetic information affect an individual and society's perceptions of that individual?
- How does genomic information affect members of minority communities?
- It needs to be seen that how does personal genetic information affect an individual and society's perceptions of that individuals.
- Issues related to the use of genetic information in reproductive decision making and reproductive right;

## 2.4 Questions raised because of the Genetic testing:

The genetic testing may arise following ethical, legal and social questions:

What if it causes unnecessary stress and unwelcome changes in personal relationships?

Should genetic testing be carried out where there is no treatment available as in albinism and dwarfism?

How to address the following cases in the light of genetic testing?

- Genetic testing for insurance

- Genetic testing for new employees

- Genetic databanks for forensic use

- Genetic databanks for institutionalized children

Would it cause social biasness? What if people with 'aggression genes', 'cancer genes' or 'mood-swing genes'?

Matters concerning commercialization of products including property rights and accessibility of data and materials. Like who owns genes and other pieces of DNA? The mindset of all concerned in this regard has to be suitably made clear.

### a) Ethical, Legal, and Social Concerns about DNA Data banking:

**Questions regarding Genes and Privacy:**

What if your blood sample for medical check-up is used for research or other purposes without being informed?

The federally established human genome program will yield an unprecedented amount of genetic information and generate new databanks even apart from the human genome program, DNA technology is moving forward; but this large-scale program, projected to take 10-15 years, is bound to accelerate the acquisition of genetic information. At the same time, it contains a mandate for examining the ethical, social, and legal implications of mapping the human genome, with specific allocation of funds for examining these aspects. A central concern raised by these developments is the safeguarding of the confidentiality of personal genetic information. With greater understanding of the human genome, the potential of misuse of DNA samples collected or preserved for purposes of criminal justice will increase. The more databanks are established, the greater the risk of breaches of confidentiality and misuse of the information.

## 3. Universal declaration on the Human Genome and Human Rights and Ethics

Science has raised ethical questions before. The most obvious case is the applications of atomic energy. But whereas atomic energy was shrouded by military secrecy, the recent developments in the life and health sciences are very much in the public arena. The fact that there is a public outcry is as important as whether or not it is justified. It proves that scientists cannot do whatever they want, and are accountable at least in a society based on democratic principles. “The behavior of the scientific community in general is positive”, says UNESCO Director-General, Federico Mayor, “and I think they deserve trust”. But, he says, it is the task of ethics to draw the line between what is possible and what is acceptable. This can be done neither by science nor by technology. To draw this line, he set up a 55-member International Bioethics Committee (IBC) in 1993, which, after four years of meetings and public debates, drafted a Universal declaration on the Human Genome and Human Rights, the first in

the field of genetics within the United Nations System. Although the Declaration is not binding, it represents a moral commitment of all Member States to adhere to a coherent set of principles in the field of genetics[62].

Articles 5 to 9 of the Declaration make provision to protect the rights of the individual regarding research or treatment that may affect his or her genome, as well as the confidentiality of genetic information, in the conditions set by law.

Article 17 encourages the practice of solidarity towards individuals, families and population groups who are particularly vulnerable to or affected by disease or disability of a genetic character. These articles are intended to protect against eugenic practices.[63]

Research on embryonic stem cells is one of the most controversial issues today. Such research should in the future make it possible to create organs and tissue, of which there is currently a severe shortage, for transplantation purposes. Spectacular progress is expected in the dealing with diseases, which are currently either difficult or impossible to treat (such as Parkinson, Alzheimer, and Multiple Sclerosis etc.). But the fact that these stem cells mainly come from human embryos raises the question of whether we should create embryos for the sole purpose of facilitating research. Opinions on the subject of embryonic stem cells differ widely. As the Report of UNESCO's International Bioethics Committee (IBC), The Use of Embryonic Stem Cells in Therapeutic Research makes clear: "The ethical legitimacy of performing human embryonic stem cell research depends, in large measure, on the status which is attributed to embryo.

The prospect of human cloning is sparking intense debate. Some still warn that cloning for reproductive purposes will be conducted, despite the fact that it has been banned both by UNESCO's Universal Declaration on the Human Genome and Human Rights (1997), which describes cloning as contrary to human dignity (Art.11), and by legislation in many countries. Although the international community has already rejected human cloning for reproductive purposes as an unacceptable

[62] See,Article Science for the 21st century : A New Commitment "The possible and the acceptable ethics in science", *UNESCO's Office of Public Information,* 2002 p. 124 ,Available at www.unesco.org/bpi/science/content/press/anglo/3.htm (Last Accessed on 4th March 2007)
[63] Ibid 62

instrumentalisation of the human being, questions remain regarding therapeutic cloning. With the progress of genetics, a new type of diagnosis, which also presents a threat, has come to light, which is pre-implantation genetic diagnosis. Such diagnosis is currently restricted for the detection of serious diseases may yet be used for eugenics, in other words, for the selection of individuals. It may become very tempting to use this diagnosis technique for enhancement purposes or to select certain physical characteristics.

The collection, treatment, storage and use of genetic data raise a host of ethical questions. UNESCO is considering an international instrument on genetic data and the IBC, which has published a report on genetic data, has examined several of its aspects:

The aim of the genetic data collection;

- informing sample donors;
- free and informed consent on the part of donors;
- regard for the particular sensitivities of particular social,
- religious and ethnic groups regarding human tissue;
- precautions which must be taken when conducting genetic tests, such as parentage testing, considering their implications for the people tested and others;
- The confidentiality; and fate of the samples.
- Some of the problems concerning genetic data, such as confidentiality and consent, can already be found – sometimes under different names – in conventional medical practice.
- As far as human organ and tissue donations are concerned, the field of bioethics is expanding. This field has been facing major questions for some time. Notably:
- How to avoid the emergence of trafficking in human organs – such as kidneys, liver and pancreas – or of human tissue – cornea or bone marrow etc. – for which there is a strong demand.
- Genetics now raise new questions, about, notably, the use of xenotransplantation (the transplantation of genetically engineered animal

organs into a human body) and genetic engineering in stockbreeding as a potential source of organs which are compatible with the human body. The life sciences are constantly adding to these already numerous and often intertwined ethical quandaries and this is why UNESCO has chosen the Ethics of Science and Technology as one of its five major priorities in its Medium – Term Strategy for 2002 to 2007[64].

## 4. Moral Rights

Two main questions may arise about the moral rights because of the DNA Technology:

1. Does the use of DNA technology give rise to any new rights not already recognized?
2. Does the use of DNA technology enhance, endanger, or diminish the rights of anyone who becomes involved in legal proceedings?

In answer to the first question, it is hard to think of any new moral rights not already recognized that come into play with the introduction of DNA technology into forensic science. The answer to the second question requires a specification of the classes of people whose rights might be affected and what those rights might be.

The people whose rights might be endangered or diminished seem to be chiefly those who are suspected or accused of or indicted for a crime or involved in other legal proceedings, such as paternity suits, denaturalization, or immigration matters. Does use of DNA technology interferes with or diminish their rights in any way? Might it enhance their rights? Which rights might be endangered?

The current use of DNA technology appears to pose no greater threat to the right to privacy than does normal fingerprinting, placement of photographs in evidence, collection of blood or saliva samples, or other established forensic techniques. DNA technology is not different in principle from those other techniques, although it holds the promise of providing a more definitive identification than most others. The fingerprinting is likely to remain the best for a while. If the use of DNA information

[64] See, Article "Challenges of Bioethics" as appeared in , From *UNESCO Press Release* ,Available at http://www.nap.edu/openbook.php (Last accessed on: 28th February, 2007)

can be strictly limited to defendant identification, it involves no greater intrusion into the privacy of an accused person than do traditional methods in forensic science, whose aim is to make as definitive an identification as possible. Without strict limits, however, DNA information can be more intrusive into privacy, in that it provides more information about a person.

In some ways, the use of DNA information about suspects can be less intrusive than traditional methods. "Rounding up the usual suspects" by checking a DNA sample against a computerized databank is both much easier and less intrusive than rounding up the suspects themselves. But people who are rounded up are made aware that they are under suspicion and can take protective steps. Where databanks already exist, a fresh blood sample would have to be taken from suspects for confirmation. Thus, it is a complex matter to determine whether the rights of suspects are enhanced or endangered by the use of DNA evidence in the forensic setting, which requires empirical evidence to be subjected to careful analysis.

Concerns about intrusions into privacy and breaches of confidentiality regarding the use of DNA technology in such enterprises as gene mapping are frequently voiced, and they are legitimate ethical worries. The concerns are pertinent to the role of DNA technology in forensic science, as well as to its widespread use for other purposes and in other social contexts. A potential problem related to the confidentiality of any information obtained is the safeguarding of the information and the prevention of its unauthorized release or dissemination; that can also be classified under the heading of abuse and misuse (discussed below), as well as seen as a violation of individual rights in the forensic context.

People have a right not to be wrongly convicted of a crime. To protect that right, a high standard of proof is imposed before a person may be found guilty. In addition, techniques used in gathering and analyzing evidence must have proven reliability (comprising accuracy, precision, specificity, and sensitivity) and should be accepted by a consensus of the scientific community. If DNA technology is as good as or better than other methods used to identify criminals and if; the implications and limitations of DNA evidence are recognized by judges and jurors, its use should pose no greater danger to the rights of accused people than the use of currently approved techniques of forensic identification. Moreover, the reliability of DNA evidence will permit it to

exonerate some people who would have been wrongfully accused or convicted without it. Therefore, DNA identification is not only a way of securing convictions; it is also a way of excluding suspects who might otherwise be falsely charged with and convicted of serious crimes.

**5. Religious issue:**

In an interesting article of Sophie Boukhari, UNESCO Courier journalist, an array of responses to the bioethical questions posed by genetic technologies, by Catholics, Protestants, Buddhists, Muslims and Jews are referred. "Although religious practice may be declining", says French geneticist and Member of Parliament Jean Francois Mattei, "the metaphysical issue is still at the core of the questions raised about genetic engineering, either by tradition, culture or duty." Should a person have recourse to prenatal screening and consider having an abortion if a serious genetic defect is discovered? Should research on embryos, gene therapy and cloning be allowed? All the "religions of the Book" (Christianity, Judaism and Islam) believe that the answers to these questions largely depend on the status of the embryo. The frontier between "good" and "bad" genetic engineering depends on whether or not the embryo is considered to be "animate". "If the embryo has soul, then it is endowed with a human as well as a biological life and any attack on its integrity is seen as a crime", says French Geneticist Rene Freedman. Following are the most commonly known views of the specific religions in relation DNA Technology[65]:

i. Jews allow experiments with embryos, especially if they have no chance of surviving. Judaism also does not rule out cloning, says French Theologian and Jurist Raphael Brai; "If cloning is done for the therapeutic reasons, the matter has to be discussed with other people. Several religious notions clash at this point, for example, the oneness of the human person and the duty to heal oneself." But cloning for reproductive reasons is not allowed, with few exceptions.

ii. Protestant Christians are generally more open to advances in genetics. They stress free will and regard each case on its merits, leaving the decision to the couple involved.

[65]See, Sophie Boukhari, "Religion, genetics and the embryo", *UNESCO Courier* (Sept, 1999) Available at http://www.nap.edu/openbook.php (Last accessed on: 28th February, 2007)

iii. Buddhists are even less dogmatic because they believe all truth is relative. A French expert in Buddhism, Raphael Liogier, notes, "the only ethical limit is suffering, for Buddha is primarily a healer". The Dalai Lama, leader of Tibet's Buddhists, says what mainly has to be taken into account are "the good effects and bad effects of genetic engineering". He agrees that it can be used to "improve the human body – the brain, for example." "The body is only a vehicle for karma [the ethical consequences of a person's actions that determine their destiny in their next incarnation]", says Liogier.

iv. Most important of all, while all the major religions generally believe human life and dignity should be respected, the Church of Rome is the only religion that considers the embryo "as a human being from the moment of conception", and it sticks firmly to this doctrine. The Vatican is against both the reproductive and therapeutic cloning on the grounds that it violates the "unified totality" of the human person and the sacred link between sexuality and procreation.

v. As per Islam philosophy - H'mida Ennaifer, of the Higher Institute of Theology in Tunis, says "Islamic jurists all condemn abortion after the fetus has received the breath of life. Some Malekites condemn it even when the child is less than 40 days old while other schools of thought allow it during the first four months of pregnancy." Islam also allows gene therapy on the human body, but in general it proscribes the modification of germ cells and bans anything which denies the notion of divine creation, starting with cloning. However, a minority of jurists regards cloning as sometimes preferable to "genetic adultery" because it respects the line of descent by avoiding a situation where a sterile couple uses sperm or eggs from a donor in artificial insemination.

As noted above, the provisions of the Universal Declaration on the Human Genome and Human Rights explicitly outlaw human cloning for reproductive purposes, as contrary to human dignity. Human dignity, inherent to each individual, excludes all practices, which tend towards the `reification' of an individual or his or her `instrumentalisation'. In other words, a human being is a subject, not an object, for science. Several countries, including United Kingdom, United States of America, Canada, Germany, have laws or are drafting laws banning human reproductive cloning.

It is now technically feasible to take a gene from one species and make it part of the genome (genetic `blueprint') of another species. A toxin-producing gene from a bacterium can be added to corn to make it pest-resistant. The gene that makes a firefly glow at night can be added to a plant's DNA to make the leaves light up when the crop is ripe. A cow can be `engineered' to produce a drug in its milk. Human genes can be added to a pig's genome so that it grows organs for transplantation to man without being rejected by the patient. In general, the creation and release of genetically modified organisms (GMOs) raises a different type of issue – bio-safety. There is a risk that a transgenic plant will cross-pollinate a natural variety and produce mutations with unknown results. Large scale planting of pest-resistant biotechnological plants exposes the pest to the toxin on a scale unknown before. This can give insects and viruses a much greater imperative to become resistant – otherwise the species might die out. Organic farmers are afraid that a new strain of toxin-resistant insect would wipe out their crops. "On the other hand, an insect-free environment is also likely to be a bird-free environment."[66]

vi. Hindu Vedanta philosophy:

The Hindu religious history Mahabharata and other *Puranas* discusses about the use of modern genetics and related technologies, of which few examples are as under,

- Birth story of Kauravas
- Birth of Krishna, Balram and jog maya
- Birth story of karn.. The Technology has its roots in the past. The Vedanta Philosophy says that on one side the DNA technology has facilities the human activities but on the other hand, as every coin has two sides, it has created the danger for the very existence ofhumanbeings. We need the healthy combination of science, technology, modernization, religion and spirituality[67].

[66]See: Honourable Mr.Justice R.K.Abichandani, "Science for the 21st Century: A New Commitment "The possible and acceptable ethics in science"paper presented in a conferednce on "Gene Age" (October,2003), Available at gujarathighcourt.nic.in/Articles/legalpers.htm (Last Accessed on 15th March 2007)

[67] See, Article published in *Prabudha Bharata /Awakened India* monthly Magazine established and started by Swamin Vivekanand-The disciple of Ramkrishna Param Hansa of Ram Krishna Mission,(2007)

vii. Greek philosopher Plato said, "positively gathered society of morally just individuals is a just society."[68] The law and society both reflect and shape each other .Nor is law abstract and remote from every day life, law effects you personally in ways which might not seem immediate obvious. Aristotle describes justice as a practice of perfect virtue is a question of abstract principle. Information vacuum among minorities may lead to Ethical, Social, and Political Dilemmas.

## 6. Economic Aspects:

The following points have to be considered for understanding the economic perspective for the DNA Technology:

- The forensic use of DNA technology will have various economic impacts.
- The proliferation of DNA evidence in investigations and trials requires a fairly rapid expansion in the number of reliable experts and laboratories.
- The cost of the equipment, training and proficiency programs, supplies, and personnel will be very large.[69]
- Material will have to be stored for databanks and for checking suspects. Costs will be associated with the upgrading and changing of databanks when new procedures are adopted.
- Those costs will affect budgets for police, prosecutors, and courts. Indigent criminal defendants might have a constitutional due-process right to have an expert witness paid for by the government.
- The courts themselves must be supplied with reliable assistance in evaluating DNA material[70]. The government will generally have to bear this cost. However, if a defendant can afford the cost and asks for expert assistance, the court can assess some costs against the defendant and some against the state.
- New costs will also be related to training and certification. The implementation of any new technology requires training and certifying of

[68] V.D. Mahajan, *"Jurisprudence and Legal Theory"* , 5th Edition,2011

[69] For example, the three proposed regional laboratories in New York State are estimated to cost $1.4 million per year. The Commonwealth of Virginia has committed several million dollars over the last 3 years to its forensic DNA activities (Paul Ferrara, personal communication, 1990).

[70] In the federal system, the court can request an expert or panel of experts to assist it, pursuant to Rule 706 of the Federal Rules of Evidence. A special register of scientific experts can be maintained for ready access.

personnel. Additional costs will be incurred to develop mechanisms to ensure quality control of laboratories that conduct forensic DNA testing.

- New technology can grow and make ever larger fiscal demands on society. It is difficult to predict the total cost of DNA testing when it becomes generally available nationwide, but it is reasonable to expect it to amount to tens of millions of dollars a year. That cost is unavoidable, but, given the present fiscal problems at all levels of government cannot be ignored.
- Setting up regional and cooperative services is one way of controlling costs. It might not be feasible or appropriate for some small forensic science laboratories to create their own DNA testing capabilities.
- In U.S.A., a major DNA testing center run by the FBI might reduce costs to smaller localities. That potential reduction in monetary cost needs to be balanced against the risks to privacy and confidentiality of having a powerful federal law-enforcement agency in charge of DNA testing and storage of DNA information.
- If laboratories come to share information, everything could eventually become linked. At the same time, the risks that privacy and confidentiality will be breached might be as great or greater with local control, in that state laws governing the use of criminal records vary widely.
- It is likely that the cost of criminal justice will be increased. In some cases, however, early exclusion of suspects who have been cleared by forensic DNA evidence will reduce cost in the judicial system. On balance, the increased costs are small relative to the cost of operating the entire system. The committee believes that the expenditures are warranted by the advantages to be expected.
- In India, if we think of establishing such Laboratories, it will cost a very high amount of currency investment in the gigantic project of DNA Labs all over the India.
- Huge amount of money is required to spend on establishment of DNA Data Bank, maintenance cost, service charges, investment on instruments, storage, transportation charges, expert person's fees etc.

# Chapter-IV

## Various Socio-Legal Dimensions of DNA Technology

### 1. Introduction:

As we have already discussed in the introduction part of the doctrinal work that DNA Technology has multi-dimensional utility and application in today's world; and following it multidimensional application and dynamic nature it has created a deep impact on science, law, society, morality and ethical issues which all stands in conflicting situation amongst themselves and has also given rise to new issues and challenges for human society at large. It has both positive and negative effects on above-mentioned aspects. Therefore it is necessary for us to study it from all angles by keeping in to account the current Indian scenario with the cause and effect theory, as DNA technology has become indispensable part of life in present society.

### 1.1 Impact and application of DNA Technology on Society at large:

*"Persona conjeneta aequiparatur interesse proportion"*: Proximity of blood and one's own interest are equivalent.

DNA finger printing, as a novel method to identify individuals has the applications in various other issues under mentioned spheres, such as:

- In criminal and civil case (administration of justice).
- Human population – The DNA FP has been applied in many popular cases like. Rajiv Gandhi case, Premananda Swami Case. Tandoor murder case, immigration case, Steve Bing case, Blue dress or Clinton Lewinsky case, OJ Simpson case,
- Plants genetics; for experiments, identification, inventions, medicines, creation and production, for establishing the Intellectual Property Rights.
- Bio-ethics
- Human enhancement
- Genetic weapons
- Genetic engineering

DNA finger printing has enormous impact on the administration of justice which can be studied in various Civil and criminal cases.

## 2 Use of DNA Information in the Legal System:

The use of DNA information can be bifurcated in the following types of cases for the sake of convenience:

- Investigation stage: In Criminal cases
- In civil cases

This chapter provides an overview of how DNA evidence might be used in the investigation and prosecution of crimes and in civil litigation.

RFLP is the technique most often considered by the courts to date. The criminal cases generally start with investigation stage and reaches to admissibility stage. The discussion of case laws and making a series of practical recommendations in this regard is very important, with judges especially in mind.

### Investigation stage: In Criminal cases

The usefulness of the DNA technology in criminal cases can be explained with the help of following points:

- Well trained investigators: To produce biological evidence that is admissible in court in criminal cases, forensic investigators must be well trained in the collection and handling of biological samples for DNA analysis.
- They should take care to minimize the risk of contamination and ensure that possible sources of DNA are well preserved and properly identified. As in any forensic work, they must attend to the essentials of preserving specimens, labeling, and the chain of custody and to any constitutional or statutory requirements that regulate the collection and handling of samples.
- Legislatures while preparing DNA legislations must prepare much of the legal framework for the gathering of DNA samples from suspects or private places, and court orders are sometimes needed in this connection.

- Wherever possible, a preserved sample should be large enough to enable the defense to obtain an independent RFLP analysis, but there should almost always be enough at least for PCR analysis, a technique likely to be widely used in forensics in the near future for amplification of the DNA in the evidentiary sample.
- All materials relied on by prosecution experts must be available to defense experts, and vice versa.
- The laboratories used for analysis must be reliable and should be willing to meet recognized standards of disclosure.

## 2.2. Criminal Investigation:

DNA Technology is the most potent and accurate method to identify the criminals in cases where trace evidence fail to provide a conclusive proof as to who is the criminal. Through DNA technology, crime investigation has become more easy and accurate. Through DNA evidence collected from the crime scene, the criminal can be traced. It is of great use in the criminal cases related to Rape, Murder, Kidnapping, Robbery, and Burglary etc. and in cases where the body is in mutilated condition as in Tandoor Case, there DNA test is the only scope for investigation[71].

In India,more than sixty-nine cases have been solved with the help of DNA fingerprinting including paternity disputes. Even Dhanu and Sivarasan alleged assassins of the late Prime Minister Rajiv Gandhi, were identified by DNA profiles. Using this technique, the Federal Bureau of Investigations formally concluded on 17th August 1998, the day of Mr. Clinton's testimony before the grand jury, that the stain of the dress contained Mr. Clinton's DNA saying that there was only one in 7.87 trillion changes that it was not later on the formal finding was the truth.

The first criminal conviction based on DNA testing was in the 1986 U.S. case of Florida v Andrews[72], in which the DNA were compared for the purpose of identifying the perpetrator of a crime. The trial Court admitted the evidence, and the jury

[71] See, Tandoor murder case: Trial court verdict published on October 28, 2003 ,Available at http://in.rediff.com/news/2003/oct/28tandoor.htm (Last accessed on: 3rd March, 2007)
[72] 533 So.2d US 841 (1988)

convicted defendant of aggravated battery, sexual battery and armed burglary of a dwelling. Thereafter various cases have been solved.

But there are few cases where DNA typing of non-human (plant and animal genetics) biological samples has been of use in criminal trials have involved identification of an individual rather than of determination of the species of origin. These cases have been unique, with title widespread application (e.g. snowball the cat and a palavered tree in Arizona), however the potential for widespread application is great, pet hairs have been transferred from suspects to crime scene and vice versa. One can imagine that plant subspecies determination or identification might be very useful for marijuana tracing. One can also imagine that grasses found on the shoes of suspects might be very important and common evidentiary specimen to link suspects to crime scenes. In these cases chances of availability of DNA fingerprint is much more than that of fingerprint.

A DNA test has confirmed that former Asam Gana Parishad[73] Minister Rajendra Mushahary was the biological father of the child whose mother had alleged that Mushahary had raped her twice and made her pregnant. The police had to seek the Court's permission for DNA profiling when the investigation into the rape case had reached the dead end only for this unique technique. It is peculiar that demand is going on death penalty for rape but is it not desirable to go for a DNA test in rape cases to reach to a conclusion easily. This will be certainly a good piece of evidence against the accused. It will also eliminate false charges of rape[74].

It is the technique that investigators used to expose the attempt to pass off the killing of five innocent civilians in Jammu and Kashmir as that of terrorist. To ascertain the identity of the dead the Government obtained DNA samples of the corpses to match them with the blood samples of their relatives[75].

DNA fingerprinting is at the cutting edge of forensic science. If DNA fingerprinting works and receives evidentiary acceptance. It can constitute the single greatest

[73] A regional political party from north-eastern state of Assam
[74]Tandoor murder case: Trial court verdict published on October 28, 2003, Available at http://www.rediff.com/news/2001/aug/06rape.htm (Last accessed on: 24th March, 2007)
[75] Ibid.

advance in the search for truth and the goal of convicting the guilty and acquitting the innocent since the advent of cross-examination.

Once a result is obtained from a DNA sample the interpretation is crucial to the correct understanding of what the result means, and this result depends on how the results are expressed, which in turn depends on what questions are asked. Asking the wrong question can mislead Judge and this is what is called the Prosecutor's Fallacy.

Before going further it is important to mention how exactly DNA match probabilities are represented. A statistical theorem known as Bayes Theorem is widely in use in courts and it can be represented as follows[76]:

(Prior ODDS) x (Likelihood Ration): (Posterior Odds)

The strength of DNA evidence is conditioned by the "prior odds" on the accuser's guilt. It is the expert witness's task to present the likelihood ration (the match probability) to the Court. The Judge's task is then to multiply the likelihood ratio by the prior odds (their assessment of the probability of the defend ant's guild before hearing the DNA evidence).

This will then produce the posterior odds, the assessment of the probability that the defendant is guilty given the DNA evidence and the other evidence presented during the trial. If the prior odds are extremely low, then the impact of the DNA evidence will be dramatically reduced.

On the finding of a match the following few questions become relevant, for example,

a. In paternity dispute the question, did a sample originated from the individual?
b. DNA is of no relevance as it is well known where the sample came from?
c. On the other hand a question on similar lines would be relevant in a criminal case or not?
d. Given that the accused is innocent what is the probability that the DNA profile from the accused matches the profile, which came from the crime scene?

[76] See, Mike Redmayne, "DNA evidence probability and the courts", *1995 Criminal Law Review*, p. 464 and also Russell Stockdale and Clive Walker, "Forensic Evidence" in Justice in Error, Clive Walker and Keir Starmer (eds*), London*, 1993, p.77., Available at http://www.lawlink.nsw.gov.au/lawlink/pdo/ll_pdo.nsf/pages/PDO_dna

e. Given that the DNA profiles match from the accused and the crime scene, what is the probability that the defendant is innocent?

The scientific experts is only competent to answer the first question, he is not in a position to answer the second question as the answer may necessarily depend on factors apart from the DNA evidence in a case. The latter is a question to be answered by the Judge or the jury, as the case may be. Essentially the prosecutor's fallacy occurs when the answer to the second question is taken as the answer to the first.

The issue of the prosecutor's fallacy came up before the Court of Appeals in a significant manner in R. V. Doheny and Adams[77].

In the facts of this case D was convicted of rape and buggery, and A was convicted of buggery. In each case the prosecution placed substantial reliance on the results derived from a comparison between DNA profiles obtained from a stain left at the scene of the crime and DNA profiles obtained from a sample of blood provided by each appellant. In each case the appellant appealed against conviction on the ground of the possibility of shortcomings in the DNA evidence and the manner in which it was presented to the jury. When asked in examination in chief what was the likelihood of the offender being anyone other than D, the forensic scientist answered that it was about I in 40 million; he went on to affirm that he was sure that D was the offender. Despite the Judge reminding the jury of the other evidence, the overall effect of the Judge's summing-up was that if the jury accepted the forensic scientist's evidence, then D was guilty. It was for the jury to decide whether it was the accused who had left the crime stain or whether it might have been one of the other persons who shared with him the same DNA profile.

The important general principle that can be derived in this case is that it is important that scientist, in given evidence, should not go into matters which were for the Judge. He should explain the nature of the DNA match and give the random occurrence ratio;

[77] (1997) US 1 Cr App R 369

he may be able to say how many people with matching characteristics are likely to be found in the country or in a more limited sub-group.[78]

**i. For identification purpose:**

Identification of a criminal and connecting it with crime is the paramount purpose in a criminal trial and DNA-technology serves this purpose. Very often criminals leave on the crime spot many elements inadvertently like blood, hair, skin cells and many other genetic evidences, if these are collected & compared through VNTR Patterns with the DNA of a criminal, he can be spontaneously identified.

For example, in many heinous crimes, the offenders leave the cadaver by severing the head of the victim on the crime spot, leaving on the spot the head-less corpse; very often it becomes difficult to identity a dead body without head. In such a situation DNA-test can solve the problem. These types of incidents very often happen on a railway track. Particularly in the remote villages, in committing murder, the dead-body is kept hidden inside a deep pond for long days. The dead-body being non-traceable for long aquatic creatures eat the human flesh resulting unworthy of identification of the decomposed body. In such a situation DNA-test can solve the mystery.

(1) DNA is generally used to solve crimes in one of two ways. In cases where a suspect is identified, a sample of that person's DNA can be compared to evidence from the crime scene. The results of this comparison may help establish whether the suspect committed the crime.

(2)In cases where a suspect has not yet been identified, biological evidence from the crime scene can be analyzed and compared to offender profiles in DNA databases to help identify the perpetrator. Crime scene evidence can also be linked to other crime scenes through the use of DNA databases.

[78] See "DNA evidence the prosecutor's fallacy: The role of Expert and suggested Directions to the Jury on Random Occurrence Ratio", 1997, Published in *Criminal Law Review* 669, available at www.cps.gov.uk

**ii. For baby-exchanging cases**:

In many parts of India there is illegal practice of newborn baby exchanging in the Hospitals. The real biological parents are deprived of their original babies.

Generally a female baby is exchanged with a male baby. The mother is deprived of her original baby. This is a cheating of the worst kind. Such type of practice is prevailing in different parts of India. But DNA test in such situations has solved the mystery. Who is the actual real mother of the disputed baby can be ascertained by DNA test.

**iii. Rape Cases:**

In Rape Cases, DNA has enormous applications. Immediately after the commission of rape, if the vaginal Swab is collected and sample sealed and semen if collected from the accused and both samples are examined in the DNA laboratory, it can be ascertained with greater accuracy, if there is complete matching between these two samples[79].

For example, assume that a man was convicted of sexual assault. At the time of his conviction, he was required to provide a sample of his DNA, and the resulting DNA profile was entered into a DNA database. Several years later, another sexual assault was committed. A Sexual Assault Nurse Examiner worked with the victim and was able to obtain biological evidence from the rape. This evidence was analyzed, the resulting profile was run against a DNA database, and a match was made to the man's DNA profile. He was apprehended, tried, and sentenced for his second crime. In this hypothetical case, he was also prevented from committing other crimes during the period of his incarceration.

**(d) Murder Cases**:

In murder cases[80], DNA fingerprinting technique may be used for detection of the culprit who has committed murder. Different types of trace elements may be available

[79] See, Article available at http://www.nytimes.com/1988/02/06/us/rapist-convicted-on-dna-match.html (Last accessed on: 12th June, 2007) Published: February 06, 1988

[80] Madhumita Shukla Murder Case where state politician Amarmani Tripathi was the main accused.

in the crime spot such as blood, hair roots etc. In many cases blood-stained clothes of the victim may be recovered from the possession of the accused or the bloodstained weapon, sword, bhojali, dagger etc. may be recovered fro the possession of the accused. All these elements are valuable materials for DNA test, which signifies presence of accused on the crime-scene. This means that old cases can now be solved and possibly prosecuted using current forensic technology. Similarly, in Trikambhai vs. State of Gujrat[81], the Gujrat High Court convicted solely on the basis of circumstantial evidence with corroboration of button and saliva on bidi found at the place of offence.

The other various types of acts and offences cases are as under where DNA Technology can be used.

(e) Kidnapping (Aggravated form)

(f) Infanticide,

(g) Abandonment of child,

(h) Illegal abortion,

(i) Immigration,

(j) Inheritance

(k) Assassination.

(l) In Paternity and Maternity disputes: VNTR (Variable number tandem repeats) analysis can conclusively determine the parentage of a child. This is possible because a person inherits his or her VNTRs from his or her parents.

"*confirm actio omnes supplet defectus licet id quod actum est ab inition non velait*", Though something has done not valid confirmation, cures all defects. So, in this regard if the confirmation of the DNA evidence is directed it would be easy for convicting accused.

[81] AIR 2009 Guj.224

(m) For General identification of Criminals

(n) For detecting innocence of many suspects: DNA technology is not only helpful for crime detection and identifying criminals, it is also helpful for exonerating many innocents from the trap of malafide criminal prosecution.

(o) Personal Identification: DNA fingerprinting has an outstanding characteristic for identifying a person amidst millions of people. The U.S. armed services have begun a program to collect DNA fingerprints from all personnel for use later, in case they are needed to identify casualties or persons missing in action. The DNA method will be far superior to the dog tags, dental records and blood typing strategies currently in use.

(p) DNA Records: Every plot of land has a definite plot number for identification. But man has until now no so much well-defined record of identification. But DNA can solve this problem. Days are not far away from us when each family will maintain DNA records for identification purpose and that will be the best method of scientific identification and that will help the administration of justice in future.

(q) Designing a baby: Until the last few decades, it was not possible to determine the sex of a child. But now with the latest genetic testing technique, one can decide the sex of their child with greater accuracy. Manique and Scoot Collins had a long dream daughter Jessica after genetic pre-screening at a fertility clinic in Fairfax Virginia. Thus, within a decade or two, it may be possible to screen kids almost before, conception for a wide range of attributes, the height, the size, the colour, even the I.Q. and personality. In the near future, parents may go to fertility clinic and pick up from a list of options the way car buyers order air-conditioning, stereo etc. It is the ultimate shopping experience "designing a baby". All these advances in science have a serious impact on the administration of criminal justice[82].

(r) In affiliation, ward ship, testacy, or divorce proceeding

(s) For immigration authorities for clear evidence of a familiar relationship.

---

[82]See, "Rapist Convicted on DNA Match",*The New York Times*, February 06, 1988 Available at http://www.nytimes.com/1988/02/06/us/rapist-convicted-on-dna-match.html (Last accessed on: 12th June, 2007)

(t) In veternity field where pedigree confirmation is required.

(u) In the field of Medicine for diagnosis of genetic diseases.

(v) In Agriculture for identification of seeds stocks and germ-plasm.

**3. DNA and Criminal Cases:**

"*habemas optimum testem confitentem reum"* -The best witness is the accused himself who confesses his guilt.

But if the accused dose not confesses his guilt then the DNA Technology is the best option to reach to the facts.

Despite the issues and evidentiary hurdles that have been referred to in the course of this project. Indian Courts have accepted the evidence of DNA experts. Unlike the area of paternity disputes where there seems to be some degree of controversy in the field of criminal law Courts have readily accepted DNA evidence in India. So far however, there have been no convictions solely on the basis of DNA evidence.

One instance of the application of DNA profiling/fingerprinting evidence being used to convict the accused persons can be seen in the case of Chandradevi V. State of Tamil Nadu.[83] This sensational case involved the rape and murder of several teenage girls in the Ashram of a god-man Premananda alias Ravi, by the god man and his accomplices.

In a lengthy judgment the Madras High Court considered 4 important questions: -

1. Whether the DNA evidence is generally accepted by the scientific community?

2. Whether the testing procedure used in this case is generally accepted as reliable, if performed properly?

3. Whether the tests were performed properly in this case?

4. Whether the conclusion reached in this case is acceptable?

[83] See, "Relevance of DNA Evidence in Sexual Offences*", Central India Law Quarterly* (2008) Available at MANU/tn/2335/2002.(Last Accessed on 3oth June 2007)

In answering the first question the Court relied on the extent to which Courts in the United States had relied on evidence of DNA analysis. The 2nd, 3rd and 4th questions were all answered in the affirmative and the accused persons were convicted on various counts on the basis of the evidence of experts on DNA fingerprinting/profiling and other evidence. However, in another case M. V. Mahesh v. State of Karnataka[84], the Court acquitted the accused, one of the grounds being that the requisite amount of DNA of high molecular weight was not present so as to make the test results sufficiently conclusive and accurate. The Court further went on to say that the DNA test was not a fool proof one and also commented on the fact that there were no national standards set or established for DNA testing in India.

Such scrutiny of the DNA testing procedure is commendable and any benefit of doubt arising from malpractices or irregularities in the scientific processes involved ought to go to the accused murder, rape, kidnapping, offences against body…..etc Old , cold, or unsolved cases that were previously thought unsolvable may contain valuable DNA evidence capable of identifying the perpetrator.

**4. The Admissibility of DNA Evidence:**

*res judicata pro verilate accipitur,* a decision of court is accepted as evidence of truth.

The discovery of DNA technology has profound impact not only in the field of genetic biology, but also in the field of law enforcement. The creation of the first DNA criminal investigative database in 1995 in Briton enabled law enforcement to better exploiting uses of DNA technology. The DNA technology has provided great advantages in the legal community. The technology has been useful in criminal investigation and also in civil disputes, such as, paternity disputes. The question therefore arises in the courts as to whether such scientific evidence as DNA should be considered in a given case. Under Section 45 of the Indian Evidence Act, 1872, it has been, inter alia, provided that, when the court has to form an opinion upon a point of science, or art, or as to identity of handwriting or finger impression, the opinions upon that point of persons specially skilled in science or art or any question as to identity of

[84] 1996 Cri LJ221 (Kant),

handwriting or finger impressions are relevant facts and such persons are called experts. The expression opinions upon a point of science of persons especially skilled in science are capable of application to all future advances in science, which enable an expert opinion on a point.

The original test for the admissibility of DNA and other scientific evidence was developed in Frye v. United States[85], and is commonly known as the "Frye standard". The Frye opinion is remarkable both for its brevity and for its lack of citational adornment. The appellant who was convicted of the crime of murder contended that the trial court had committed an error in sustaining the objection by counsel of the government against the offer of the defendant (accused) of an expert witness to testify to the result of the systolic blood pressure deception test to which the defendant was subjected prior to the trial. The theory underlying the test was that "truth is spontaneous, and comes without conscious effort, while the utterance of falsehood requires a conscious effort, which is reflected in the blood pressure". The Court of Appeal of District of Columbia held:"….. And while courts will go a long way in admitting expert testimony deduced from a 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 it belongs." "We think the systolic blood pressure deception test has not yet gained such standing and sufficient 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. The judgement is affirmed." Thus, when MtDNA / PCR testing were new and done by only a few laboratories they would not have been treated as admissible under the Frye standard, which asked the courts to determine whether the scientific evidence in question has "gained general acceptance in the particular field in which it belongs". Frye Standard was considered to be a roadblock to admissibility of even efficacious evidence simply because the techniques were recently discovered. There was therefore a need for a fresh look on the aspect of admissibility of scientific evidence in courts[86].

[85] 293 F.1013 (DC Cir.1923)

[86] See, Honourable Mr.Justice R.K.Abichandani, "The Gene Age – A Legal Perspective", Available at http://gujarathighcourt.nic.in/Articles/legalpers.htm. and 54 App. D. C. 46, 293 F. 1013 No. 3968

The breakthrough came in 1993 when the U.S. Supreme Court in Daubert v. Merrell Dow Pharmaceuticals, Inc.[87], held that the Frye's "general acceptance" test was superseded by the Federal Rules of Evidence which provided the standard for admitting expert scientific testimony in a federal trial.[88] It was held that nothing in the text of the rule established "general acceptance" as an absolute prerequisite to admissibility. It was, however, held that the fact that the Frye's test was displaced by the Rules of Evidence did not mean that the Rules themselves placed no limits on the admissibility of purportedly scientific evidence. Nor is the trial Judge disabled from screening such evidence. "To the contrary, under the Rules, the trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable". It was held that, "the requirement that an expert's testimony pertain to "scientific knowledge" establishes a standard of evidentiary reliability". The key question to be answered in determining whether a theory or technique is scientific knowledge that will assist the court will be whether it can be tested or and has been tested.

The Court held that "general acceptance" is not a necessary precondition to the admissibility of scientific evidence under the Federal Rules of Evidence which assigned to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand. Pertinent evidence based on scientifically valid principles will satisfy those demands. The court noted that there are the important differences between the quest for truth in the courtroom and the quest for truth in the laboratory, observing: "Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly. Broad advances the scientific project and wide-ranging consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in it is an advance. Conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final, and binding legal judgment – often of great consequence – about a particular set of events in the past. We recognize that, in

---

Court of Appeals of District of Columbia, united states (1923),available at http://www.caselaw4cops.net/searchandseizure/evidence.htm(accessed on: 24th April, 2007)

[87] 509 U.S. 579 (1993)

[88] Rule 702 governing expert testimony provided: "If scientific, technical, or other specialized knowledge will assist the tried 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".

practice, a gate-keeping role for the judge, no matter how flexible, inevitably on occasion will prevent the jury from learning of authentic insights and innovations. That, nevertheless, is the balance that is struck by Rules of Evidence designed not for the exhaustive search for cosmic understanding, but for the particularized resolution of legal disputes.[89]"

In order to determine whether scientific evidence is admissible, the court may consider – (1) whether the principle or technique has been or can be reliably tested, (2) whether it has been subjected to peer review or publication, (3) its known or potential rate of error, (4) whether there are standards or organizations controlling the procedures of the technique, (5) whether it is generally accepted by the community, and (6) whether the technique was created or conducted independently of the litigation. The Daubert test which still allows for consideration of "generally accepted" factor as one of the factors has somewhat increased the admissibility of DNA procedure, because, now newer tests can be recognized depending upon their authenticity and effectiveness.

In USA, the famous O. J. Simpson's case was decided mainly on the basis of DNA profiling. In India too, DNA Technology is used for solving serious problems of crime detection /investigation and other relevant cases. Gautam Kundu Vs State of West Bengal[90] Sajeera Vs P.K Salim [91], etc. are some cases in which DNA evidence was relied on. In India, there are more than 1500 cases in which DNA testing was taken into consideration for solving the problem of law enforcement. In USA over five-thousand cases resulted in conviction without any investigation thanks to DNA Technology. This makes its clear that it aids in the\ advancement of justice as it helps the police, prosecutors, public –in searching the truth, not only this, the technology has been used to exonerate innocent persons in post conviction stages. But DNA Technology has raised two important issues in front of legal fraternity namely determining admissibility and explaining the standard of weighing evidence,

[89] 509 U.S. 579 (1993)
90 AIR 1993 SC 2295
91 17 2000 Cr.L.J. 108
92 17 2000 Cr.L.J. 108

including other related questions like experts evidence etc. The Frye Test[92] in USA has solved the problem by laying down three important guidelines popularly called as Frye Rule.

These are as follows: -

Rule 1: Whether DNA technology is a science and is accepted so in world community.

Rule 2: Is there any technology to establish Rule 1.

Rule 3: Whether the technology is properly applied.

These rules have established the admissibility of DNA evidence in the legal system. The courts in USA have taken judicial notice of DNA evidence. Several States in USA have enacted laws that essentially mandate the admission of DNA evidence because of its potential powers of definitive identification. In short it can be said that it has climbed from circumstantial evidence to real evidence. In USA there are two enactments namely the Innocence Protection Act, 2003 and The Advancement of Justice through DNA Technology Act, 200320 lay special emphasis to use DNA Technology. The first act favours a person, who is being wrongly convicted; in fact it is a model statute for obtaining post conviction DNA testing.

## 5 Role of Expert:

*"cuilitbet in arte perito est credendem",* The credence should be given to one who is skilled in his peculiar Profession.

Through it is well known that an individual's DNA is unique to him/her. What is often not realized is how much of an individual's DNA is in common with that of other individuals.[93] Therefore, the scientific expert only has a part of the entire sequence of the individual's genome available for him to make his judgment. This

[92] As evolved in Frye v. United States, 293 F2d. 1013 (DC Cir.1923)

[93] See, Denial Burke and Denial Whiteman, "*Argue with science*? The admissibility Debates surrounding DNA identification", Available at www.biology.arizona.edu. (accessed on15th April, 2007)

clearly has a bearing since the judgment is bared not on the whole but only a part of the possible material and therefore all that more difficult.[94]

How DNA evidence is and should be presented in a Court of law is also an important question, which requires attention. It is also examines the evidentiary aspects of DNA fingerprinting with respect to both civil and criminal cases.

**a. DNA and Probability, Some Issues:**

As stated earlier, an individual's DNA is unique to that individual. However, much of our DNA is common with the rest of the living world and also with other individuals. This makes differentiation between individuals with absolute certainty very difficult. For this reason much of DNA fingerprinting evidence is in terms of probabilities.

**b. Presentation of DNA Evidence in Court:**

There is fundamental difference between how DNA evidence is presented and how other kinds of identification /identity evidence is presented in a Court of law. The difference has more to do with the fact that unlike DNA evidence, earlier types of identification evidence are not derived from a coherent body of data and statistical reasoning.

It would be useful to compare the evidence of an expert on fingerprints and the evidence of an expert in the case of DNA. A fingerprint expert gives an opinion, usually by stating that he/she is certain that the sample belongs to the person/accused. On the other hand the DNA expert gives an opinion by presenting the evidence in the form of a numerical statement known as a match probability. [95]

**c. DNA Evidence is not infallible:**

Due to the fact that each individual's DNA is unique to him or her, the perception that DNA evidence is infallible is created. These perceptions of infallibility are in fact

[94] In at least one Indian case Chandrasdevi and others v. State of T.N., the court has relied on expert evidence on DNA evidence that has stated that out of 3.3 billion base pairs only about 3 million vary from person to person. I.e. 1% DNA is useful for analysis, Available at manu/tn/2335/2002

[95] LAN Evet, Lindsey Foreman, Graham Jackson and James Lambert, "DNA profiling: a discussion of issues relating to the reporting of vary small match probabilities", *Criminal law review*, 2008, p. 341,Available at http://www.alrc.gov.au/publications/44-criminal-proceedings/presentation-dna-evidence(Last Accessed on July 12 2007)

unfounded. There are two important factors to be taken into consideration in this regard.

- Apart from the fact that there may be errors in the testing process, there is also the major question of statistical reliability. It must always be remembered that even where the probability that a sample comes from Person X is 1 in 1 crore. One cannot rule out the Possibility that the sample came from another person. That is the very nature of probability of evidence.[96]
- Another very important factor is that DNA evidence should not be looked at in isolation.[97] This is particularly true of criminal cases where the burden of proof is usually on the prosecution and the case has to be proved beyond reasonable doubt. [98]

### d. Expert Evidence and the Prosecutor's Fallacy

One of the most interesting and some what controversial issues with respect to DNA analysis relate to the opinion and role of the scientific expert in the courtroom. Like all other scientific evidence, DNA evidence also has to be proved and this is done with the aid of the testimony of an expert[99].

Before proceeding further, it is important to set out the relevant provisions of the Indian Evidence Act, which apply to expert testimony with respect of DNA evidence. DNA Fingerprinting and analysis is almost invariably with respect to matters relating to identification. S-9 of the Indian Evidence Act is important in this regard and it speaks of facts that are necessary to explain or introduce relevant facts.[100] As far as Expert testimony is concerned Ss. 45 and 51 are of particular relevance. S. 45 speak

---

[96] In the field of probability, it is said that where the happening of the certain event is certain the probability of that event is expressed as 1. As far as DNA evidence is concerned, current scientific methods do not provide for a match probability of 1.

[97] Supra Note 97

[98] To illustrate this point the following example may be used – The DNA evidence points to the fact that person X was at the scene of the crime at 9.30 pm. However there is also evidence by way of testimony of witness and the recording of the security camera that person X was at a particular place. Assuming that the person does not have a twin, person cannot be convicted on the basis of DNA evidence in light of the other evidence. Either an error has been taken place during testing or another person has the same DNA match as person X.

[99] R. V. Doheny and Adams , (1997) 1 Cr App R 369.(case where prosecutor's fallacy came into picture)

[100] The relevant portion of sec-9 of the Indian Evidence Act reads as follow…"Facts…which establish the identity of anything or person whose identity is relevant…are relevant in sons far as they are necessary for that purpose."

about the evidence of experts generally. [101]S. 46 speak about the facts bearing on the opinion of experts,[102] while S. 51 deals with the relevancy of the grounds on which the opinion of an expert is based. [103]

Efficiently cover the opinion given by an expert of DNA, through they were drafted some time before the discovery of DNA. It is also crucial that while dealing with DNA analysis the right questions be asked depending on the facts and circumstances of the case.[104]In this regard two major kinds of cases are examined in this section, namely, criminal cases and cases relating to parentage.

**e. 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.

"*Nemo Punitur Pro Alieno Delicto",* No one should be punished for the wrongs of another.

The DNA Technology must be used after conviction of the person. DNA technology is not only useful for strengthening cases against suspects but has become extremely helpful in probing innocence of suspects and even past convicts. DNA testing has proved the innocence of convicted felons in many cases. The National Institute of Justice under the guidance of Former Attorney General Janet Reno, issued a report in 1996[105], stressing importance of the use of DNA evidence to exonerate the innocents. The report provided twenty-eight case studies where the use of previously unavailable DNA technology proved the innocence of convicted felons. These twenty-eight men

[101] Sec-45 –Opinion of an Expert: "When the court has to form an opinion upon a point of foreign law or science or art …..Such person is called experts.'

[102] Sec-46-Facts bearing on the opinion of the expert-"Facts not otherwise relevant are relevant if they support or are inconsistent with the opinion of the expert when such opinions are relevant.'

[103] Sec-51"Whenever the opinion of a living person is relevant, the ground on which such opinion is based are also relevant." Also see: Mike Redmayne,"DNA evidence probability and the courts,", 1995, *Criminal Law Review*, 464,Available at www.lawlink.nsw.gov.

[104] For example in paternity dispute the question 'Did a sample originated from the individual? Is of no relevance as it is well known where the sample came from. On the other hand a question on similar lines would be relevant in a criminal case.

[105] entitled "Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial", USA, 2006

in the study had served an average of seven years in prison before exoneration. Three years after the initial report, the National Commission on the Future Use of DNA Evidence issued another report entitled "Post Conviction DNA Testing: Recommendations for Handling Requests. This report was aimed at highlighting legal and scientific issues involved in post conviction testing and provided recommendations for prosecutors, defense counsel, the judiciary, victim assistance groups, and laboratory and law enforcement personnel. The post conviction cases highlight the importance of DNA technology and more specifically DNA database, as an investigative tool. [106]

The DNA evidence is now a predominant forensic technique for identifying criminals when biological tissues are left at scene of crime. DNA testing on samples such as saliva, skin, blood, hair or semen not only helps to convict but also serves to exonerate. The sophisticated technology makes it possible to obtain conclusive results in case in which the previous testing had been inconclusive. Post-conviction testing will be requested not only in cases in which the DNA testing was never done, but also in cases in which more refined technology may result in an indisputable answer. The Working Group on Post Conviction issues under the aegis of the National Commission on the future of DNA Evidence published a report[107] on the subject DNA victims' rights and restorative justice. The document discusses the kind of legal issues that had already arisen and others that will probably develop as applications for post conviction DNA testing continue to be made and the technology to conduct those tests advances. The probative value of DNA testing has been steadily increasing as technological advances and growing databases expand the ability to identify perpetrators of crime and eliminate the suspects. The strong presumption that verdicts are correct, one of the underpinnings of restrictions on post-conviction relief has been weakened by the growing number of convictions that have been vacated because of exclusionary DNA results. As observed in the report, DNA evidence gives rise to thorny legal issues, because post-conviction requests for testing do not fit well into the existing procedural schemes or established constitutional doctrine.

---

[106] See, Allison Puri "*An International DNA Database: Balancing Hope, Privacy, and Scientific Error*," Allahabad Law Agency, 2003, p.189

[107] See, U.S. department of Justice, "Post Conviction DNA Testing: Recommendations for Handling requests", September 19, 1999 ,For comments on the case see "DNA Evidence the prosecutor's Fallacy-The role of expert-suggested directions to Jury on random Occurance Ratio"1997 *Criminal Law Review*, p. 669.

By issuing orders, the Court can play an important role in helping to obtain access to evidence prior to testing, which is part of the screening process and helps determination if DNA evidence will be relevant to the case. In cases in which the biological evidence was collected and still exists, and if the evidence is subjected to DNA testing or re-testing, exclusionary results will exonerate the petitioner or support his claim of innocence, the court can issue orders permitting DNA testing or re-testing. Once post-conviction DNA test results have been obtained, if the results are favorable to the inmate and no alternative explanations exist, the court should be prepared to grant a joint request to vacate the conviction and in the absence of a joint request, an evidentiary hearing should be set to determine if there is a reasonable probability of a change in the verdict or judgment of conviction. In jurisdictions where conviction cannot be so upset on a joint request and appellate remedies are already exhausted, the clemency powers of the sovereign State can be invoked by forwarding an appropriate recommendation on the basis of the outcome of such DNA testing or re-testing.

In the Indian context, the Constitution empowers the President of India under Article 72 and the Governor of a State under Article 161 to grant pardons, reprieves, respites or remissions of punishment or to suspend, remit or commute the sentence of any person convicted of the offences referred to hereunder.

It is obligatory on the laboratory to perform quota DNA tests and to interpret and report the results accurately and without bias. The database can be helpful for linking previously unrelated cases and for screening and large number of known individuals already convicted of a crime. A "cold hit" from a database can prove to be a boon to a person undergoing sentence for proving his innocence. It would however appear that the need for post-conviction DNA testing will wane over a period of time when DNA testing with high discriminatory results will be performed in all cases in which biological evidence is relevant, and advanced technologies will become commonplace in all laboratories. Coordination among prosecutors, defense attorneys, law enforcement agencies and crime laboratories is required[108].

[108] The duties, responsibilities of prosecutor, defense lawyers, and judiciary etc. while dealing with post conviction cases have been discussed in the conclusion part of the research work.

**6. Use of DNA Technology in civil cases, such as paternity, custody, and proof of death cases, succession and property;**

- The standards for admissibility must also be high, because DNA evidence might be dispositive. It is important to distinguish between civil and criminal cases in determining the admissibility of scientific data while preparing DNA legislations.
- In a civil case, however, if the results of a DNA analysis are not conclusive, it will usually be possible to obtain new samples for study. As in criminal cases, laboratories and other interested parties must treat evidence according to established protocols.
- The advent of DNA typing technology raises two key issues for judges: determining admissibility and explaining to the prosecution and defence lawyer and parties to the case the appropriate standards for weighing evidence. The role of expert for expert evidence plays a noteworthy role, therefore the responsibilities and role of expert during such civil as well as criminal trials must be demarked by legislation by introducing a different chapter in DNA.

**6.1 Law Relating To Parentage Related Issues- Paternity And Maternity*:*** This can be explained under the following heads:

a. Parentage Testing
b. Evidence
c. Identification

**a. Parentage testing:**

*"affirmanti non neganti incumbit probation"*, The burden of proof lies up on him who denies and therefore DNA Technology is used where the person denied paternity and the burden of proving this lies on him.

Parentage testing refers to testing done to confirm or deny biological parentage of a particular child or individual. Such testing may be conducted by blood group or DNA analysis. DNA parentage testing may exclude a person as the biological parent of a child with certainty but it cannot prove absolutely that a person is the child's

biological parent. The test result can, however, provide a probability that a person is the biological parent of a child and, if that probability is sufficiently high, an inference of parentage may be confidently drawn[109]. Parentage testing is relationship testing and requires participation of two, sometimes three individuals in order to reveal useful information about biological relationship between those persons. The context in which outcome of parentage testing is revealed is often highly emotionally charged. Where parentage has been misattributed, there may arise issues of "betrayal, revenge, truth and the search for resolution" for many years. This raises the question whether law should emphasize biological parentage over social parentage in matters of parental responsibility, guardianship and maintenance, succession and so on.

DNA parentage testing may be used to rebut a presumption arising under the Act, or to establish evidence in the circumstances where no presumption arises. A man might seek DNA parentage testing in order to obtain evidence of non-paternity for the purpose of civil proceedings against the child's mother to prove "paternity fraud" and claim damages for emotional stress and financial loss that he suffered due to such fraud. DNA parentage testing may provide evidence to show that a person has a biological connection with a deceased person and can be a proof in support of a succession claim. In mass disasters, such as, airplane crashes and the World Trade Centre collapse, DNA parentage and relationship testing is increasingly used in identifying human remains where the body of the deceased is no longer recognizable.The scientific accuracy of parentage testing is of vital importance, whether it is conducted by accredited or unaccredited laboratories. In a case where the family court ordered a man to undergo DNA parentage testing in relation to a child of whom he claimed to have no knowledge, the test result disclosed a 98.5% probability that he was the father of the child and was required to pay maintenance for the child, years later, the man's brother admitted having had a relationship with the child's mother, and parentage testing showed a 99.5% probability that the brother was the child's father[110]. The social, psychological and economic consequences of unreliable

[109] See, ALRC Discussion Paper 66, "Protection of Human Genetic Information, DNA Parentage Testing", 2001,Available at www.alrc.gov.au/inquiries/protection-human-genetic-information(Last accessed on 21st May 2007)

[110] See, case reported in G. Bearup, "The Doubt about Dad", The Good Weekend ,*The Sydney Morning Herald*, 3rd November 2001, 16, 20, and is referred in paragraph 31.42 of the ALRC Discussion Paper 66, Available at www.alrc.gov.au/inquiries/protection-human-genetic-information(Last Accessed on 21st May 2007*)*

testing point towards an imperative need to maintain the highest technical, scientific and professional standards in conducting parentage testing. It is suggested that parentage testing be done under supervision of courts to ensure both the accuracy and reliability of the evidence admitted. Possibility of `DNA fraud' by laboratory staff in such tests is a matter of grave concern and there should be a proper mechanism to address issues arising from the test results and for safeguarding and protecting the integrity of samples against tampering or deliberate fraud. The option of using court supervision would make parentage testing subject to a court order and would enable the courts to provide independent oversight of testing, including in relation to the validity of consent.

Legislation should be enacted to ensure that only government-recognized laboratories in accordance with the regulatory requirements that may be statutorily laid down conduct DNA parentage testing in India. Family Courts Act should be amended to provide a special chapter dealing with DNA parentage testing and adequate provisions should be made there under to ensure that parentage testing meet the highest technical and ethical standards, particularly in relation to consent to testing, protecting the integrity of genetic samples, and providing counseling. The parentage testing reports should be admissible in evidence only if made in accordance with the statutory requirements.

Law should recognize a child's right to give or withhold consent to the testing of his or her own genetic sample where the child has acquired sufficient maturity and understanding, of the process and its implications to safeguard his or her own interest. Legislation should provide for enabling a child above 12 years of age and having sufficient maturity to make a free and informed decision whether to submit a genetic sample for parentage testing. Paramount consideration should, however, in all events be the welfare of the child concerned.

Parentage cases, which involve disputes as to maternity, are quite rare. In any case the determination of maternity is somewhat more simplified because of something called mitochondrial DNA or Mt DNA [111]. Mt. DNA is peculiar since it is inherited only

[111]Mitochondria organelles within the cell those are responsible for the respiratory functions of the cells.

through the mother; it has great application in cases involving maternity disputes,[112] but not so in cases involving paternity disputes. The usual two questions with respect to paternity disputed are as follows:-

A. Is there a suggested alternative father?

B. Is there a completely unknown father?

However, in both situations there is always a residual doubt that is attendant with evidence of probability of match.

3. The Rule of Law based on the dictates of the Justice has always made the Courts inclined towards upholding the legitimacy of the child, unless the facts are so conclusive and clinching as to necessarily warrant a finding that the child could not at all have been begotten to the father and as such the legitimacy of the child is rank justice to the father. Courts have always desisted from lightly or hastily rendering a verdict and that too, on the basis of slender material, which will have the effect of branding a child as a bastard and his mother as unchaste women. In view of the provision of Sec.112 of the Evidence Act, there is no scope of permitting the husband to avail of blood test for dislodging the presumption of legitimacy and paternity arising out of the Section28. Blood group test to determine the paternity of a child born during wedlock is not permissible.[113]

4. To determine child's parentage, there are statutory presumptions, such as, under Section 112 of the Indian Evidence Act[114], that the fact that any person was born during the continuance of a valid marriage between his / her mother and any man, or within two hundred and eighty days after its dissolution, the mother remaining unmarried, shall be conclusive proof that he is the legitimate child of that man, unless it can be shown that the parties had no access to each other at any time when that child could have been begotten.

---

[112] ibid

[113] Smt. Dukhtar Jahan vs. Mohammad Farooq AIR 1987 SC 1049. and Gautam Kundu Vs Shaswati Kundu Criminal Revision No. 800/92 (Cal) and see also:,Tushar Roy vs Shukla Roy, 1993 Cr. L.J 1659 (Cal)

[114] "Birth during marriage, conclusive proof of legitimacy – The fact that any person who was born during the continuance of a valid marriage between his mother and any man or within during two hundred and eighty days after its dissolution, the mother remaining unmarried, shall be conclusive proof that he is the legitimate son of that man, unless it ca be shown that the parties to the marriage had no access to each other at any time when he could have been begotten."

The Hon'ble Supreme Court in Gautam Kundu Vs State of West Bengal[115] added some guidelines regarding permissibility of blood tests to prove paternity:

1. That the Courts in India cannot order blood test as a matter of course.

2. Whenever applications are made for such prayers in order to have roving inquiry, the prayer for the blood test cannot be entertained.

3. There must be a strong prima facie case in that the husband must establish non-access in order to dispel the presumption arising under Sec.112 of Evidence Act.

4. The court must carefully examine as to what would be the consequences of ordering the blood test.

5. No one can be compelled to give sample for analysis.

As compared to position in England, where keeping pace with modern thinking on the continuing and shared responsibility of parenthood, The Family Reforms Act, 1969 was replaced by The Family Reforms Act, 1987 which enabled the Judiciary to determine the parentage rather than paternity.

**b. Evidentiary Aspects of DNA and Cases relating to Paternity Disputes:**

In India DNA fingerprinting and analysis has been widely used in paternity cases[116]. Prominent among these is the effect of the new developments in forensics in the form of DNA profiling/fingerprinting and the case for an amendment to S.112 of the Indian Evidence Act dealing with conclusive proof in paternity cases[117].

In Smt. Kanti Devi v. Poshi Ram[118], the Apex Court held that the result of a genuine DNA test is said to be scientifically true. But even that is not enough to escape from the conclusiveness of Section 112 of the Act. e.g. if a husband and wife were living

[115] 30 AIR 1993 SC 2295

[116] See, Arukumar v. Turaka Kondalal Rao, 1998 Cri.L. J.4279 Where a single locus probe RFLP and STR analysis was carried out to prove the paternity of the child

[117] The other major issue with respect to paternity cases, on which there is much conflicting case, law deals with whether the Courts can direct one of the parties to give a sample of DNA and the effect of refusal to undergo a DNA test. This has obvious constitutional implications.

[118] AIR 2001 SC 2226

together during the time of conception but the DNA test revealed that the child was not born to the husband, the conclusiveness in law would remain un-rebbutable. This may look hard from husband's point of view. It is submitted public policy that children should not suffer the social disability on account of the laches or the lapses of parents. As per Modi's Medical Jurisprudence and Toxicology, there is a lot of chance that maximum period of the pregnancy can be above 280 days this section dose not apply to all critical situations to establish the legitimacy of the child the DNA testis the only method[119].

### c. Parentage Identification:

The role of DNA test in parentage identification is also very important. Parentage identification means paternity and maternity identification. Parentage identification is necessary to prove the legitimacy of child. Maternity identification by DNA test is necessary in child abandonment case and infanticide. Paternity identification is necessary in the cases where financial support maintenance is to be given, property is to be inherited and in rape, sexual relation with consent, incest if pregnancy could not be terminated when it was detected. The first reported paternity case of DNA typing is in re Baby Girl.[120] Another important case of inheritance is Alexander where an illegitimate child claiming an inheritance permits it to disinterment for a DNA test.

### 7. Adultery:

Section 497 of Indian Penal Code, 1860 deals with Adultery. In cases of adultery, if the married women got conceived, suppressed this fact of pregnancy from her husband so on so forth, the husband could easily get confirmed of such pregnancy of his wife through her paramour. Further to know the chastity of the women and the sacredness of the nuptial contact, the DNA is very much needed to ascertain the truth or otherwise of such suspected pregnancy and infidelity of the wife, the husband can take the very extreme step of killing her[121].

---

[119] See, Jaising P Modi, "*Modi's Medical Jurisprudence and Toxicology*",23rd Edition, 2007, Allahabad Law Agency, p. 540 to 542.

[120] In re Baby Girl M. (1984) 37 Cal.3d 65, 207 Cal.Rptr. 309; 688 P.2d 918, Available at http://scocal.stanford.edu/opinion/re-baby-girl-m-28396 (Last accessed on: 31st May, 2007)

[121] Gautam Kundu Vs State of West Bengal, 1993 Cri LJ, 3233

Section 497 of IPC prescribes no punishment for wives who indulge unlawful sexual intercourse without permission from her husband. But adultery can be one of the grounds for the refusal of maintenance in section 125 of Cr. P. C. This is no offence by the married wife, though she is betrayed her husband as no punishment is there for her wrongful act.

But exactly in opposite situation when the husband denies the maintenance to wife and his legitimate child by alleging wife for adultery, then in such situation the wife can claim maintenance by undergoing DNA Testing and can prove her innocence. Hence to avoid such unfortunate incidents, DNA test can be proved helpful.

**8. Inheritance and Succession:** *"deficiante uno non potest esse haeres",* There being no utility of blood, one cannot be a heir.

*"deas salus haerendum facere potest non homo",* God Alone Can Make Heir Not Man.

Under Hindu Marriage Act, 1955 an illegitimate child (legitimized by the virtue of Sec 16) inherits the property of his parent's property in which the father is the coparcener.31 Thus under such circumstances to establish the legitimacy or illegitimacy of such children and to inherit the property, the DNA test is the only perfect medical evidence for in heritance or non inheritance of the properties[122].

**9. Maintenance:**

In case of the disputes relating to illegitimate child the DNA technology plays an important role to compel the father of the illegitimate of child to give him maintenance when he denies the paternity and maintenance.

Section 125, The Code of Criminal Procedure, 1973 states that it's the duty of the man to maintain his wife, legitimate or illegitimate children, parents as long as they can't maintain themselves. So the man can take the defence that the children doest belong to him. So in these situations DNA test provide the ultimate conclusive

[122] King v. Lufe, 103 ER 316

remedy to determine the paternity and maternity of the child, so that he can claim maintenance.

## 10. DNA and Right to Privacy/Information:

### 10.1 Concept of right to privacy

**(a) What is meant by right to privacy?**

*necessitas publica major est quam private",* Public necessity is superior to private. Therefore there has always the conflict between right to privacy and public interest in form of right to information

The term "privacy" is the rightful claim of an individual to determine to the extent to which to which he wishes to share of himself with others and his control over the time, place and the circumstances. It is individual's right to withdraw or participate as he sees fit. It also means an individual's right to control dissemination of the information about himself as such is his own personal possession.

**(b) The Universal Declaration of Human Rights gives express recognition to right to privacy under Article - 12:**

"No one shall be subject to arbitrary interference with his right to privacy, family, home or correspondence to attack upon his honour and reputation. Everyone has right to the protection of the law against such interference or attack."

**(c) India is also a signatory to The International Convention on Civil and Political Rights, 1966.**

Article 17 of the Convention reads as under:

1. No one shall be arbitrary or unlawful interference with his privacy, family or correspondence or lawful attack on his honour or reputation.
2. Everyone has right to protection of the law against such interference or attack.

**(d)** Article 8 Of the **European Convention on Human Rights** provides for: Right to respect for private life.

**(e) Concept of right to privacy in United States -DNA testing and its application in legal system:**

In U.S. the Constitution and the bill of rights establishes that mall the citizens are free to enjoy and exercise their basic liabilities except for limitation, which may be imposed due to exercise of the valid governmental power. The fourth Amendment provides them most direct protection of the right to privacy. The first elaborate discussion on right to privacy occurred in Boyd v. United State[123]. However the most well known cases on right to privacy are Grisword V. Connecticut[124] and Rove V. Wade[125]

**(f) Concept of right to privacy in India:**

The right to privacy has derived itself from essentially two sources, the common law of torts and Constitutional law. In common law, a private action for damages for an unlawful invention of privacy is maintainable.

In Kharak Singh V. State Of Uttar Pradesh[126] a question was raised whether right to privacy could be implied from the existing fundamental rights such as, Article-19 (1)(d) , 19(1) (c) and 21. The Supreme Court ruled, "Personal liberty is used as compendious term to include the varieties of rights, which make up the personal liberty of an individual other than those dealt with in Article 19(1).

In Govind V. State of M. P.[127] The Supreme Court accepted the right to privacy as an "emotion" from Article 19(1) and 21. The right to privacy is not however absolute. Reasonable restrictions can be placed upon the right in public interest under Article 19(5). In Rajgopal V. State of T.N.[128] The Supreme Court asserted that the right to privacy has acquired constitutional status; it is implicit ion the right to life and liberty guaranteed to the citizens under Article 21.

[123] 116 U.S. 616 (1886)
[124] 381 U.S. 479 (1965)
[125] 410 U.S. 113 (1973)
[126] 1963 AIR 1295, 1964 SCR (1) 332
[127] 1996 (0) MPLJ 649
[128] 1995 AIR 264, 1994 SCC (6) 632

**(g)** The National Commission to review the working of the constitution has in its recommendations a new Article namely Article-21-B, should be inserted on the following lines.

21-B (1) Every person has a right to respect for his private and family life, his home and his correspondence.

(2) Nothing in Clause (1) shall prevent any state from making any law imposing reasonable restriction on the exercise of the right conferred by clause (1), in the interest of the security of the state, public safety or for the prevention of the disorder or the crime, for the protection of the health and morals, and for the protection of the rights and freedom of others.

The Judiciary and Legislation should strive to bring balance between the right to privacy and public interest with welfare of sate.

**11. Genetic Privacy:**

DNA sampling involves intrusion into three forms of individual privacy[129]:

**Bodily privacy** in cases where the sample is taken from a person's body;

**Genetic privacy**, where predictive health and other information about the person is obtained from the sample.

Behavioural privacy where the information is used to determine where a person has been and what he has done. Moreover, DNA sampling may also impinge on familial privacy where information obtained from one person's sample provides information regarding his or her relatives. Privacy and respect for human dignity need not be abandoned when balancing civil liberties with the larger interests of the community. Formulation of sound privacy principles can enhance the integrity and legitimacy of DNA profiling. The privacy principles with a statutory backing would bring about transparency and accountability and would reassure the community that what is

129 See, "Essentially Yours: The Protection of Human Genetic Information in Australia*", ALRC Report 96* Available at http://www.alrc.gov.au/publications/39-forensic-uses-genetic-information/use-genetic-information (Last accessed on 2nd June, 2007)

sacrificed for greater safety and security is done so legitimately. In Australia, there is a comprehensive privacy law covering private sector.[130]

The power and potential of genetics rests in the knowledge it provides, thereby raising concerns about privacy and confidentiality in various situations. The personal information contained within the genetic tissue is more important than the tissue itself. The information gained from increased genetic knowledge will be of greatest interest to the affected individuals as well as to family members, employees, schools, insurers, medical and legal institutions. Genetic privacy would be an important constitutional issue arising in different contexts of individual's legal rights. The challenging task will be of striking a proper balance between privacy concerns and the fair use of genetic information.

Confidentiality even when carefully protected by researchers can be no substitute for an informed consent of individuals whose DNA sample is studied by researchers. Informed consent is seen as a strong and important way for individuals to exercise their privacy rights. The policy question for all authorities deliberating in the Gene Age is how to make laws which assure consumers of healthcare that their personal privacy is maintained and that their genetic information is not used against them, but at the same time, to encourage the advancement of genetic research for improving the standards of human health and the quality of life. An individual's genetic information and DNA sample are the property of an individual except when the information or sample is used in an anonymous research in which the identity of the person from whom the sample is collected cannot be determined.

Special privacy protections are needed to be developed by law because (i) genetic test results can be used to predict future health risks that might be of interest to insurers or employers, (ii) genetic test results apply to a whole family and therefore, are of interest to others, besides the individual patient, and (iii) information from a genetic test can be kept in many different places and under conditions over which an individual has no control.

A Genetic Privacy Act, therefore, should address to the following questions:

[130] The Privacy Act, 1988 as amended by the Privacy Amendment (Private Sector) Act, 2000

- Who can collect genetic information?
- Who can retain genetic information, and how long?
- Who can disclose genetic information and under what conditions?
- There should be a privacy statute preventing any person from obtaining genetic information from any individual, or from an individuals DNA sample, without first obtaining informed consent of the individual or the individual's representative.

The statute may provide exceptions to the requirement or informed consent in the following circumstances:

(i) in the case of certain law enforcement and legal proceedings; (ii) for anonymous research; (iii) for identification of deceased individuals such as in mass disasters, due to earthquakes, flood furies or terrorist activities; (iv) for newborn screening procedures; (v) for the purpose of establishing patenting under court orders.

The genetic privacy statute should prohibit employers from obtaining, seeking to obtain or using genetic information to discriminate against or restrict any right or benefit otherwise due or available to an employee or a prospective employee and make it as unlawful employment practice for an employer to require an employee or prospective employee to take a genetic test. Procedures for obtaining informed consent should be specified. If health insurers ask an applicant to take a genetic test, they must obtain the authorization of the applicant for the test and they cannot use the results of the test to either induce or discriminate against the person in providing him or her with insurance.

In determining whether taking of body samples is justified in all circumstances the statute may cast a duty upon the police officer to balance the public interest in obtaining evidence tending to confirm or disprove that the suspect committed the offence concerned against the public interest in upholding the physical integrity of the suspect.

In balancing those interests, consideration of the following matters would be relevant:-

(i) the extent to which the suspect may have participated in the commission of the crime; (ii) the gravity of the offence and the circumstances in which it is committed; (iii) age, physical and mental health and cultural background of the suspect to the extent they are known; (iv) whether there is less intrusive and practical way of collecting evidence tending to confirm or disprove the involvement of the suspect in the crime; (v) the reasons, if any, for the suspect for refusing consent. A police officer may ask the suspect (other than a child or incapable person) to consent to a forensic procedure if he is satisfied on the balance of probabilities that: the person is a suspect, that there are reasonable grounds to believe that the obtaining of the DNA sample of the suspect is likely to produce evidence tending to confirm or disprove that the suspect committed a relevant offence, that the request for consent is justified in all the circumstances, and that the suspect is not a child or an incapable person. [131]

## 12. DNA Database and Constitutional Concerns:

In 1994, the DNA Identification Act authorized the FBI to establish the combined DNA Index System (CODIS), which consisted of three tiers of DNA data, namely, the Local DNA Index System (LDIS), which consisted of information installed by the laboratories of local police and sheriff departments; the State DNA Index System (SDIS) which allowed the individual local laboratories to exchange information throughout the state, and the National DNA Index System (NDIS) that allowed states to share information between each other on a national scale[132].

The Australian Law Reform Commission[133], in its report "Essentially Yours: The Protection of Human Genetic Information in Australia", in Chapter 43 relating to DNA Database Systems referred to the provisions for the usage, storage and disclosure of information of DNA database system contained in Part 1D of the Crimes

[131] Forensic Procedures can be devised on the lines of Part 1D of the Crimes Act, 1914 (Cth); See various legislations referred in paragraphs 39.17 to 39.58 – Part J "Forensic Uses of Genetic Information" of the Report of the ALRC – "Essentially Yours: The Protection of Human Genetic Information in Australia"; See also Oregon Genetic Privacy Act.

[132] See, Honourable Mr.Justice R.K.Abichandani, "The Gene Age – A Legal Perspective" ,Available at http://gujarathighcourt.nic.in/Articles/legalpers.htm (accessed on: 12th June, 2007)

[133] See, Australia. Law Reform Commission, National Health and Medical Research Council (Australia). Australian Health Ethics Committee "Essentially yours: the protection of human genetic information in Australia : report" *Australian Law Reform Commission, 2003* http://books.google.com/books/about/Essentially_yours.html?id=PnkLSwAACAAJ (accessed on: 25th June, 2007)

Act and noted that, as of February 2003, Commonwealth had established three DNA databases for law enforcement purpose; the National Criminal Investigation DNA Database (NCIDD System) was established in June 2001 to facilitate intra-jurisdictional matching of DNA profiles, and inter-jurisdictional matching of profiles between participating jurisdictions, for law enforcement purposes, the Disaster Victim Identification Database (DVI) was established in October 2002 to identify the victims of the terrorists bombings in Bali, Indonesia, and other similar overseas incidents, finally, the Australian Federal Police (AFP) operates its own DNA database for law enforcement purposes. The CrimTrac Agency operates the NCIDD system and the DVI database pursuant to part 1D of the Crimes Act, 1914. It is an executive agency of the Commonwealth Government, established as a national law enforcement information system for Australia's police services.

DNA database system as defined in Section 23YDAC of Part 1D of the Crimes Act 1914 (Cth) of Australia, means a database (whether in computerized or other form and however described) containing: (a) the following indexes of DNA profiles: (i) a crime scene index; (ii) a missing persons index; (iii) an unknown deceased persons index; (iv) a serious offenders index; (v) a volunteers (unlimited purposes) index; (vi) a volunteers (limited purposes) index; (vii) a suspects index; and information that may be used to identify the person from whose forensic material each DNA profile was derived; and (b) a statistical index; and (c) any other index prescribed by the regulations."

With the expansion of DNA databases, a concern has grown over privacy and abuse issues associated with such databases. The database supporters argue that statistics show that many offenders of particular types of crimes e.g. sex offenses, have a high incidence of repeat offenses, and a DNA database will help law enforcement identify suspects of new crimes who were previously convicted of earlier crimes. It is expected that DNA databases will produce a deterrent effect to counteract recidivistic tendencies and released convict will be less likely to commit crime again if he knows that his DNA is on file with the government and he can therefore be easily detected. The opponents of DNA databases, however, claim that such a course violated the society's commitment to reform, especially with respect to juvenile offenders, and the

presumption of innocence. They also fear that, with a centralized system, DNA data easily could get into the wrong hands.

The major concern that most database critics have is that DNA database sampling statutes allow for the mass screening of individuals without individualized suspicion or probable cause. The general justification given to support such sampling is the notion that a class of certain convicted felons is more likely to pose a danger to society than others. Critics claimed that such a justification undermined citizen's protection against unreasonable searches and seizures.

The issue arose in Donald E. Landry v. Attorney General[134] before the Massachusetts Supreme Judicial Court, whether involuntary taking of blood samples from the person in accordance with the provisions of the Act violated Fourth Amendment of the U.S. Constitution which protected the right of the people to be secured in their persons, houses, papers, and effects, against unreasonable searches and seizures, by providing that these shall not be violated and no warrants shall issue, except upon a probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized. The plaintiffs challenged the validity of a Massachusetts DNA database statute, which required involuntary collection of blood samples from all persons convicted of thirty-three different types of offenses. The given legislative purpose of the statute was to "assist local, state and federal criminal justice and law enforcement agencies in: (1) deterring and discovering crimes and recidivistic criminal activity; (2) identifying individuals for, and excluding individuals from, criminal investigation or prosecution; and (3) search for missing persons. The statute states and regulates the use of the database for primary criminal investigative purposes. The statute, however, also allows for the use of the database for other court proceedings and advancing other humanitarian purposes. The plaintiffs argued that the statute allowed for an unconstitutional search and seizure under both the Federal and State constitutions. The Massachusetts Superior Court agreed and issued a preliminary injunction against the statute. The Massachusetts Supreme Judicial Court however, disagreed with the lower court's reasoning and reversed the decision holding that the Act did not violate the Fourth Amendment. It was observed:

[134] SJC-07899 & 07916) 429 Mass. 366, 709 – NE2d 1085-(1999)

"There is no disagreement that the involuntary collection of a blood sample from a person designated to furnish one under the Act constitutes a "search and seizure" for purposes of the Fourth Amendment.

The premise for the above approach is that convicted persons unlike other citizens have a diminished expectation of privacy in their identity. Once a person is convicted of a serious crime, his identity becomes a matter of state interest and he loses any legitimate expectation of privacy in the identifying information derived from the blood sampling. The courts using this analysis go on to examine the reasonableness of the search and seizure, and they have all concluded that the intrusion occasioned by a blood test is "not significant", involving little risk or pain. The courts engage in a balancing test, weighing government's strong interest in preserving an identification record of convicted persons for resolving past and future crimes against the minor intrusion into their diminished privacy right in their identities by the taking of a DNA sample.[135] The other approach used to justify taking of blood from convicted persons for DNA identification analysis is based on existence of "special needs beyond law enforcement". In State v. Olives[136] search & seizure for DNA was justified on the ground that the government has "special need", "to prevent accidents and casualties in railroad operations that result from impairment of employees by alcohol or drugs". Under this analysis, the establishment of a DNA data bank is considered a deterrent to recidivism on the part of convicted persons, and therefore, suspicion less blood testing is justified because it serves a special need beyond "normal" law enforcement.

It is recognized that maintenance of fingerprint, photograph and arrest records serve an important law enforcement function. The arrest record serves as a means for identification and apprehension of criminals. The State has an established and indisputable interest in preserving a permanent identification record of convicted persons for resolving past and future crimes and uses fingerprints, and now will use DNA identification, for this recognized purpose. The balance of interest clearly weighs in favor of the use of DNA in accordance with the governing statute to create a record of identification. In Landry's case, the Court held that, "… While obtaining and analyzing the DNA under the Act is a search and seizure implicating Fourth

[135] Jones v. Murray, 962 F.2d 302, 307.
[136] 122 Wash.2d 73, 98(1993)

Amendment concerns, it is a reasonable search and seizure. This is so in light of a convicted person's diminished privacy rights. The minimal intrusion of Blood test and the legitimate government interest in the investigation and prosecution of unsolved and future criminal acts by the use of DNA in a manner not significantly different from the use of fingerprints.

In Robert Roe v. Ronald Marcotte[137], United States Court of Appeal for the Second Circuit, while considering the Public Act 94 – 246 of the Connecticut Legislature which provided that, any person who is convicted of a violation of the sections mentioned therein on or after October 1, 1994 and is sentenced to the custody of the Commissioner of Correction or has been convicted of a violation of the referenced sections and on October 1, 1994, is in the custody of the Commissioner of the Correction shall, prior to release from such custody, have a sample of his blood taken for DNA analysis to determine identification characteristics specific to the person; and further, any person convicted of a violation of the specified provisions on or after October 1, 1994, who is not sentenced to a term of confinement shall, as a condition of such sentence, have a sample of his blood taken for DNA analysis to determine identification characterizes specific to the person. The plaintiffs were subject to the provisions of the statute because of their conviction of sex offences, which were specified under the statute and their continued incarceration on or after October 1, 1994. The DNA statute was challenged as unconstitutional to the extent that it encompasses sexual offenders, whether or not their current imprisonment was predicated upon a sexual offence. The court concluded that a reasoned interpretation of "special needs" doctrine supports the constitutionality of the DNA statute. Dealing with the contention that the statute violated the equal protection clause because it impermissibly distinguishes between individuals convicted of crimes characterized as sexual offences and those convicted of other violent offences, the Court observed that the statute's alleged "under inconclusiveness" did not provide a basis for invalidating it, and that, under rational basis review, legislature may proceed "one step at a time". The Court held that the Statute did not violate the Equal Protection Clause.

[137] 410 U.S. 113 (1973)

The Supreme Court of State of Kansas in State of Kansas v. James E. Maass[138], in which James E.Maass appealed from the District Court's order requiring that specimens of his blood and saliva be submitted to the Kansas Bureau of Investigation, contending that the court lacked statutory authority to enter the order or, in the alternative, that the application of KSA 2001 SUPP. 21-2511 in his case was unconstitutional, held that the said provision did not constitute an unreasonable infringement upon the defendants' right of privacy or constitutional protection from an unreasonable search and seizure; and that, the District Court's order requiring blood and saliva specimens did not infringe upon Maass' right of privacy or constitute an unreasonable search and seizure. The Court held that the provisions were constitutional, as the minimally intrusive nature of providing blood and saliva samples was significantly outweighed by the State's interest in establishing and maintaining a state-wide automated DNA database to search, match and store DNA records.

In India, right of privacy has been culled out of the provisions of Article 21 of the Constitution and other provisions relating to the fundamental rights read with the Directive Principles of State policy. India is a signatory to the International Covenant of Civil and Political Rights, 1966. Referring to Article 17 of that Covenant and Article 12 of the Universal Declaration of the Human Rights, 1948, the Supreme Court in People's Union for Civil Liberties (PUCL) v. Union of India[139] it was held that, the right to privacy is a part of right to "life" and "personal liberty" enshrined under Article 21 of the Constitution, and it cannot be curtailed except according to the procedure established by law. In M. P. Sharma v. Satish Chandra,[140], it was observed that a power of search and seizure is in any system of jurisprudence an overriding power of the State for the protection of social security and that power is necessarily regulated by law. The Court observed that when the constitution-makers have thought fit not to subject such regulation to constitutional limitations by recognition of a fundamental right to privacy, analogous to the American Fourth Amendment, "we have no justification to import it into a totally different fundamental right, by some process of strained construction." Nor is it legitimate to assume that the statutory provisions for searches would defeat the constitutional protection under Article 20(3) (right against self-incrimination). However, the right to privacy was more specifically

[138] S.No.87, US, 918, March 7, 2003
[139] (1997) 1 SCC 301
[140] AIR 1954 SC 300

in issue in the context of disclosure of the outcome of the blood test in Mr. "X" v. Hospital Z[141], in which the appellant's blood sample was tested and he was found to be HIV positive which resulted in the appellant's proposed marriage being called off. The Supreme Court held that the right to privacy has been culled out of the provisions of Article 21 and other provisions of the Constitution. However, the right was not absolute and may be lawfully restricted for prevention of crime, disorder or protection of health or morals or protection of rights and freedom of others. It was held that, having regard to the fact that the appellant was found to be HIV (+), its disclosure would not be volatile of either the rule of confidentiality or the appellant's right of privacy as "A", whom the appellant was likely to marry, was saved in time by the disclosure, otherwise, she too would have been infected with the dreadful disease if the marriage had taken place and consummated. Once the law provides "venereal disease" as a ground for divorce to husband or wife, such a person who was suffering from that disease, even prior to the marriage cannot be said to have any right to marry so long as he is not fully cured of the disease.

Statutes such as Part 1D of the Crimes Act, 1914 (Cth) provide for establishing database system, offences in relation to the DNA database system, the protection of information stored in the DNA database system and the destruction of the forensic material. These provisions can be studied for devising similar provisions in respect of forensic procedures to be adopted for a database system in the Indian context.

**13. Genetic Discrimination:**

One ethical issue on the genetic horizon that has already begun to take focus is genetic discrimination. It is thought that, with the identification of all the genes in the human genomes that either condition or in some case cause disease accompanied by an availability of inexpensive methods of testing the genome of each individual, a person's individual genome would become part of a databank, one side of which would be proper medical care from birth to grave and even cure of genetically based diseases, while the other, the problems starting with insurability, and ending up in form of discrimination that for genetic reasons would prevent certain individuals from obtaining employment and, even medical services. Once the genetic disorders of

[141] (1998) 8 SCC 296

individual become known, it could justify higher premiums by the insurance company.

The greater the risk, higher the premium. Insurance may even be denied to those whose genes predict extended or expensive medical treatment. The existing state of computer linkage would make it difficult to prevent the movement of data from hospital to insurance carrier and to anyone else intending to find it out. One of the most important factors is the principle that genome information should not ultimately be restricted and the more we know, the better the health care plans can be. But this is contingent on whether we can have information without discrimination. The current structure seems to make it profitable for employers and insurance carriers to discriminate against individuals with certain genetic configurations, that is, it is in their best financial interest to limit or even deny health care. A restructuring is called for so that it becomes profitable to deliver, not withhold healthcare. To accomplish this, the whole nation will have to become more egalitarian – that is, to think of the nation itself as a single community willing to care for its own constituents.

## 14. The Human Genome Project, 1990 – 2003:

The Human Genome Project (HGP) traces its roots to an initiative in the U.S. Department of Energy (DOE). Since 1947, DOE and its predecessor agencies have been charged by the Congress with developing new energy resources and technologies and pursuing a deeper understanding of potential health and environmental risks posed by their production and use. In 1986, DOE took a bold step in announcing the Human Genome Initiative, convinced that its missions would be well served by a reference human genome sequence. Shortly thereafter, DOE joined with the National Institute of Health (NIH) to develop a plan for a joint HGP that officially began in 1990. During the early years of the HGP, the Welcome Trust, a private charitable institution in the United Kingdom, joined the effort as a major partner. Important contributions also came from other collaborators around the world, including Japan, France, Germany and China[142].

[142] See, "Genomics and Its Impact on Science and Society: The Human Genome Project and Beyond" Available at, http://www.voidspace.org.uk/technology/genome/2.shtml (accessed on: 21st July, 2007)

- The HGP's ultimate goal was to generate a high-quality reference DNA sequence for the human genome's 3 billion base pairs and to identify all human genes.
- Other important goals included sequencing the genomes of model organisms to interpret human DNA
- enhancing computational resources to support future research and commercial applications
- Exploring gene function through mouse-human comparisons, studying human variation, and training future scientists in genomics.

The powerful analytic technology and data arising from the HGP raise complex ethical and policy issues for individuals and society. These challenges include privacy, fairness in use and access of genomic information, reproductive and clinical issues, and commercialization. Programs that identify and address these implications have been an integral part of the HGP and have become a model for bioethics programs worldwide. In June 2000, to much excitement and fanfare, scientists announced the completion of the first working draft of the entire human genome. First analyses of the details appeared in the February 2001 issues of the journals Nature and Science. The high-quality reference sequence was completed in April 2003, marking the end of the Human Genome Project two years ahead of the original schedule. Coincidentally, this was also the 50th anniversary of Watson and Crick's publication of DNA structure that launched the era of molecular biology. Available to researchers worldwide, the human genome reference sequence provides a magnificent and unprecedented biological resource that will serve throughout the century as a basis for research and discovery and, ultimately, myriad practical applications. The sequence already is having an impact on finding genes associated with human disease. Hundreds of other genome sequence projects – on microbes, plants and animals – have been completed since the inception of the HGP, and these data now enable detailed comparisons among organisms, including humans.

Beyond sequencing, growing areas of research focus on identifying important elements in the DNA sequence responsible for regulating cellular functions and providing the basis of human variation. Perhaps the most daunting challenging is to begin to understand how all the "parts" of cells – genes, proteins, and many other

molecules – work together to create complex living organisms. Future analyses on this treasury of data will provide a deeper and more comprehensive understanding of the molecular processes underlying life and will have an enduring and profound impact on how we view our own place in it.

## 15. Protection of Human Genetic Information[143]

The Australian Law Reforms Commission recently published the results of the inquiry conducted jointly with NHMRC's Australian Health Ethics Committee, "Essentially Yours: The Protection of Human Genetic Information in Australia, a two volume, 12,00 page report, containing 144 recommendations about how to deal with ethical, legal and social implications of the "New Genetics". The report covers a wide range of areas, including human genetic research and genetic databases, genetic privacy and discrimination, and regulating the use of genetic testing and information in employment, insurance, immigration, parentage testing, sport and other contexts[144]. The report has been described as "an extraordinary accomplishment", providing a "world -leading platform for policy development". It is a comprehensive and instrumental report producing a number of welcome recommendations. The following are the main recommendations made by the A.L.R.C. Final Report[145]:

(i) The establishment of a standing Human Genetics Commission of Australia (*HGCA*) to provide high-level, technical and strategic advice about current and emerging issues in human genetics, as well as providing a consultative mechanism for the development of policy statements and national guidelines in this area.

(ii) Discrimination laws should be amended to prohibit discrimination based on a person's real or perceived genetic status.

(iii) Privacy laws should be harmonized and tailored to address the particular challenges of human genetic information, including extending protection to genetic samples, and acknowledging the familial dimension of genetic information. For example, doctors might be authorized to disclose confidential information to a genetic

[143]See, ALRC Discussion Paper 66 "Protection of Human Genetic Information", Available at www.austlii.edu.au/au/other/alrc/publications/dp/66/(Last Accessed on 15th July 2007)
[144] Ibid 132
[145] Ibid 132 and also see

relative where it is necessary to avert a serious threat to an individual's life, health, or safety.

(iv) Ethical oversight of genetic research should be strengthened by: ensuring that all genetic research complies with National Health and Medical Research Council, (NHMRC) Standards; better supporting Human Research Ethics Committees; providing more guidance to researchers and research participants about best practice; developing new rules to govern the operation of human genetic research databases; and tightening reporting requirements.

(v) Employers should not be permitted to collect or use genetic information except in those rare circumstances where this is permitted under anti-discrimination laws or is necessary to protect the health and safety of workers or third parties, and the action complies with stringent HGCA standards.

(vi) The insurance industry should be required to adopt a range of improved consumer protection policies and practices with respect to its use of genetic information (including family history) for underwriting purposes. New laws and practices should ensure that: genetic information is only used in a scientifically reliable and actuarially sound manner; reasons are provided for any unfavorable underwriting decision; industry complaints-handling processes are strengthened and extended to cover underwriting decisions; and industry education and training about genetics are improved.

(vii) A new criminal offence should be created to prohibit someone submitting another person's sample for genetic testing knowing that this is done without consent or other lawful authority (e.g. a court order, or the statutory authority given to police officers).

(viii) Lack of harmonization is threatening the effectiveness of any national approach to sharing DNA information for law enforcement purposes. The governments should develop national minimum standards for the collection, use, storage, destruction and matching of DNA samples and profiles. No inter-jurisdictional sharing of information should be permitted except in accordance with these minimum standards

(ix) DNA parentage testing should be conducted only with the consent of each person sampled, or pursuant to a court order. Where a child is unable to make an informed decision, testing should proceed only with the consent of either parents, or a court order.

## 16. Human Enhancement:

The most controversial issue regarding biotechnology is the prospect of employing it for the purpose of human enhancement. The distinction between enhancement and therapy is linked to the distinction between health and disease. A therapeutic modification is one that brings a trait that was below a recognizable, species-wide norm up to that norm. The term "trait" is meant, in its broadest sense, to include physical attributes, mental or physical abilities, dispositions, and capabilities. While it is true that therapeutic modifications attempt to treat disease whereas enhancement modifications attempt to improve a trait that is not diseased, there can be considerable debate over whether a particular modification constitutes an enhancement and why. Ethical issues regarding enhancement modification should then be seen in terms of the ethics of medicine and the professional duties and responsibilities of health professionals. There are modifications that, strictly speaking, are enhancements, but whose purpose is to respond to the threat of a disease. For example, a modification that improves people's resistance to particular diseases beyond the normal capacity would count as an enhancement but its purpose would be disease prevention and so arguably therapeutic. There could be modifications that raise a trait from one point within the normal range of that trait to a higher point in that range.

This suggests that the classification of modifications should be tripartite: therapeutic, (proper) enhancement, and intra-normal. Cosmetic surgeries, which can often be regarded as intra-normal modifications, are thus placed in the same category as genetic modifications to create super people. Biotechnology covers a range of technologies and procedures, many of which could conceivably be employed for enhancement. Drugs could be designed to interact with the body's chemistry in such a way as to alter behavior, biological functioning, structure, or affect them. Even without introducing drugs, special procedures – such as transfusing persons with their own blood or "blood doping" – can affect traits or behavior. But the most discussed enhancement technology is one in which a person's genome is altered. While a

popular image of genetic enhancements is that of some magic-wand transformation in which the person is a passive recipient, the matter can be more complex. The object of a somatic modification is a modified individual, but the object of a germ line modification is a modification that becomes part of the individual's legacy or inheritance. Somatic enhancements are simpler as far as ethics and public policy is concerned. It is considered that using biotechnology to effect an improvement is wrong because it is artificial. There is also a concern that, using biotechnology in order to effect an improvement undermines the value of the improvement. The value we place on certain achievements may depend upon the struggle and effort required to achieve them. If they could be made effortless – at least on the part of the individual – and common, we might well cease to value them. It is also suggested that, using biotechnology to enhance people is not the sort of thing physicians should do because the values or aims of the medical profession are held to be incompatible with performing enhancements. This view however leaves ethics of enhancements untouched.[146]

### 17. Genetic Weapons:

Scientists have warned that recent advances in biological research could eventually lead to the creation of a new type of biological arsenal capable of targeting a specific group of human beings with common genetic characteristics, as may be the case with certain ethnic groups.It will unfortunately be possible to design biological weapons of this type when more information on genome research is available Report", which he wrote for the BMA, examined the questions of how the revolution in biotechnology might be used to attack the genetic constitution of an ethnic group. The world community is already struggling to eliminate existing biological weapons, which carry agents spreading deadly diseases like anthrax and other lethal toxins, and can devastate human beings without causing damage to buildings or infrastructure[147]. A few hundred kilograms of a "weapon zed" bacterial preparation has the potential to wipe out up to three million inhabitants concentrated in a city like New York. In the

[146] See, Robert Wachbroit, "Human Enhancement Uses of Biotechnology":Encyclopedia of Ethical, Legal and Policy Issues in Biotechnology, Wiley Reference Works "Biotechnology,Weapons and Humanity" ,Available at http://onlinelibrary.wiley.com/doi/10.1002/0471250597.mur098/full and also see http://findarticles.com/p/articles/mi_m1310/is_1999_March/ai_54311680/ (Last accessed on: 13th August, 2007)

[147] http://gujarathighcourt.nic.in/Articles/legalpers.htm (Last accessed on 15th September, 2007)

past, however, countries have rarely used such biological weapons in warfare, because of their fear of eliminating friendly populations and killing their own combatants. The problem of the proliferation of biological weapon research has been aggravated by fall-out from the collapse of the former Soviet Union. Most of the nearly 30,000 scientists who were involved in biological research in the USSR during the 1980s were out of job because of the country's economic difficulties. Such scientists could be engaged by terrorists or cult groups for acquiring biological weapons which may be used by them irresponsibly having regard to the nature of their goals. The professional scientists and physicians should shoulder their ethical responsibilities and take no part in biological and genetic weapon projects. There is also a growing concern about the misuse of genetic information available on Internet. Scientists worldwide share information on new findings in biological research through Internet, which could be manipulated by private groups. Internet service providers are under an ethical obligation to ensure that information on biological weapons is not made available on their websites[148].

The spectre of new biological weapons made possible by the mapping of the human genome makes it more urgent than ever to prevent biotechnology research from being hijacked. It sounds like science fiction, but like many another prediction that was once dismissed. As far-fetched it may become a reality.

Scientists have warned that recent advances in biological research could eventually lead to the creation of a new type of biological arsenal capable of targeting a specific group of human beings with common genetic characteristics, as may be the case with certain ethnic groups. "It will unfortunately be possible to design biological weapons of this type when more information on genome research is available," says Dr Vivienne Nathanson, head of science and health policy at the British Medical Association (BMA), the body which represents the medical profession in the United Kingdom.

This terrifying prospect may be an unwelcome piece of spin-off from research being carried out under the Human Genome Project (see box), an international scientific effort to map and sequence the genes in the human body and find out more about

[148]See, Ethirajan Abrasion, "Genetic Weapons: A Twenty-First Century Nightmare", , Kamal Book House, 2006, Available at http://www.mail-archive.com/ctrl@listserv.aol.com/msg74311.html

human DNA (deoxyribonucleic acid), the molecule which provides the biological instructions to make a human being.

**Repairing defective genes**

The genome research achieved a breakthrough when scientists for the first time deciphered the full genetic programming of an animal. The creature was a microscopic roundworm known as Caenorhabditis elegans, but because worms and humans have turned out to share many genes in common, the worm genome is regarded by biologists as an essential basis for understanding how the human genome works.

Scientists say a detailed understanding of genetic mechanisms of human beings will help them to find out the causes of many diseases. For example, knowledge of an individual's genetic make-up will enable doctors to predict whether or not a specific drug will work on a particular patient, allowing therapies to be more accurately targeted. Similarly, genetic testing for predisposition to a range of illnesses could become feasible, and by using what is known as gene therapy doctors would be able to replace deficient genes or repair defective ones.

However, genome research may turn out to have a grim downside.
It has proved that biologically there are more similarities between human beings than differences, further dissolving traditional prejudices of race and ethnicity. However, differences do exist, and if investigations provide sufficient data about ethnic genetic differences between population groups, it may one day be possible to target the groups with dangerous micro-organisms.

The apartheid regime in South Africa is widely believed to have developed forms of biological weaponry for use against the black population. In the past, however, countries have rarely used such biological weapons in warfare, partly because of their fear of eliminating friendly populations and killing their own combatants. The new developments in genetic research described by Professor Dando would remove these limitations.

Genetic information is already being used in some countries to "improve" biological weapons, e.g. by equipping them with agents to provide increased antibiotic

resistance–and it is likely that this trend will accelerate as the knowledge and understanding of its applications become more widely known.

The problem of the proliferation of biological weapon research has been aggravated by fall-out from the collapse of the former Soviet Union. Most of the nearly 30,000 scientists who were involved in biological research in the USSR during the 1980s are now out of a job because of the country's economic difficulties. Last year, some of them disclosed that they had been approached by certain countries which have shown particular interest in learning about microbes that can be used in war to destroy or protect crops, as well as genetic engineering techniques that could be used to make deadly germs for which there may be no antidotes.

The scientists in countries that belonged to the former Soviet Union should be diverted from involvement in programmes with sinister motives by schemes such as scientist-to-scientist exchanges, joint research projects and the conversion to civilian use of laboratories and institutes once associated with the Soviet military effort. One prospect that alarms arms control experts is that biological weapons will fall into the hands of terrorist or cult groups. Twelve people were killed and 5,000 injured in the Tokyo subway in 1995 in an attack launched by the Aum Shinrykyo cult using sarin, a lethal nerve gas that produces asphyxia. Investigations later revealed that the cult group had had no problem in recruiting scientists to work on biological weapons but could not employ the weapons due to lack of a proper delivery system.

As a first step in coping with the problem of potential new biological weapons, arms control experts are calling for the bolstering of the Biological and Toxin Weapons Convention (BTWC), an international treaty signed in 1972. The convention prohibits its signatories from developing, producing, stockpiling and acquiring biological weapons.

though 142 nations have signed the convention so far, this has not deterred countries from developing or obtaining knowledge on biological weapons. "This is mainly because there is no verification system attached to the convention," he says.

**Monitoring the uses of genome mapping**

"The threat of new genetic weapons is clearly going to be an ongoing problem for the international community. Such weapons are covered by the current treaty, but this needs to be strengthened by an effective verification protocol and fully implemented so we can be sure states comply with their obligations. A variety of tools should be used, including arms control, export controls and enhanced intelligence capability to monitor countries of concern.

The BMA report cited earlier says professional scientists and physicians should shoulder their ethical responsibilities and take no part in biological and genetic weapon projects. It calls for close monitoring of developments in biotechnology worldwide and open debate, particularly in relation to the use of genome mapping. However, These measures can minimize the threats but not eliminate them

There is also growing concern about the misuse of genetic information available on Internet. Scientists worldwide share information on new findings in biological research through Internet which could be manipulated by private groups .Internet service providers have an ethical obligation to ensure information on biological weapons is not available on their websites.

One big problem in monitoring is how to distinguish between research carried out for good and evil ends. The fact is that genetic research which develops specific therapeutic agents is scientifically indistinguishable from research to develop a lethal or disabling agent targeted at specific clusters of genes in an ethnic group. This makes it all the more necessary to make sure that information is used for positive purposes. One avenue to be explored is to ensure that developing countries are given the opportunity to share the benefits of the modern revolution in biotechnologies which can be used for disease control and economic development. In return they would be required to promise that malign research would not be carried out in their laboratories. "This is currently being negotiated by countries which are party to the BTWC," he says.

## 18. Gene Patents

### Introduction

### 18.1 Background to biotechnology and Intellectual Property -

Since the discovery of Recombinant DNA technology in the early 1970's, Biotechnology has become an important tool for many researchers and industries. Biotechnology and the inventions arising out of it have many inventors and have played an important role in improving the health, food supply and environment. Turning Biotechnology inventions into protected Intellectual Property, with concomitant Intellectual Property Rights have been taking place for over a century.

For example, Louis Pasteur was granted a French patent in 1865 for yeast clones that he isolated from mixtures of yeast species. The application of technology to agriculture has helped contribute enormous increases in yield and quality. The isolation of adrenalin over a century ago from the human suprarenal gland was an important advance in the field of medicine. Rapid developments in biotechnology during the past decade have enabled corporations, scientists and "bio prospectors" to alter nature's handiwork for commercial profit. A major strategy for private exploitation in this area is to obtain the patent rights to an organism or its component parts. As these developments affect all of society, we need to decide whether any corporation, institution, or individual should have the right to private ownership of life.

The society has been benefited a lot from patent inventions, but the question is whether the application of the patent system to DNA sequences is achieving its goals, namely using innovation for the public good, and the rewarding of people for useful new inventions. We know that many patents that assert rights over DNA sequences have already been granted but are of doubtful validity. The effects of many of these patents are extensive as well as controversial, because inventors who assert rights over DNA sequences obtain protection on all uses of the sequences which has generated a lot of controversy as they directly come into conflict with many moral and

ethical questions. In the light of this controversy we have attempted to examine various aspects relating to DNA patenting[149].

### 18.2 How the Patent system works:

Meaning: Before turning to the question of patents involving genes, it is important to discuss the patent system in general.

*Patents are exclusive rights granted for a limited period of time by states through their legal systems to inventors to prevent others from exploiting the patent holder's invention.* Patent applications contain claims which set out the precise nature of the protection.

The patent claims are drafted to avoid the exact duplication of the the inventor's work Patents can be broadly divided into three categories, though these categories are not formally distinguished under the patent system.

i. A product patent is a patent on the product itself. The term 'product' normally means a mechanical, chemical or biological entity, substance or composition (as distinct from a device or electrical circuit). A patent that asserts rights over a product itself covers all uses of that product.

ii. A process patent is a patent on a method or process. This covers a process, and may also include what is directly produced from the process. If a product is made by another process, not covered by the patent, it does not infringe it. A use patent is a patent on the use of the product for a specific purpose; only the specified use is covered.

An important feature of product patents is that they extend to new uses of the invention that may develop subsequently, even if these uses were not anticipated or predicted by the owner of the patent.

---

[149]Carsten Fink, How Stronger Patent Protection in India Might Affect the Behavior or Transnational Pharmaceutical Industries, Development Research Group The World Bank Oliver Mills, Biotechnological Inventions: Moral Restraints and Patent Law, *Ashgate Publishing, Ltd*, (2005) 170 1 447U.S.303, 206 USPQ 193 (1980) and See also 2004 SCC 34.
Swiss Federal Institute of Intellectual Property, Research and Patenting in Biotechnology-a Survey in Switzerland.WIPO Academy notes.Property and Bioethics- An Overview, Consultation Draft WIPO
Margaret Sampson, The Evolution of the Enablement and Written Description Requirements under 35 U.S.C. §112 in the area of Biotechnology, 15 BerkeleyTech.L. J. 1233, 1234 (2000).
Bioethics and Patent law – The Relaxin case, *WIPO Magazine*, April 2006.

Of the three main kinds of patent i.e. product, process and use patents, *only product patents can assert rights over DNA sequences themselves.* Use patents only extend to the use of the sequence. In practice, use patents may also restrict access to the DNA sequence itself.

### 18.3 Gene patenting:

Genetic Science and related technologies are important in medical research and in the development and provision of healthcare, and, their significance for human health is likely to increase as more becomes known about the biological functions of genes and the proteins they produce.

Human genetic research aims to enhance understanding of how genes and environmental factors operate and interact to influence the health of individuals and populations – and in so doing, to generate knowledge with the potential to improve individual and community health. Human genetic research may translate into the development and provision of new forms of healthcare involving, among other things, medical genetic testing, pharmacokinetics, gene therapy, and the use of therapeutic proteins or stem cells. There are many ways in which the potential subject matter of gene patents might usefully be categorized.

The potential subject matter of gene patents can be grouped into the following four broad categories:-

i. Genetic technologies – The methods and items used in genetic research and genetics – based healthcare, including those used in sequencing DNA, medical genetic testing, other diagnostic uses and gene therapy;
ii. Natural genetic materials – Forms of genetic material in their natural state, including DNA, RNA, genes and chromosomes;
iii. Isolated genetic materials – Forms of genetic material isolated from nature, including genetic materials of whole genomes, gene fragments.

iv. Genetic products – Item produced by the use of genetic materials, including proteins, nucleic acid probes, nucleic acid constructs such as vectors and plasmids, and anti-sense DNA.[150]

Patenting of new and improved genetic technologies would ordinarily be the least controversial area of gene patenting, since the issues of "invention", "novelty" and "usefulness" is clearer than they are in case of patents over genetic materials. There is a distinction between a gene or a gene fragment.i.e. in the human body or another organism and a gene or gene fragment that has been extracted from the body by a process of isolation and purification. In general, raw products of nature are not patentable. DNA products usually become patentable when they have been isolated, purified, or modified to produce a unique form not found in nature.[151]

Isolated genetic material will be patentable, genetic materials in their natural state usually are not. Natural genetic materials include genetic materials in living cells, such as, stem cells. Claims must be formulated so as to clearly distinguish what is claimed to be patented from the naturally occurring molecule. While naturally occurring (e.g. as embryonic stem cells), stem cells may be patentable when isolated and propagated to produce a "cell line". Genetic materials include living cells that have been modified by genetic manipulation – such as, in gene therapy. The Human Genome Project has noted that therapeutic cloning, also called "embryo cloning" or "cloning for biomedical research" is the production of human embryos for use in research. The goal of this process is not to create cloned human beings but rather to harvest stem cells that can be used to study human development and treat disease. Stem cells are important to biomedical researchers because they can be used to generate virtually any type of specialized cell in the human body". [152]

The question as to whether a live human – made micro – organism is patentable subject matter under the U.S. law, Title 35 U.S.C, 101, which provided for the issuance of a patent to a person who invents or discovers "any" new and useful "manufacture" or "composition of matter" within the meaning of that statute arose before the U.S. Supreme court in Diamond v. Chakrabarty, The Supreme Court found

[150] See ALRC Issue Paper 27, Intellectual Property Rights over Genetic Materials
[151] See Human Genome Project, "Patenting Genes, Gene Fragments, SNPs, Gene Test, Proteins and Stem Cells, U.S. Department of Energy", 17th June 2003).
[152] See Human Genome Project, "Patenting Genes, Gene Fragments …" U.S. Dept. of Energy

that the patentee had "produced a new bacterium with markedly different characteristics from any found in nature and one having the potential for significant utility". It was held that, "His discovery is not nature's handiwork, but his own; accordingly it is patentable subject matter," under Title 35 U.S.C. 101.

The Supreme Court noted that Chakrabarty's patent claims were of three types:

First, process claims for the method of producing bacteria;

Second, claims for inoculums comprised of a carrier material floating on water, such as straw, and the new bacteria;

Third, claims to the bacteria themselves.

The patent examiner allowed the claims falling into the first two categories, but rejected claims for the bacteria, on two grounds: (i) that micro-organisms are "products of nature", and (ii) that as living things they are not patentable subject matter under 35 U.S.C. 101. The invention was claimed to be human-made, genetically engineered bacterium, capable of breaking down multiple components of crude oil. Because of this property, which was possessed by no naturally occurring bacteria, Chakrabarty's invention was believed to have significant value for the treatment of oil spills. By breaking down multiple components of oil, Chakrabarty's microorganism promised more efficient and rapid oil-spill control. (Oil decomposed into simpler substances can serve as food for aquatic life). When the Supreme Court was pointed out the grave risks that may be generated by such research endeavors, the Court observed that, the briefs presented "a gruesome parade of horrible", and it was told that, genetic research and related technological developments may spread pollution and disease, that it may result in a loss of genetic diversity, and that, its practice may tend to depreciate the value of human life.

The Supreme Court observed that these arguments passionately presented reminded the court that, at times, human ingenuity seems unable to control fully the forces it creates – "that, with Hamlet, it is sometimes better "to bear those ills we have than fly to others that we know not of". The Court disagreed, and observed that the grant or denial of patents on microorganisms was not likely to put an end to genetic research

or to its attendant risks. "The large amount of research that has already occurred when no researcher had sure knowledge that patent protection would be available suggests that legislative or judicial fiat as to patentability will not deter the scientific mind from probing into the unknown any more than Canute could command the tides. Whether respondent's claims are patentable may determine whether research efforts are accelerated by the hope of reward or slowed by want of incentives, but that is all". The Court observed that it was without competence to entertain these arguments either to brush them aside as fantasies generated by fear of the unknown, or to act on them, and that the matter was of high policy for resolution within the legislative process which involves balancing of competing values and interests, that, in a democratic system, was the business of elected representatives.

Our Genes define us, as a species as well as individuals, and hence for human genes there are strong oppositions both on the religious and secular front. Patents are being granted to genes despite there being many arguments for keeping the genes in the public domain. A patent cannot be granted on a gene as it naturally occurs. Isolation of the gene is required for it to be patentable. The patent offices have treated genes as a new chemical compound and have granted "composition of matter" patents. Thus a patent granted on an isolated and purified DNA composition confers the right to exclude others from any method of using that DNA composition for upto 20 years from the date of filing. However Human Beings are not patentable as human multicellular living organisms are not a patentable subject matter under section 101.

### 18.4 Why are genes being patented[153]?

Genes have been used for gene therapy though it is still in the early developmental stages. The technology used in each gene therapy will have huge commercial value in the coming future making patenting crucial. However gene therapy is not a patentable subject matter in India.

Some of the genes encode proteins that can act as therapeutic agents. (e.g.; the human growth hormone). Hence by offering patent protection to such genes, the interests of the pharmaceutical industries will be maintained. However, the pharmaceutical

[153]See, Issues and controversies in Patenting Recent Biotechnological Inventions – Is the patenting of life equivalent to owning it?, Available at http://www.legalserviceindia.com/article/l254-Patenting-Recent-Biotechnological-Inventions.html(last Accessed on 10th August 2007)

industries should be granted access to the genes and not the ownership. Monopolies on genes are not in public interest.

For Biotechnological companies, gene patents are considered as value generators and enhance the value of the company in the eyes of the investors. Most of the Biotechnological companies and research institutes have created Technology Transfer Offices (TTO) so that the patents generated by their research will generate huge financial rewards.

Sequences of genes and genomics provide data for further research. The patenting of genes forces the disclosure of information instead of it being kept as a trade secret. Full and free access to genomics data is essential for academic research and owning gene patents are the best way to ensure hindrance free access to such data.

**Some glaring questions relating the Patentability of genes**

There is a current debate on the inherent dangers of the process of creating transgenic organisms, which is why UK and many countries in Europe are banning transgenic crops or imposing a moratorium.

Transgenic DNA has the potential to generate new viruses and bacteria that cause diseases, and may also cause cancer by integrating into mammalian cells. The transgenic DNA from terminator or GURT technologies involve even greater risks, as they contain dangerous genes that prevent germination, which can nonetheless escape into other species. Furthermore, the technologies depend on gene-splicings that have to be engineered and regulated very precisely, but those requirements are beyond the capability of the genetic engineer. The hazards of the transgenic DNA resulting from GURT technologies are much greater, because the imprecisions of inserting multiple gene-constructs are multiplied, and because of the gene-splicing sequences and genes deliberately introduced. Gene splicing has the potential to create new combinations of genes and to scramble genes and genomes when it is imprecise.

How can we regard this as a patentable invention when it is so hit or miss and unreliable? It is both scientifically flawed and ethically unacceptable to create so much suffering.

The patentability of genes and other nucleic acid sequences is justified on the ground that they have been subject to a microbiological or nonbiological process, i.e, gene sequencing, which is itself a standard process patentable and patented under existing patent laws for invention. So, the actual patented entity is the nucleic acid sequence itself and its putative function.

However, the DNA or RNA sequence is subject to change by mutation, deletion, insertion and rearrangement. Thus, the patent for the gene and the patent for the gene variant will legally clash. The same arguments of mutability of entire genomes raise the question as to which genome is being patented. If the patent is on one DNA base sequence, does it cover genomes differing in DNA base sequence?

### 18.5 Legal protection given to biotechnology:

Patents are viewed as vital to protecting the commercial interests and intellectual property rights in biotechnology. Patents are limited rights based on a claim that a new technological invention has been created and fully communicated to the public. Patents can cover new products, processes that creates these new products, new processes for producing existing products and new processes generally. While patenting of a biotechnological invention it is important that it meets the 3 criteria's laid down by the TRIPs to meet patentability, namely which are new or novel, involves an inventive step or not obvious and capable of industrial application. The TRIPs gives the option of excluding certain forms of subject matter from patentability.

1. Diagnostic and surgical methods for the treatment of humans or animals.
2. Plants and animals other than micro-organism and biological processes for the production of plants or animals other than non-biological and micro-biological processes.

However the patenting of new life forms raises arguments in favor of and against the issuance of such patents. Most recently, public debate has centered on the patenting of animals. Discussions regarding the patenting of a genetically engineered organism can involve questions relating to the environmental application of the organism, scientific questions, ethical issues and economic considerations.

The other forms of IP Protection that can be offered to biotechnology involve *plant breeder's rights, trademarks, trade secrets and geographical indications.*

Extent of protection offered by patents-some legal and technical Concern - The protection conferred by a patent on a biological material extends to any biological material derived from that biotechnologically invented material through propagation or multiplication and possessing the same characteristics. The protection conferred by a patent on a product containing the genetic information extends to all material in which the product is incorporated.

However the protection does not extend to plant-propagating material or breeding stock sold to a farmer by the holder of the patent or with his consent, provided that the farmer uses the biological material or livestock for his own agricultural purposes.

Where a breeder cannot acquire or exploit a plant variety right without infringing a prior patent, he can apply for a compulsory license for non-exclusive use of the invention protected by this patent, subject to payment of royalty.

Biotechnology is special and it is based on living organisms[154]. Indeed, biotechnological inventions can be self-reproducing and self disseminating. The Biotechnology Industry Association (BIA), the representative body of international biotech product makers in a representation to the office of the US Trade Representative (USTR) on February 2008 contented that each patent applicant is responsible for tracing the history of all naturally-derived biological materials contributing to the invention, even if the applicant obtained the material from a commercial supplier and the material has been available from secondary sources for decades. The failure to identify the geographical source of a biological material used in the invention may be the basis for opposition or revocation proceedings. Such requirements pose unacceptable risks for patent applicants and would undermine the incentives of the patent system to promote innovation in biotechnological inventions.

The application of the patent system in the field of biotechnology and biomedicine is justifiable as a way of striking a reasonable balance between the right of inventors and

[154]See, Article on Patents, Available at http://www.docstoc.com/docs/22615485/patent(Last Accessed on 20yh August 2007)

the public interest. But such patents involve some legal and technical issues which are as follow:

**a. Should not be allowed special status**

The first concern is that patents which assert right over DNA sequences in particular human DNA sequences should not be allowed by virtue of the special status or nature of DNA. While dealing with this question we have to draw an important distinction between the acquisition of knowledge about the nature and functions of a DNA sequence, and the information contained within that sequence. Although we think that the judgment that isolated DNA sequences are eligible for patenting, is based on questionable extrapolation to the case of genetic information from the case of the isolation of chemical compounds, we accept that a limited number of the early patents granted on that basis need not now be called into question in view of the inventiveness required to isolate the DNA sequences. Since the early days of the pioneering experiments using positional cloning techniques patents have been field on many DNA sequences, which were mass-produced by a mixture of computational and cloning techniques. Even if it can be convincingly argued that these sequences were eligible for patenting, the patents should be examined in the light of the criteria for inventiveness and utility. We note that as a technique have advanced, and in particulars as the use of computers to identify genes has become more widespread the eligibility of DNA sequences for patenting should have diminished.

**b. Patents not meeting legal criteria should not asserts rights over DNA sequences**

The second concern is that patents which assert rights over DNA sequences should not be allowed because they do not meet the legal criteria for patenting. With regard to the legal criteria for assessing patents with claims to DNA sequences, while the test of novelty can be met, the tests of inventiveness and utility are more problematic. In the case of inventiveness, we hold that as the use of computational databases becomes the standard way of identifying genes, it is difficult to see how the test can be met, despite current US practice. In the case of utility, we argue that the standard of credibility required for a claimed utility needs to be set higher than the mere

theoretical possibility of this utility; some positive evidence that the DNA sequence has the claimed utility should be required.

Patenting of Micro-organisms and Cells – The first successful directed insertion of recombinant DNA into a host micro-organism took place in 1973, and since then scientists realized the huge potential involved in directing cellular machinery to develop new and improved products and processes. Many of these products were micro-organisms or cells. Hence with the development of the recombinant DNA technology, the potential of patenting the living organism resulting from the technology arose[155].

Post Chakrabarty trends- The Chakrabarty decisions and the subsequent actions enacted by the US congress provided great economic stimulus to the patenting of micro-organisms and cells, and in turn provided stimulus to the growth of the biotechnological industry in the 1980's. However, increased patenting of biotechnological inventions has led to litigation related to patent infringement issues. The patent litigation is only likely to increase in future considering the overlapping of patent claims, the high value of products, problem of prior publication and the fact that many companies are pursuing the same product. The increase in the patent claims leads to the inability of the patent offices to process the biotechnological inventions in a timely manner. Turnover amongst the patent examiners, luring them to the private sectors by offering higher pay etc are reasons for the delay in the reviewing of patents[156]

Supreme Court of Canada in Monsanto Canada Inc. v. Schmeiser has laid down that higher life forms were not patentable because they were not a manufacture or composition of matter within the meaning of invention of the Patent Act.

---

[155] In 1980, in the Diamond v. Chakrabarty ruling, the Supreme Court of US ruled that a living micro organism could be patented. Chakrabarty had developed a genetically modified bacterium capable of breaking down the multiple components of crude oil. Since this property was not possessed by any naturally occurring bacteria, the invention was thought to have significant value. It was held that a non-naturally occurring manufacture was a product of human ingenuity. DNA compounds having naturally occurring sequences are eligible for patenting when isolated from their natural state and when it meets the Hence by a 5-4 ruling it was held that a live, human made micro-organism is a patentable subject matter under section 101 as a "manufacture" or "composition". The fact that biotechnology was not predicted as a branch of science when the congress enacted section 101 does not arrive at the conclusion that micro-organisms are not a patentable subject matter until the congress expressly authorizes such protection

[156] See, Article on Patents, available at http://www.legalserviceindia.com/article/l254-Patenting-Recent-Biotechnological-Inventions.html(Last accessed on 2nd October 2007)

## 18.6 Patenting of Transgenic Animals –

The first animal patent was issued in April, 1988 to Harvard University for a particular type of mammal, namely the Harvard oncomouse, genetically engineered to obtain a cancer- causing gene. The oncomouse has been genetically engineered to carry a particular type of gene called as the oncogene which makes it susceptible to cancer and hence makes it ideal for cancer research. Subsequently the USPTO announced that it would consider non-naturally occurring non-human, multi-cellular organisms, including animals to be patentable subject matter under its laws.

Most of the animal patents have been granted to transgenic animals produced by recombinant DNA or genetic engineering. Negative impacts of patenting of transgenic animals- The major concern that arises out of patenting of transgenic animals are that transferring genes from one species to another transgresses the natural barriers between them and affects the integrity of species. Species belonging to the same group, though they may slightly vary from one region to the other based on the environmental conditions, they primarily have the same gene pool. By allowing patenting of transgenic animals, the fundamental genetic architecture is being tampered with.

### a. Ethical-Moral Issues-

A number of ethical issues stem from the patenting of animals. Most of them deal with the consequences that could arise subsequent to patenting of animals while the other arguments focus on the religious, philosophical and spiritual grounds. The arguments which go against the patenting of animals are difficult to prove as many of them are factual assertions which are still to occur or to be proven. The DNA is considered to be intimately related to the species identity and hence no part of it should be controlled for commercial interest. In case of human beings, human DNA is unique and hence possesses intrinsic value of a sacred kind. It can also be put as ‘Human DNA bears the image of God’ and to tamper with them and own them for commercial and economic interests would hurt the sentiments of the many. The view that plants, animals and microorganisms comprising life on earth are part of the natural world into which we are born and hence the conversion of these species, their

molecules, or parts into corporate property through patent monopolies is counter to the interest of the people of the country and world, has been taken by many.

However most of the religious and ethical issues arise out of product patents which have been given to organs, cells, genes and proteins. Hence one possibility that could be accepted by such religious leaders could be the issuance of 'process patents', whereby only the process involved in the manipulation of particular genes are patented rather than the genes in itself.

Exciting invention in the field of bio technology have been made in recent years following the examples of the owners of bio tech patents companies with high investment in the field of bio technology now recognized the advantage of protecting and enforcing their intellectual property rights and in relatyion to this a series of ethical questions relating to the patent aspect has emerged. In the middle of this debate are ordinary citizens, often uncomfortable with the idea that something as fundamental as a gene can be patented but at the same time eager to see new medicines. The objection which is forwarded against genetic patenting is that genes are "products of nature" and therefore ought to be off-limited[157].

The next argument that is forwarded against D.N.A patenting is that such patents make important products more expensive and less accessible. The biotech industry claims that patents are necessary so that innovative, life-saving technologies can be developed. In actuality, patents enable companies to create a monopoly on a product, permitting artificially high pricing.

Patents on living organisms are morally objectionable to many people. Patenting organisms and their DNA promotes the concept that life is a commodity and the view that living being are "gene machines" to be exploited for profit. If it is possible to consider a modified animal an invention, are patents and human reproductive cells and their marketing far behind? Patents derive from concepts of individual innovation and ownership, which may be foreign to cultures which emphasize the sharing of

[157] The courts have recognized a "products of nature" doctrine and used it to reject some patent applications. However a counter-principle has also evolved[157] : Advocates of gene patents cite the sophistication of this work (i.e. gene patenting) in arguing that ownership rights are not being granted to scientists simply because they stumble on an aspect of nature, but rather because they are deploying complex techniques to manipulate nature in the service of human goals.

community resources and the free exchange of seeds and knowledge. Many disputes involving patent infringement cases emerged because of question related to obviousness, enablement or the priority of invention that had to be decided by the courts. More difficult were the questions about the ownership rights and privileges. For example, in the patent 'Unique T-lymphocyte line and products derived therefrom', the inventors used the spleen of a patient Mr. John Moore who suffered from hairy cell leukemia and came for treatment to Dr. David Golde at UCLA. As part of the treatment, his spleen was removed and Dr. Golde developed a cell line with enriched T-lymphocytes that produced large amounts of lymphocytes useful for cancer or AIDS treatment. Without Mr. Moore's initial knowledge or consent, but requiring his repeated visits to the hospital, Dr. Golde and the University of California applied for a patent on the cell line derived from Mr. Moore's spleen which was granted in 1984. Mr. Moore subsequently sued Dr. Golde and the University supreme Court. Both the Appeals Court and the Supreme Court recognized the novelty of Mr. Moore's claim Mr. Moore on the issue of conversion (unauthorized use of his body part), but recognized his right to be informed of what the physician was doing involving his health and well being. It's as irony that a person is not given any benefit of the substance which he himself had produced, and at the same time others are minting money from the same substance.

First World patenting of Third World genetic resources represents theft of community of biological resources.

Patents held by the industrialized world on biological resources from the developing world will serve as a tool for the North to accumulate more wealth from the already impoverished south. Microorganisms, plants, animals and even the genes of indigenous people have been patented for the production of pharmaceuticals and other products. Requiring developing nations to pay royalties to the wealthy industrial nations for products derived from their own natural resources and innovation in robbery. Moreover the developing world has never received compensation or recognition for these intellectual and technological contributions. Patenting life forms will exacerbate this inequality. This "bio-colonialism" will continue the pattern of a few transnational corporations profiting at the expense of genetic resources of the third world countries.

But biocolonist have their own defense; they argue that "Decoding the human genome will increase our knowledge a thousand fold times a thousand fold of the nature of Homo sapiens. And with that knowledge will come immense power. Before we create, we will almost certainly destroy, committing a new form of human selection, genomecide. Through systematic but simple foetel genetic tests in the next decade, we will ruthlessly search out and eradicate those human genes we regard as inferior,Certainly there will be great benefits a cure for AIDS malaria, maybe eventually nearly all of the disease that affect humanity. Genomics is the future of a whole new set of pharmaceutical industries that will create thousands of individually tailored drugs.

But the question is where to draw the line? Will one abort multi-celled fetuses because the tests show genes that code for Alzheimer's in later life? Would we now eradicate the former US President Ronald Reagan, whose Alzheimer's is genetically inherited, just after conception? What is the definition of an acceptable genetic human being? What is a valid human life?

Law and morality are inter-connected and some areas of law require the legal adjudicators to draw on morality in considering the decision making process. The patent law especially concerning the patenting of biotechnological inventions does just this. The best example of this would be Article 53 (a) of the European Patent Convention 1973, which does not allow the grant of patents “for inventions the publication or exploitation of which would be considered to be contrary to ‘ordre public or morality”. Most of the national patent laws of various countries embrace the moral standards within its ambit. When the legislatures enact patent laws, the moral standards of the community to which they belong to are one of the factors which affect their content. Moreover, the patenting system cannot be considered to be an ethically neutral concept. A system can be considered to be ethically neutral when it does not affect A’s interests vis-à-vis B’s interest. The whole crux of patents is to exclude others from access to information contained in the claims and hence it cannot be considered to be morally or ethically neutral. This act of excluding others to protect your interest will inevitably affect some one else’s rights in some way or the other.

Patenting within the biotechnological sphere and the subsequent opposition proceedings which have been undertaken by NGO's such as the Greenpeace, which have become worried by prospects such as the patenting of life, have led courts to highlight the relationship between patents and morality. However it has to be kept in mind that the concept of morality is relative to the values prevailing in society. The decisions based on morality should not be based on what some members of the public find objectionable, but should include a detailed analysis of the effect on human health, economic impact, environmental issues and opinion of the population as a whole. The main point, however is that non-patentability would only mean that the invention is not the subject of any property rights, it can still be used and worked even if it is contrary to public interest and morality as it still lies in the public domain[158].

## 18.7 Why say NO to Life patenting[159]?

The WTO has forced countries to introduce laws that allow the patenting of life forms and living organisms. In India, this was done through the Patents Act of 1970. Due to the introduction of such a monopolistic set up where biotechnological inventions can be patented, it has led to an epidemic of Biopiracy and the patenting of traditional knowledge.

The following are the other reasons which have been laid down to object life form patenting.

i. Farmers would be obliged to pay royalties on every generation of plants and livestock they buy and reproduce for production purposes.
ii. Breeders will no longer have free access to germ plasm for developing new varieties of plants and animals.
iii. Consumers will end up paying high prices for food, medicine and other biotechnological products.
iv. In the end, public research which is paid for by all will be privatized by a few.
v. Food supply will be threatened by monopolistic control over genetic resources.

[158] http://www.legalserviceindia.com/article/l254-Patenting-Recent-Biotechnological-Inventions.html
[159] ibid

vi. The concept of Human rights will be threatened as human beings, and parts of their bodies will become the exclusive property of the patent holders.

vii. Animal welfare will become a thing of the past as the patent system stimulates genetic engineering of animals for production of food and medicine no matter how they suffer.

viii. The main objection to the patenting of life forms are that DNA is a product of nature and not a product of human ingenuity.

## 18.8 Whether Patent Law Protects Biotechnological Inventions

*The relationship of law and morality is particularly foundt in the sphere of patent law.*

When Louis Pasteur in 1873 received US Patent 141,072, claiming 'yeast, free from organic germs of disease, as an article of manufacture', first patent concerning a micro-organism was granted.

In essence, the India Patents Act gives only very limited protection to research-based pharmaceutical companies. Patenting of human material in the form of gene sequences is considered to be wrong as it amounts to commercialization of life. Failure of the basic patent principles to cater to the needs of genetic inventions has given rise to ambiguities for companies concerned with bio-technology.

## 18.9 Factors determining the question of patentability

Protection of intellectual property is at the core of the business for biotechnology firms. When considering these issues, one also needs to recognize that legal regimes other than patent systems are typically relied upon to address other public interests, such as the environmental or medical safety of products, efficacy of products, and unfair competition that may occur in the assertion of patent rights. The transparency of the patent system supports ethical scrutiny of biotechnology and can help inform the bioethics debate.

Oliver Mills has suggested that in order to protect adequately biological invention, effectively harmonizing legislation regarding patentability criteria is necessary.

## 18.10 Dangers involved

Han Somsen has differentiated between pre-grant and post-grant concerns. He is of the view that pre-grant objections relate to subject-matter, requirements and disclosure whereas post-grant objections revolve around blocking effects of patents on research as well as health-care. Prof Gardner has put: "Our experience with animals suggests that there would be a very real danger of creating seriously handicapped individuals if anybody tries to implant cloned human embryos into the womb."

Biological inventions possess properties that pose unique challenges to the patent system. We always hear that morals or ethics are impeding bio-tech progress, but in reality these ethics have ensured a check whether small over biotechnological inventions. Patenting human genes amounts to a form of modern slavery since it involves the dismemberment of women and their piecemeal sale to commercial enterprises.

## 18.11 Benefits

Decoding human genome will be of great benefit to human race, a cure for AIDS or maybe eventually all of the diseases that afflict humanity can be wiped off. So we can say Genomic is the future of a whole new set of pharmaceutical industries that will create thousands of individually tailored drugs and consequently billions of dollars would be needed to invest in these complex researches. Where will this money come from? Obviously from the people, who will in turn benefit from this research. And regarding the high pricing of life saving technologies, it is it has observed that many of the pharmaceutical companies sell these drugs at a much lower rate than feared.

Defenders of such patents such as biotechnology firms, joined by some researchers in academia and the pharmaceutical industry argue fiercely that without patents society won't benefit from revelations about the molecular roots disease. Moreover the arguments that patenting DNA promotes the view that life is a commodity, cannot be accepted because it is not that the main aim of the DNA patenting to earn profit or to use it for someone personal interest, on the contrary the overall aim of the patent system is to promote the public interest and to provide a fair reward to inventors. The

patents system is said to be justified because it provides an important incentive for the development or new products and technologies related to healthcare.

### 18.12 Conclusion

1. A ban on patenting genome sequences would be both impractical and unrealistic and tighter rules are needed on the conditions under which such patents are granted.
2. The most commonly heard refrains from those critical of the private sector's control over biotechnology is that no patents should be granted on DNA sequences because such stretches of DNA are 'natural', and therefore cannot qualify as inventions (which is what the patent system was set up to protect).If the human genome - and all its contents - belongs to anyone, it should be commonly owned by all mankind. Staking claims to the sequences that make up individual genes, even if previously unknown is portrayed as the ultimate form of "biopiracy".
3. Unfortunately, perhaps, such a viewpoint appears somewhat utopian. We live in a world where society, through its patent laws, has already agreed that certain kinds of products can be patented. A likely candidate, for example, would be a gene sequence that forms an essential element of a novel diagnostic test for a disease.
4. But that does not mean that nothing can - or should - be done about DNA patents.
5. In future, a patent should only be granted on a gene if the social benefit likely to emerge from knowing the genetic code for that gene can be clearly defined. Patents on gene sequences should no longer cover all possible uses of that sequence, some of which may be unknown. In this regard it is submitted that patents must satisfy the condition of not being contrary to morality or 'ordre public' and suggest that patent offices should seek general ethical guidance, as necessary, from relevant bodies.

DNA patents should be the exception rather than the rule"."
It is not as simple as, 'Patents, good or bad?' or 'Licensing, good or bad? "The mission should be to make sure that all this research benefits people".

William Heseltine (President, Human Genome Science) has interestingly noted that trying to patent a human gene is like trying to patent a tree. You can patent a table that you build from a tree, but you cannot patent the tree itself.

By signing "Budapest Treaty on the International Recognition of the Deposit of Micro organisms for the Purposes of Patent Procedure", India can assist in the standardization process of biotechnology pate in the country. Since patent system cannot survive in a moral vacuum, so we must not let any conflict continue between bio-technology and patents regarding it.

## 19 Biotechnology-

### 19.1 Concept definition:

A combination of biology and technology. It is used to describe developments in the application of biological organisms for commercial and scientific purposes. So "bio" stands for biology and the science of life, and "tech" stands for technology, or the tools and techniques that the biotechnologists have in their workbox. Those tools and techniques include microorganisms and a range of methods for manipulating them, such as genetic engineering[160].

## 20. Genetic engineering

### 20.1 Concept definition:

1) The complex of techniques for the production of new genes and the alteration of the structure of the chromosomes to produce effects beneficial to man, in agriculture and medicine

2) The intentional production of new genes and alteration of genomes by the substitution or addition of new genetic material.

[160] It is a vast subject to be discussed on, but required to mention in research as DNA is part and parcel of the same and we cannot ignore this topic.:the scope has been narrowed down in websites Available at http://www.ndsu.edu/ndsu/academic/factsheets/ag/biotech.shtml and http://www.eco-business.com/business/algaetechinternational/and http://www.lycos.com/info/biotechnology--technology.html and http://education-portal.com/articles/Associate_of_Biotechnology_Degree_Overview.html(last Accessed on 25th October 2007)

## 20.2 Fundamentals of Genetic Engineering

Genetic engineering is the process of transferring specific genes from the chromosome of one organism and transplanting them into the chromosome of another organism in such a way that they become a reproductive part of the new organism. The process that produces the resulting recombinant DNA involves four steps:

i. The desired DNA is cleaved from the donating chromosome by the action of *restriction enzymes*, which recognize and cut specific nucleotide segments, leaving a "sticky end" on both ends. The restriction enzymes also splice the receiving chromosome in a complementary location, again leaving "sticky ends" to receive the desired DNA.

ii. The desired DNA fragment is inserted into a vector, usually a plasmid, for transfer to the receiving chromosome. Plasmids are an ideal vector because they replicate easily inside host bacteria and readily accept and transfer new genes. Plasmids are circular DNA molecules found in the cytoplasm of bacteria that bond with the desired DNA fragment with the help of the joining enzyme, *DNA ligase*, to create the resulting *recombinant DNA*.

iii. When the host cell reproduces, the plasmids inside also reproduce, making multiple clones of their DNA. Because the plasmid DNA contains the desired as well as unwanted DNA clones, the entire product is referred to as a *gene library*. The desired gene is similar to one book in that library.

iv. To recover the desired DNA, the current technology is to screen unwanted cells from the mixture and then use gel electrophoresis to separate the remaining genes by movement on an electric grid. Gel electrophoresis uses a positively charged grid to attract the negatively charged DNA fragments, thereby separating them by size, because the smaller ones will migrate the most. Radioactive or fluorescent probes are added, which attract and bind with the desired DNA to produce visible bands. Once isolated, the DNA is available for commercial use.

In 1973, researchers Cohen and Boyer created an interesting model for screening the host cells to finds the desired DNA fragment. In their experiment, they inserted the desired DNA and a DNA segment that made the host bacteria resistant to a particular antibiotic, tetracycline. When the antibiotic was applied to the general population,

only those bacteria that had received the plasmid survived—so they knew their desired DNA fragment was located in the surviving bacteria.

## 20.3 Current Recombinant Cloning Technology

Reverse transcriptase is an enzyme that acts opposite of normal transcriptase. It uses RNA to code for DNA. It is also found in the virus linked to AIDS.

A more advanced method of producing DNA clones uses the enzyme reverse transcriptase and mRNA in a four-step process, which creates a pure segment of desired genes:

1. mRNA is made by a selected cell particularly for its genetic characteristics.
2. mRNA splices out the interons.
3. mRNA is isolated and used as a template with reverse transcriptase to make the complementary DNA.
4. The DNA product therefore contains only the desired DNA segment and the host cell will continue to produce the product.

With this type of emerging technology, the “shotgun” approach to cloning is simplified by not copying the entire genome of the individual, but only the specific genes required

## 20.4 Human Disorders and Gene Therapy

Genetic disorders are the harmful effects on an individual caused by inherited genetic diseases or mutations. Usually genetic disorders are recessive, so they are only expressed in a small percentage of the population, but a much larger percentage are carriers. When expressed in the homozygous recessive individual, they often code for the wrong protein or amino acid sequence. There are many genetic disorders; however, two are common in today's population: hemophilia A and sickle-cell anemia.

Hemophilia A is a recessive sex-linked genetic disorder that is exhibited by approximately 1 in every 10,000 Caucasian males. Multiple genes code for the multistep process of blood clotting. Mutation in any one of them creates hemophilia

A, the inability to form blood clots. Individuals with this disease must avoid all cuts and bruises, both internal and external. In severe cases, the individual may lose massive amounts of blood.

Sickle-cell anemia is a recessive genetic disorder that affects 1 in every 500 African Americans. A mutation of an allele causes the allele to code for a sickle-shaped hemoglobin molecule. The defective hemoglobin molecules do not transport as much oxygen as the hemoglobin in normal red blood cells because they tend to rupture. They also sometimes wedge in a blood vessel, blocking the flow of blood cells. Tissues and organs downstream from the obstruction may suffer serious damage. Interestingly, sickle cells are a survival advantage in certain areas because they are a defense against malaria and may protect some people from the disease.

Although most genetic disorders cannot be treated because of technology limitations, certain ones such as phenylketonuria (PKU) can be treated if discovered in time. For instance, a baby with PKU is maintained on a low-phenylalanine diet to prevent mental retardation caused by its buildup.

Most humans inherit genetic disorders because of the improper functioning of a particular gene sequence. In theory, replacing the defective gene with a healthy one should solve the problem, which is the essence of gene therapy. Although in its infancy as a treatment for disorders such as hemophilia and sickle-cell anemia, patients have received genetically engineered cells as an experimental treatment for missing genes. At this time the data are incomplete regarding the results. Currently, researchers are attempting to engineer cells, usually from bone marrow, to enhance the abilities of immune cells to fight off cancer and resist infection by HIV. This approach may lead to an effective treatment for nonhereditary diseases.

## 21. Human Genome Project

The Human Genome Project (HGP) is the most exciting breakthrough in human genetics in modern times! Geneticists from around the world collaborated to determine the nucleotide sequence for the complete human genome. This genetic map gives the location of each of the approximately 100,000 human genes composed of roughly 3 billion nucleotides.

The immense value of this knowledge will provide new understanding of how all genes work, how they are regulated, and how and why they create biological molecules. The human genome can then be compared to other known animal genomes to examine similarities and differences that may be useful in the creation of new genetic recombinations. Some of the knowledge gained may allow gene replacement and other gene-therapy strategies. For instance, it is known that sharks never contract cancer. If there is a cancer-inhibiting gene in sharks that could be incorporated into humans with no side effects, another serious health concern could be avoided. The possibilities open genetic engineering as a profitable, socially beneficial enterprise in the near future. It is estimated that there are more than 3,000 human genetic disorders!

## 21.1 Legal and Ethical Considerations

Many challenges to the new technology need to be addressed so that the research and treatment may proceed without violation of public trust and confidence. Legal and ethical challenges can be classified into the following question categories:

- Who has the right to the cure?
- What will be the cost and availability?
- Do we have the right to alter a person's genes?
- Do we have the right to control the genetic complement of the human population and other eugenic considerations?
- Several scientific questions also pose additional considerations:
- The development of new genes combinations increases genetic diversity, which is normally considered a positive effect, but may have unintended, unforeseen consequences.
- Creating new genes may also create new pathogenic organisms for which we have no cure.
- Do we have the ability to safely handle new genetically altered organisms?
- Certain bacteria have already been utilized to clean up oil spills; are there other uses?

The use of *recombinant DNA* technology has become commonplace as new products from genetically altered plants, animals, and microbes have become available for

human use. In 1997, Dolly made headlines as the first successfully *cloned* large mammal (sheep). Since then there have been many similar advances in medicine, such as treatments for cancer; many advances in agriculture, such as transgenic insect-resistant crops; and many advances in animal husbandry, such as growth hormones and *transgenic* animals (an animal that has received recombinant DNA).

Most biotechnologists envision DNA technological applications as one of the new frontiers in science with tremendous growth and discovery potential.

# Chapter-V

## Legal Perspective of DNA Technology

## 1. Legislations in India

### 1.1 Constitution on India :

Following are the relevant articles of the Indian Constitution, which deals directly or indirectly with the use, and application of DNA technology

-Article 51-(a), (h), (j) Fundamental Duties

-Article-20 (3)

Article-21 Fundamental Rights Including Right to Privacy, Right To Information ,22,226 and 227

### (i) Article -51- Fundamental Duties

The Constitution of India, by Article 51A (h) and (j), declares that, it shall be the duty of every citizen of India "to develop the scientific temper, humanism and the spirit of inquiry and reform"; and "to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of Endeavour and achievement." The Parliament is legislatively competent to make laws with respect to the Union agencies and institutions for professional, vocational or technical training, promotion of special studies or research, or scientific or technical assistance in the investigation or detection of crime and with respect to coordination and determination of standards in institutions for higher education or research and scientific and technical institutions.[161] The constitutional provisions take care of the scientific developments that may take place and may be put to use for the benefit of the people. The Constitution provides efficient scales for balancing between public and private interests and the Courts have put to use its provisions for an effective social

[161] V.D. Mahajan,Entries 65 and 66 of the Union List in the Constitution of India, *Constitution of India*, 9th Edition (Entries 65 and 66 of the Union List).

engineering to protect both the cherished human rights recognized by the Constitution and the paramount public interest in a welfare State.

**(ii) Article 20(3):**

Articles 20(3) of the Indian Constitution provides that no person accused of any offence shall be compelled to be a witness against himself. Article 20(3) is based upon the presumption drawn by law that the accused person is innocent till proved guilty. It also protects the accused by shielding him from the possible torture during investigation in police custody. What Article 20(3) contemplates is forcing testimony thereby incriminating oneself in a crime. Therefore police cannot forcibly extract confession. The term witness in this clause means source of information thereby incriminating self. But precondition to this is some sort of force or coercion. One cannot take advantage of his own wrong. Using DNA Technology for detecting the culprit is in no way against this right. In reality it facilitates the advancement of Justice; anyhow it is different from confession provided that DNA test is carried under the supervision/guidance of Judiciary, which will ensure just, fair and reasonable procedure. In Raman Lal Bhogi Lal Shah Vs V.K. Guha [162], Supreme Court held that protection under Article 20(3) is only against the person being compelled to be a witness against himself. It doesn't mean that he need not give information of matters, which don't tend to in cremate him. The accusatorial system gives too much importance to the right of the accused. It doesn't care about law enforcement if the accused is innocent then why he is refuge under Article 20(3), when subjected to DNA test. In order to reach the right conclusion, one must see the right perspective.

**(iii) Article 21-Right to life**

Our Constitution being an organic document caters the need of organic man with its omnipresence in every part of our lives. Fundamental rights are incorporated with a view to foster development of man and to check state action in this field. Fundamental

[162] B.R.Sharma, "Forensic Science in criminal investigation and Trials", Universal Law Co. Forth Ed., 2003 Available at Http.// in.news.yahoo.com/USA/DNAacts.asp (Last Accessed on 2nd November 2007)

rights in themselves are not absolute, which is in consonance with jurisprudential ideology. So they cannot be stretched too far or else the legal system will be in problem.

Under the garb of Article 21, the accused cannot be helped to free him. The concept of predominance of the legal sprit as accepted by the general conscience of the common man and the intellect speaks that if there is a written law or even there if there is not written law, such law must provide for justice which is actually manifested in action and not only on paper. So to be in line with predominance of legal sprit, care must be taken not only of the interest of the accused but the interest of the victim and society at large. Therefore proper thought should be given while appreciating any form of evidence within the notion of predominance of legal sprit.

a. Drawing Blood and Legal Questions:

It goes without saying that a blood/DNA test can only be conducted if blood or DNA samples are taken. In case, blood/DNA samples are otherwise available, it has to be further proved that these truly belong to the donor or the person in question and further that these match with the specimen samples. Unless samples are taken for matching – comparison, a report cannot be obtained from an expert and the chances of comparison would not arise.[163]

What would be the position when any sample is not available and the person? Whose blood/DNA test is to be undertaken? Does not consent to give it? Whether a sample of blood for DNA test can be taken by force? What is the legal scene in developed countries? Is there any law in India regarding the taking of blood/DNA sample? Can such a sample be taken under compulsion or use of force? What are the shortcomings in this behalf? In the absence of a specific legislation, how a sample of blood of a minor/child or chronically ill patient can be taken? All and such similar questions are being considered by legal regime all around the world.

So far as DNA technology is concerned there is the conflict between two fundamental rights i.e. right to privacy and right to information. welfare of the state and public policy. Because due to absence of specific legislation on DNA technology the court

[163] Criminal Law Journal 2004

cannot compel a person to go for DNA or blood test because it amounts to breach of right to privacy, the courts can only direct the parties to the criminal case or civil suits to go for the same. but it in criminal case for the interest of the victim and welfare of then state as a part of public policy and to give justice to victim there arise the question of right to information from the concerned person who is suppose to disclose the relevant facts to establish the conclusive proofs during the judicial proceedings before the courts of law.

So when we think to introduce any legislation on DNA technology we will have to respect the constitutional rights and at the same time see to it that the justice must be delivered properly.

### 1.2 The Indian Evidence Act, 1872

Section 2,3,4,5,27,45,112,113,114,115,122

The Indian Evidence Act 1872 does not directly specify the use or applicability of DNA technology. But some of its sections take into consideration the use of the DNA technology as a matter of Evidence. The sections, which take in to consideration the use and application of DNA technology directly or indirectly, are as under

Section -9 deals with "Facts…which establish the identity of anything or person whose identity ids relevant ….are relevant in so far as they are necessary for that purpose"

Section -45 Deals with the expert evidence " When the court has to form an opinion upon a point of foreign law or science or art or as to identify the handwriting or finger impressions, the opinion upon point of that person specially skilled in such foreign law, science, or art in question… such persons are called experts"

Section -46-Fcts bearing the opinion of an expert

Section-51 deals with grounds of opinion,

Section 112-deals with the provision of the legitimacy of the child born. At the same time illegitimacy of the of a child if "no access" between husband ands wife is established.

Section114- Court may presume existence of certain facts -The Court may presume the existence of any fact which it thinks likely to have happened, regard being had to the common course of natural events, human conduct and public and private business, in their relation to the facts of the particular case.

**a) Evidence of Expert**

Application of DNA testing is now well established in developing countries. In India in several cases the judgement has been given either based on the result of DNA testing alone or with other corroborative evidence, although many courts in India have accepted DNA test. It has not been included in Indian Evidence Act. It is therefore left to the discretion of the judges whether the DNA test under section 45 of the Indian Evidence Act to be accepted or not.[164]

The first paternity dispute in India[165], which solved by DNA fingerprinting test, was the case No. M.C. 1 f 1988 in the Court of the Chief Judicial Magistrate of Telicherry (*Thalassery).* The Chief Judicial Magistrate held that: The Evidence of Expert is admissible under Section 45 of the Indian Evidence Act, 1972. So also, the grounds on which the opinion is arrived at are also relevant under S.51 of the Indian Evidence Act, PW 4 is an expert in the matter of molecular biology and the evidence tendered by him is quite convincing and I have no reason why it should not be accepted. Just like the opinion of a chemical analyst, or like the opinion of a fingerprint expert, opinion of PW4, who is also expert in the matter of cellular and molecular biology, is also acceptable."This verdict was challenged the High Court but the High Court upheld the verdict of the Telicherry Court stating that the results of DNA test by itself could be deciding paternity.

[164] DNA identification Act which allowed DNA Data bank to be created and amended the Criminal code to provide a mechanism for the judge to order persons convicted of designated offences to provide blood , buckle or hair samples from which DNA profile will be derived.- has been passed in Canada Britain has Criminal Justice Act provides for forcible testing of blood testing.

[165] Pandit, M. w. and Dr. Lalji Singh "DNA testing Evidence Act and Expert witness" *Indian Police Journal* December 2000

**b) Evidentiary Aspects of DNA and Cases relating to Paternity Disputes: -**

In India DNA fingerprinting and analysis has been widely used in paternity cases.[166] In this section of the project, several interesting issues will be dealt with. Prominent among these is the effect of the new developments in forensic in the form of DNA profiling/fingerprinting and the case for an amendment to S.112 of the Indian Evidence Act dealing with conclusive proof in paternity cases. The other major issue with respect to paternity cases, on which there is much conflicting case, law deals with whether the Courts can direct one of the parties to give a sample of DNA and the effect of refusal to undergo a DNA test. This has obvious constitutional implications.

**Section 112 and DNA Evidence**

Section 112 of the Indian Evidence Act deals with the proof of legitimacy of offspring if they are born during wedlock or within a certain period of the dissolution of marriage. In many ways it is a unique section. On the one hand it establishes the fact of marriage as conclusive proof of the legitimacy of the children and at the same time mentions that the conclusive proof of legitimacy (i.e. marriage) can be avoided if the parties could not have begotten the child as the spouses had no access to each other.[167] The obvious purpose behind such a section would be to prevent the unnecessary bastardization of illegitimate children and the condemning of their mothers and unchaste. However, with the advent of DNA fingerprinting analysis some problems have arisen. The problem that is being referred to came up for consideration by the Supreme Court in case of Kamti Devi v. Poshi Ram.[168]. In the facts of this case the respondent was the husband of the appellant. Fifteen years after marriage the appellant gave birth to a child. The respondent filed a civil suit for declaration that he was not the father of the said child. Though the issue was not directly in issue in the instant case, the Supreme Court opined that even a DNA test that indicated that the respondent was not the father of the child would not be enough to rebut the

[166] Arukumar v. Turaka Kondalal Rao, 1998 Cri.L. J.4279 Where a single locus probe RFLP AND STR analysis was carried out to prove the paternity of the child

[167] Sec- 112 0f Indian Evidence Act – Birth during Marriage. Conclusive Proof of Legitimacy:" The fact that any person born during the continuance of the valid marriage between his mother and any man, within two hundred and eighty days after his dissolution, the mother remaining unmarried, shall be conclusive proof that he is the legitimate son of that man, in AIR 2001 SC 2226 it can be shown, that the parties to the marriage had no access to each other at any time when he could be begotten. '

[168] ibid

conclusiveness of the marriage as proof of legitimacy of the child. The Court held that the only way of rebutting the conclusive proof provision would be to adduce evidence of non-access.

In light of the fact that S. 112 was drafted at a time when even the discovery of DNA had not been contemplated, the section should be amended. What would be ideal is that another outlet apart from proof of non-access be provided in the form of evidence of a DNA test to rebut the conclusive proof provision in S.112. The Bombay High Court has also lamented the absurdity of having only proof of non-access when DNA evidence can decide the matter in a more scientific manner.[169]

The *raison deter* under the Evidence Act is against the legitimization of a child and is based on public policy and that a child should not suffer on account of lapses of parents. It is also the normative legislative intention that when certain fact is considered as conclusive proof of another fact, the judiciary generally disables the party in disrupting in such proof. The only exception provided in Indian Evidence Act is in the form of an outlet to a party, who wants to escape from the rigor of that conclusiveness. In such cases, it's the DNA test, which helps the Courts to decide on the contentious issue, based on aspect of conclusiveness[170]

Many a time's questions have been raised before the Courts in cases of DNA fingerprinting, creating a hindrance to the investigating agencies, and they are: whether a suspect, or for that matter anybody can be forced to give a blood sample for testing? And whether such a testing would be considered a violation of Article 20(3) of the Constitution of India, which protects every citizen from providing self-incriminating evidence? And whether an order forcing an individual for DNA testing would be violation of his right to privacy? And if the person refuses to submit

[169] Sadashiv Mallikarjun Khedarkar v. Nandini Sadashiv Khedarkar, 1995 Cri. L. J. 4090(Bom) at 4093 R.J. Vidyanath J.Observed as under -'There may be instances where the husband and wife are living together and the wife may have gone astray and then delivered a child through illicit connection. But in the view of legal presumption under sec-112 of Indian Evidence Act the husband cannot be allowed to prove that the child is not born to him since husband and wife are living together, even if it is proved that wife had some illicit relationship with another person. What should be done in such a case is a question death has cropped up in my mind … but if we go by rigor or presumption under Sec-112 of the Evidence Act no husband can be permitted to prove that the child born to the wife is not his, if the husband and wife ere together even if wife is proved to be living in adultery.

[170] Gautam Kundu Vs State of West Bengal.26

himself/herself to such test whether adverse the Court can draw inference or presumption?

Justice Jagganatha Rao, Chief Justice of the Kerala High court pointed the lacunae in this regard in 1995 in a verdict of the paternity dispute, Justice Rao pointed out in his judgments two facts:[171]

(i) DNA testing is as yet not considered a conclusive proof under Section 112 of the Evidence Act, and

(ii) Law has not been passed by the Parliament for such testing.

Section 112 uses the words, "conclusive proof and refers to non-access as the sole exception. Therefore, as the language of the section stands, no other evidence is permissible except non-access, to prove that a person is not the father. This was held in several decided cases and also recently by the Supreme Court in Kanti Devi v. Poshi Ram.[172] That case concerned DNA evidence but the Supreme Court refused to permit the evidence on the ground that except non-access no other evidence is permissible to prove that a person is not the father. Judgment of the Supreme Court in 1993 also highlighted the fact that there is no provision in Indian laws to force or compel people to undergo blood tests or any other type of DNA testing

Bombay High Court in the case of Sadashiv Malikarjun Kheradkar v. Smt. Nandini Sadashiv Kheradkar, [173], it was held that the Court has power to direct blood examination but it should not be done as a matter of course or to have a roving inquiry. The Bombay High court even felt that there should be a suitable amendment by the Legislature and after nothing that no body can be compelled to give blood sample, it was held that the Court can give a direction but cannot compel giving of blood sample.

In a recent case of Mrs. Kanchan Bedi v. Shri Gurpreet Singh Bedi[174], where the parentage of the infant was in question, and the application filed by the mother for

[171]Though the Indian Evidence Act Proposed Bill 20o3 apart from the sole exception of 'non- access" other exceptions by way of blood-group[p tests, but subject to very stringent conditions.
[172] AIR 2001 SC 2266: 2001 Cri LJ 2615.
[173] 1995 Cri LJ 4090
[174] AIR 2003 Delhi 446

conducting DNA the father contending that it would violate his rights vehemently opposed test. Hon'bleVikramjit Sen, J. held that: "it-appears to me to be difficult to resist that the law, as it presently stands, does not contemplate any impediment or violation of rights in directing persons to submit themselves for DNA test, especially where the parentage of a child is in controversy for the grant of maintenance. It was further held that where the parentage of a child is I controversy for the grant of maintenance, parties submitting themselves for the DNA test is not violation of rights. He relied on the decision of the Hon'ble Supreme Court in the case of Geeta Daha v. NCT of Delhi (DB), [175], where a Division Bench of Hon'ble Supreme Court had ordered that a DNA test be conducted on a fetus of a rape victim. Hon'ble Vikramjit Sen. J. distinguished this case from the case of Goutam Kundu v. State of West Bengal,[176], where it was held that "wife cannot be forced to give blood sample and no adverse inference against her for this refusal". In M/s. X v. Mr. Z, [177], a single Judge of Delhi High Court had allowed a similar application and had directed that at the cost of husband, the Pathology Department of All India Institute of Medical Sciences should conduct the DNA test. The DNA test was to be conducted of a fetus.

### c) Direction to Give Sample and Adverse Inferences

*(Nemo Tenetur Scipsum Accusare- No Man Can Be Condemned To Criminate Himself)*

In a very important and recent judgment Delivered by the Hon'ble Supreme court of India in the case of Sharda v. Dharampal, [178]where the core question was, whether a party to a divorce proceeding can be compelled to a medical examination. In this case the Respondent on the ground that such an order violates his right to privacy opposed an order for DNA test. The three Judge Bench of the Hon'ble Supreme court held that: "If for arriving at the satisfaction of the Court and to protect the right of a party to the lies who may otherwise be found to be incapable of protecting his own interest, the court passes an appropriate order, the question of such action being volatile of Art. 21 of the Constitution of India would not arise. The court having regard to Art, 21 of the Constitution of India must also see to it that the right of a person to defend himself

[175] 1997(1) JCC 101
[176] 1993 Cri LJ 3233: AIR 1993 SC 2295
[177] AIR 2002 Delhi 217
[178] 2003 AIR SVW 1950: AIR 2003 SC 3450

must be adequately protected." It further held that if respondent avoids such medical examination on the ground that it violates his/her right to privacy or for a matter right to personal liberty as enshrined under Art. 21 of the constitution of India, then it may in most of such cases become impossible to arrive at a conclusion. It was also said that if despite an order passed by the Court, a person refuses to submit himself to such medical examination, a strong case for drawing an adverse inference would be made out. Section 114 of the Indian Evidence Act enables a Court to draw an adverse inference if the party does not produce the relevant evidences in his power and possession.

Some controversial issues have also arisen with respect to whether a person can be compelled to give DNA samples as evidence. These problems have arisen particularly with reference to the dictum of the Supreme Court in Goutam Kundu v. State of West Bengal[179]. The interpretation of this case and others has led to some conflicting decisions in the High Courts.

In Syed Mohammad Ghouse v. Noorunnissa Begum[180], the Andhra Pradesh High Court held that the respondent in this case was under no compulsion to submit to a DNA test. The order of the family Court directing the DNA test was set aside and the Court relied on Kundu's case [181] In Goutam Kundu v. State of West Bengal the Supreme Court had made the following observations with respect to directions to give a blood test:

1. "That Court in India cannot order blood test as a matter of course."
2. "Wherever applications are made for such prayers in order to have roving inquiry the prayer for blood test cannot be entertained."
3. "There must be a strong prima facie case in that the husband must establish non-access in order to dispel the presumption arising under Section 112 of the Evidence Act."
4. "The Court must carefully examine as to what would be the consequence of ordering the blood test: whether it will have the effect of branding a child as a bastard and the mother as an unchaste woman."
5. "No one can be compelled to give sample of blood for analysis."

[179] 1993 Cri LJ 3233: AIR 1993 SC 2295
[180] 2001 Cri LJ 2028
[181] 1993 Cri LJ 3233: AIR 1993 SC 2295

However there have been several High Court cases that have distinguished Kundu's case while dealing with cases of DNA testing and paternity. In Kanchan Bedi v. Gurpreet Singh Bedi [182]the defendant denied that any marriage had taken place between him and the plaintiff, and therefore he was not the father of the child. A DNA test was demanded to determine the paternity of the child and the direction of the Court with respect to the DNA test was challenged. Kundu's case was distinguished on facts[183] and on the ground that the future of a minor infant was in question and the Court's parens patriae jurisdiction had been invoked in this regard.

Again, in Sajeera v. P.K. Sahm[184] a direction to undergo a DNA test was given. However in this case it was already admitted by the mother that the child was born out of wedlock and there had been an illicit relationship. Moreover the Respondent had expressed willingness to undergo the test at the petitioner's cost and there was no question of compulsion.

Another related issue is of the refusal to undergo a DNA test in paternity cases. It has been held by the Supreme Court that refusal to undergo a paternity (DNA) test would bar a party from challenging the paternity of the child. Dwarika Prasad Satpathy v. Bidyut Prava Dixit.[185]. This decision of the Supreme Court has been followed in the case of K. Selvaraj v. P. Jayakumari [186]and it was also stated that an adverse inference can be drawn if the party refuses to undergo a DNA test. The point of adverse inference is also referred to in another case Sadashiv Mallikarjun Kheradkar v. Nandini Sadashiv Mallikarjun Kheradkar [187]This seems to be a preferable interpretation and strikes a balance between the two extremes. The Court does not have the power to direct the giving of a sample, but if it is not given the Court may draw an adverse inference.

---

[182] 2003 (103) Delhi LT 165

[183]The difference being that in the facts of Kundu's case the marriage of the spouses was admitted in the possible reason for the decision was that the legitimacy of the child was presumed and the subjection of the wife to a test was an attempt to "outrage her modesty".

[184] 2000 Cri L J 1208 (Ker). No question of compulsion arises in the case of preserved fetus and direction to conduct paternity test can be made- Alika Khosla v. Thomas Mathew, Manu/DE/1842/2001.

[185] 2000 Cri LJ 4748 (Kerala), 2000 Cri LJ 1 : AIR 1999 SC 3348

[186] 2000 Cri 1995, Cri LJ 4090 (Bom).

[187] 1995 Cri LJ 4090 (Bom).

An ordinary finger print (thump impression) is a reliable technique in crime detection but DNA finger printing is much more reliable, because ordinary finger prints are not always available in the crime scene, as shrewd criminals commit crimes by using hand gloves.

Every person has a unique and distinct DNA Characteristics and it will not match with any other person.[188]

By employing the basic structure of DNA finger printing many complicated legal problems have been solved.

### 1.3 Criminal Procedure Code, 1973

Section 125, 53, 54,295(4), 156,174,482

(i) Section 125- Maintenance of children both illegitimate legitimate, parents and wife125 (2) (C) maintenance of illegitimate child, section125 (5) no, maintenance to adulterous wife. When it is proved through DNA test that parties civil suit are parents of the child, or if blood relation is established between the child and the accused person for the purpose of this section then the child (i9rrespective of legitimacy) and his mother becomes entitled to get maintainance from that person.

Following are some other provisions of the Criminal Procedure Code which can establish the relationship with application of DNA Technology in one or other way in case of commission of heinous crime such as murder, homicide, infanticide, abetment to commit suicide, sexual offences and all. Where after the examination of the things collected from the crime scene and matching the same with the accused persons DNA, it become easy for investigation agencies and court to reach to the conclusion that who committed the crime.

(ii) Section53- Examination of an accused by medical practitioner at the request of police officer

(iii) Section-53 An Examination of a person accused of rape by medical practitioner-

[188] The Unreported Judgments (Journal Section) Volume 2005 (2). Article by Dr.Durga Pada Das

(iv) Section 54- Examination of the arrested person by medical practitioner at the request of arrested person

With predominance of legal sprit in mind, Justice Malimath Committee recommended that DNA expert being included in the list of experts under Section 295(4) of Code of Criminal Procedure, 1973. Section 54 of Cr.P.C. provides for medical examination of the accused in case if there are any injuries on his person. In Ananth Kumar Vs Andhra Pradesh the expression 'examination of the person' includes physical examination, medical test of blood, Semen, sputum, urine etc. Thus under these provisions DNA Test can be done by medical practitioner. In D.J Vaghela Vs Kantibai Jethabai the High Court held that obtaining of blood, semen, saliva, urine etc; under Section 53 of Cr.P.C, is not volatile of Article 20(3) of the Constitution which permits protection against self incrimation under Sections 156 &174 of Cr.P.C. Predominance of legal spirit demanded that the court must be empowered to order for DNA testing (medical examination), so as to facilitate justice.

Thus, Justice MalimathCommittee Report also recommended for amendment of Section 482 of Cr.P.C, 1973, in the following words:

*"Every Court shall have inherent power to make such order as may be necessary to discover truth or to give effective order under this Code or to prevent abuse of the process of the Court or otherwise to secure the ends of the justice"* By using this provision the court will be better equipped with more powers of investigation like the Courts of inquisitorial system. DNA testing can also be carried out with the help of this provision. Section 313 of Cr.P.C, must be amended so as to draw adverse inference against the accused, if he fails to answer any relevant material against him. Therefore, DNA evidence can be used against the accused in light of this provision.

### 1.4 Code Of Civil Procedure, 1908 (section 151, Order XXXII r-15, Order XXXVI Rule -10-A)

Section 151 of Code of Civil Procedure saves the inherent power of the Courts to investigate up to any extent as may be necessary for the ends of justice ought to prevent abuse of the process of the court. So, DNA test can be conducted and necessary directions can be given by the use of the inherent powers of the court in

cases related to Succession and inheritance. As there is no direct law or legislation in India authorising Courts to direct the parties to the civil case to go for blood test or to under go DNA test, as it clashes with Constitutional provisions such as right to life, privacy, against self incrimination etc. in India.. So the give provision can be applied as an exception to the rule.

## 1.5 The Indian Penal Code 1860

Following are the important sections of Indian Penal Code[189]

Where there is a direct or indirect indication of the use of the DNA technology: these all relevant section are used in chapter 2 and 3 of the thesis under the title "Use of DNA Technology in administration of criminal justice system."

(i) The offences affecting the human body

Section-299 culpable homicide

Section-300 Murder

Section301- culpable homicide by causing death of a person other then the person whose death was interned

Section-304-A-Causing Death By Negligence

Section 304-B- Dowry death

Section-306- Abetment of suicide

Section312 Causing miscarriage

Section-313 to 315—causing miscarriage, injuries to unborn child, exposure of infant's concealment of birth of baby

[189] The above mentioned sections have already been discussed in chapter IV and VI of the research work with the description of case laws and supreme court-high courts judgments held in India.

(ii) Sexual offences

Section 375 Rape

Section 376 –A intercourse of man within wife during separation

Section 376-B Intercourse By A Public Servant With A Women In Custody

*Section -376 C- Intercourse By Superintendent Of Jail, Remand Home-*

Section376-D By Management Staff Of Hospital

(iii) Offences against marriage-

Section-497- Adultery

### 1.6 Identification of Prisoner's Act, 1920

The Justice Mallimath Committee has recommended for amending Section 4 of Identification of Prisoner's Act, 1920 on lines of Sec.27 of Prevention of Terrorism Act, 2002 (POTA)[190].

Sec.27 of POTA provided that the police officer while investigating any case can request the Court of CJM or the Court of CMM, as the case may be, in writing for obtaining samples of handwriting, fingerprints, blood, saliva etc. from any accused person. If these recommendations are implemented, it will be possible for the investigating agencies to go for DNA testing in identifying the culprit.

### 1.7 Transplantation of the human Organs Act 1994

It has recognized the status of gene test. Under this Act, to establish the identity of the nearer relation ship of donor and recipient, two-multi locus gene test is required in case of doubt. In this case use of DNA technology becomes helpful to curb the criminal malpractice of transplanting human organ without his knowledge, consent

[190] POTA was in force for certain duration and now it has been replaced with National Secuities Act 1980.

and with ignorance done by the medical practitioner by providing forensic evidential proofs of the same.

### 1.8 Patent Laws

Patent claims may assert rights over DNA in various ways, for example, they may claim one or more of the following.

- The DNA sequence, whether comprising a complete or partial gene promoters' enhancers
- Individualexons
- Expressed sequences as expressed sequence tags (*ESTs*) or *cDNAs* whole transcribed genes as cDNAs
- Individual mutations known to cause disease
- Variation between people not associated with disease (polymorphisms)
- Cloning vectors, formed from bacterial DNA, which are used to express
- Proteins in replicated DNA sequences
- Nucleic acid probes, which are fragments of DNA that are used to locate particular parts of DNA sequences
- Methods of identifying the existence of a DNA sequence or a mutation or deletion in an individual
- Testing kits for detecting genetic mutations
- Whole genomes

In the Doctrinal work, referring to the case of Diamond v. Chakraboarty, it was observed that, perhaps the most well known example of a living organism, which was granted a patent, is the genetically engineered bacterium that was the subject of litigation in that case. The Supreme Court allowed the grant of the patent to stand, US Chief Justice Burger famously remarking that in principle `anything under the sun that is made by man is eligible for patenting'. Other living organisms that have been patented include yeasts, viruses, and cell lines[191].

[191] See The Ethics of Patenting DNA, Discussion Paper by Nuffield Council on Bioethics-2002, para 3.12,Available at www.legalservicesindia.com/articles/dna.htm and

European patent law relating to naturally occurring phenomena and living organisms have evolved along similar lines. The 1998 EC Directive on the Legal Protection of Biotechnological Inventions (98/44/EC) states in Article 3 that: for the purposes of this Directive, inventions which are new, which involve an inventive step and which are susceptible of industrial application shall be patentable even if they concern a product consisting of or containing biological material or a process by means of which biological material is produced, processed or used. Biological material, which is isolated from its natural environment or produced by means of a technical process, may be the subject of an invention even if it previously occurred in nature.

Article 5 of the EC Directives states that, an element isolated from the human body or produced through a technical process, including the sequence or partial sequence of a gene, may be patented even where that element's structure is identical to that of a natural element. It can therefore be seen that in both the US and Europe, DNA sequences are regarded by the law, in principle, as being eligible for patenting once they have been isolated from their natural environment. However, to be granted a patent, they must meet the legal criteria of being novel, inventive and having utility or being capable of industrial application. The question whether DNA sequences are eligible for patenting is distinct from the question whether they meet these legal criteria.

Under the Patents Act, 1970, which is applicable in India "Invention" as defined in section 2(1) (j) means, any new and useful – (i) art, process, method or manner of manufacture, (ii) machine, apparatus or other article, (iii) substance produced by manufacture. Amongst the inventions which are not patentable are an invention the primary or intended use of which would be contrary to law or morality or injurious to public health; the mere discovery of a scientific principle or formulation of an abstract theory; the mere discovery of any new property or new use for a known substance or of the mere use of a known process, machine or apparatus unless such known process results in a new product or employs at least one new reactant; a substance obtained by a mere admixture resulting only in the aggregation of the properties of the components thereof or a process for producing such substance; any process for the

medicinal, surgical, curative, prophylactic or other treatment of human beings or any process for a similar treatment of animals or plants to render them free of disease or to increase their economic value or that of their products[192].

Section 5(1) of the Act, inter alia, provides that, in the case of inventions claiming substances intended for use, or capable of being used, as food or medicine or drug no patent should be granted in respect of claims for substances themselves, but claims for the methods or process of manufacture shall be patentable. However, a claim for patent of an invention for a substance itself intended for use, or capable of being used, as medicine or drug may be made, if it falls within sub-section (2) of section 5.

Section 6. Persons claiming to be the true and first inventor of the invention are entitled to apply for patents under this section.

To fulfill the requirement of novelty, an invention must not have been previously disclosed to the public. Individual genes in their natural state are not directly accessible and additional work is required to isolate them. The question is whether this is enough to allow the conclusion that the isolation of a gene actually deserves of recognition in the form of patent protection. The requirement for inventiveness means that applicants must be able to demonstrate that, when compared with what is already known, the claimed invention would not be obvious to the skilled person'- an ordinary worker with a good knowledge and experience of the subject.

There has been considerable debate about whether isolated DNA sequences, as they are used in diagnostic tests, medicines or as research tools, are inventive and known as obvious to the skilled worker. The Nuffield Council on Bioethics in Ethics in its Discussion Paper "Ethics of Patenting" has drawn an important distinction between the acquisition of knowledge about the nature and function of a DNA sequence, and the information contained within that sequence, in the following terms:

"Even though we think that the judgment that isolated DNA sequences are eligible for patenting is based on a questionable extrapolation to the case of genetic information from the case of the isolation of chemical compounds, we accept that a limited number of the early patents granted on that basis need not now be called in question,

[192] See clauses (b), (c), (d), (e) & (i) of Section 3 of the Patents Act, 1970

in view of the inventiveness required to isolate the DNA sequences. Since the early days of the pioneering experiments using positional cloning techniques, patents have been filed on many DNA sequences, which were mass-produced by a mixture of computational and cloning techniques. Even if it can be convincingly argued that these sequences were eligible for patenting, the patents should be examined in the light of the criteria for inventiveness and utility. We note that as techniques have advanced, and in particular as the use of computers to identify genes has become more widespread, the eligibility of DNA sequences for patenting should have diminished."

With regard to the legal criteria for assessing patents with claims to DNA sequences, it was said: "While we accept that the test of novelty can be met, the tests of inventiveness and utility are more problematic. In the case of inventiveness, we hold that as the use of computational databases becomes the standard way of identifying genes, it is difficult to see how the test can be met, despite current US practice. In the case of utility, we argue that the standard of credibility required for a claimed utility needs to be set higher than the mere theoretical possibility of this utility; some positive evidence that the DNA sequence has the claimed utility should be required. Finally, we consider the requirement that patents should satisfy the condition of not being contrary to morality or `order public', and suggest that patent, offices should seek general ethical guidance, as necessary, from relevant bodies."

The Discussion Paper of the Nuffield Council suggested a number of ways in which the patent system should be modified for the future and made several recommendations aimed at ameliorating the deleterious effects of patents that have already been granted. Some of these are:

(a) Exclusive rights awarded for a limited period are, in the main, defensible and that the patent system has in general worked to the benefit of people. Nonetheless, in the particular case of patents that assert property rights over DNA, consideration should be given to whether the balance between public and private interests has been fairly struck.

(b) The rights asserted over DNA sequences that have been identified and characterized only by in silico analysis of the DNA sequence and comparisons with

other identified sequences should not be allowed, on the grounds of lack of inventiveness. The granting of patents that assert rights over DNA sequences should become an exception rather than norm.

(c) The criteria already in place within existing patent systems for the granting of patents, particularly the criterion of inventiveness, be stringently applied to applications for product patents which assert, inter alia, rights over DNA sequences for use in diagnosis. The European Patent Office (EPO), the United States Patent and the Trade Mark Officer (USPTO) and Japan Patent Office (JPO) should together examine ways in which this may be achieved. The USPTO and US lawmakers should give consideration to whether patent laws need to be amended for this purpose.

(d) The protection by "use patents" of specific diagnostic tests, which are based on DNA sequences, could provide an effective means of rewarding the inventor while providing an incentive for others to develop alternative tests

(e) In specific cases in which the. Enjoyment of exclusive rights to the diagnostic use of DNA sequence is not in the public interest, those seeking to use the diagnostic tool or develop an alternative, should seek a compulsory license from the relevant authorities if they are refused a license from the owner of those rights on reasonable terms, and the authorities may grant such license

(f) Granting of patents which assert rights over DNA sequences as research tools should be discouraged. The Council welcomed recent Utility Guidelines for DNA sequences introduced by the USPTO, which have, in effect, been endorsed by the EPO. The Council expected if these recommendations which included review of the guidelines and strengthening them to achieve their purpose was implemented, the result would be that patents which assert rights over DNA sequences for use in research will become the rare exception rather than the norm.

(g) When rights are asserted in terms intended to cover all sequences that contained EST (a research tool whereby the coding parts of genes could be rapidly sequenced), that is the subject of the original patent, no patent should be granted.

(h) The public institutions which already have been awarded patents that assert rights over DNA sequences as research tools be strongly encouraged not to license them exclusively to one or a limited number of licensees, even when, by not doing so, they may suffer some loss of revenue in the short term. Whenever possible, the private sector should

(i) Research exemption' be given a statutory basis in the US and clarified in Europe by policy-makers as a matter of urgency.

(j) Once a gene associated with a disease is identified, the use of the relevant DNA sequences in gene replacement therapy, to alleviate the effects of mutations in that gene, is obvious (particularly when such use is claimed on a purely speculative basis). Therefore, protection by product patents should seldom be permissible. Patent protection should be concentrated on developing safe and effective methods of appropriate gene delivery.

(k) While rights asserted over DNA sequences, which are used to make new medicines based on therapeutic proteins, are generally acceptable, they should be narrowly defined. This means the rights to the DNA sequence should extend only to the protein described.

The USPTO, EPO, JPO and other relevant bodies should give consideration to the concept of limiting the scope of product patents that assert rights over naturally-occurring DNA sequences to the uses referred to in the patent claims, where the grounds for inventiveness concern the use of the sequence only, and not the derivation or elucidation of the sequence itself[193].

### 1.9 Indian Succession Act, 1925

As per succession law, property right goes to a person who can prove the privy in blood, privy in estate and privy in relations. For this there must be a blood relation between the ancestors or parents denying property right-succession right and the so called heir claiming the property right. DNA Test is on of the best option or the only solution to establish or deny the blood relations. But there is absence of such relevant

[193] Ibid 192

provisions in succession act or relevant procedural laws. again here court can direct and cannot compel the parties to under go DNA test or blood test.

### 1.10 Family Laws in General:

Family Laws such as Hindu Laws, Mohammedan laws (Hindu Succession Act, 1956, Guardians and Wards Act, 1890, Hindu Marriage Act, 1955 and Family courts Act, 1984) and other laws as far as the disputes of marriage, paternity and maternity, Adoption and a maintenance guardianship are concerned, to resolve such type of disputes it is indispensable to go for DNA test. But absence of specific provisions restricts the flexibility of such laws.

### 1.11 Medical Termination of Pregnancy Act 1971 (Amd) 2004

Section- 3: "when pregnancies may be terminated by registered practitioners."

When a pregnancy is alleged by the pregnant women to have been caused by rape. This section goes hand in hand with section 376 of Indian Penal Code. Where by conducting DNA test on the fetus the criminal can be send behind bar if allegation is proved by expert opinion.

## 2. DNA Legislations in Other Countries / DNA Technology in Different Countries (An Overview)

### 2.1 Laws In New Zealand

New Zealand first raised the issue of DNA testing in 1978 when the New Zealand Criminal Law Reform Committee published a Report on Bodily Examination and Samples as a Means of Identification. At that time, the recommendation of testing criminal suspects was met with heavy resistance. During the next several years, the controversial report all but disappeared from the public's conscience. In the late 1980s, however, a private bill was introduced that proposed many of the same recommendations After remaining dormant for a few years, New Zealand's Minister of Justice announced government support for DNA testing and a national DNA databank..

The Criminal Investigations (Blood Samples) Act was passed in 1995 and went into affect in 1996. Under the Act, DNA samples from persons convicted of certain offenses, volunteers, and suspects are included in a national databank. Over 11,000 samples have been entered in the databank since its inception, and officials estimate that approximately three hundred samples are added each month. Starting in 1998 the databank began to search for comparisons between the individual samples and unsolved crime scene samples. Currently, approximately thirty percent of the crime scene samples match an individual sample present on the database. In addition, about twenty percent of the unsolved crimes match samples from other crimes on the database.

Despite the obvious success of the New Zealand databank, some groups still are concerned about the privacy issues implicated. While the Act was still under consideration, New Zealand's Privacy Commissioner expressed concern over some of the legislation's provisions. While noting the presence of certain safeguards, the Commissioner objected to the inclusion of voluntary samples of innocent people. He stated in a report regarding the proposed legislation that only samples from those convicted of serious offenses should be entered into the databank He supported his contention by arguing that certain convicted felons pose a greater risk to society as potential recidivists, while no similar justification exists for the inclusion of voluntary samples of innocent people. Likewise, the Auckland Council for Civil Liberties worries that DNA data banking creates a slippery slope of state surveillance that infringes the public's privacy rights. The general concern is that as society becomes more accepting of DNA sampling, police will continue to expand the DNA databank until it includes a large, if not complete, portion of society.

To harness the power of DNA test New Zealand enacted Criminal Investigation (Bodily Sample) Act[194].

[194] See, Allison Puri , "An International DNA Database: Balancing Hope, Privacy, And Scientific Error", Available at http://www.bc.edu/bc_org/avp/law/lwsch/journals/bciclr/24_2/05_TXT.htm (Last accessed on 25th November 2007)

## 2.2 Laws in China[195]

Ever since the 1997 rape and murder of Democratic Progressive Party official Peng Wan-ju, sex crimes have become a central issue for the public in China According to an analysis conducted by sociologists, approximately 10,000 sexual assaults are reported each year in Taiwan. In 1995, 624 people were prosecuted for sex crimes but only 216 were convicted. Sociologists claim that the low conviction rate is due to the difficulty of gathering appropriate evidence in such cases. Given these troubling statistics, China was ripe to pass a law in early 1999 that allows the Ministry of Justice and the Ministry of the Interior to establish a DNA databank.

Under the law, convicted and suspected sex offenders would be asked to provide voluntary blood samples. If they refuse, a prosecutor may force them to provide samples via a subpoena. The legislation allows the DNA samples to be kept for at least ten years In addition, written and photographic documentation of the DNA records may be retained until ten years after the death of the person who provided the sample. A similar proposal in southern China that would allow the formation of a DNA database, however, has encountered more resistance. Under the proposal, people suspected of committing crimes with a jail term of five or more years would be required to submit a non intimate sample. The database also would include samples from criminals convicted of serious offenses In addition; the draft law allows people to volunteer to submit a DNA sample to eliminate themselves from suspicion for specific crimes.

Limitation of draft: Proponents of the law argue that the draft law is too restrictive because it would require judicial authorization or consent in order to force a sample from a suspect. They claim that this will cause a tremendous backlog in the courts. On the other side of the debate, some argue that inclusion of convicts' samples is unfair to ex-convicts who are supposed to have paid their debt to society. In addition, others argue that the law should not allow for the inclusion of voluntary samples. They claim that this is a tactic to collect samples from society as a whole. Although the samples would be voluntary, many maintain that this would shift the burden of proof onto the public to prove their own innocence. In addition, the Privacy

[195] Ibid 194

Commissioner for Personal Data is closely reviewing the proposed legislation to ensure that it does not conflict with the Personal Data (Privacy) Ordinance

### 2.3 Laws in Canada:

Canada has passed DNA Identification Act, which became official on June 30, 2000[196]. This legislation allowed a DNA data bank to be created and amended the Criminal Code to provide a mechanism for a judge to order persons convicted of designated offences to provide blood, buckle or hair samples from which DNA profiles will be derived. The National DNA Data Bank respects considerations of genetic privacy and follows strict guidelines as specified in the DNA Identification Act. The biological samples collected from convicted offenders and the resulting DNA profiles can only be used for law enforcement purposes. It assists law enforcement agencies in solving crimes by:

- Linking crimes together where there are no suspects;
- Helping to identify suspects;
- Eliminating suspects where there is no match between crime scene DNA and a DNA profile in the National DNA Data Bank; and,
- Determining whether a serial offender is involved.

In Canada taking of a genetic sample without consent is held to be valid when the sample is collected by a health care professional.(relevant Indian case Sharda v. Dharampal,[197])Recently Advancing Justice through DNA Technology Act of 2003 has been enacted in the United States of America to [198]eliminate the substantial backlog of DNA samples collected from crime scenes and convicted offenders, to improve and expand the DNA testing capacity of Federal, State, and local crime laboratories, to increase research and development of new DNA testing technologies, to develop new training programs regarding the collection and use of DNA evidence, and for other purposes. By this Act imperative amendments have been made in DNA Identification Act of 1994 and DNA Analysis Backlog Elimination Act of 2000. Omnibus Crime Control and Safe Streets Act of 1968.

[196] Ibid 194
[197] AIR 2003 SC 3450.
[198] Ibid 194

This Act also provides for the establishment of National Forensic Science Commission which shall make specific recommendations to the Attorney General, as necessary, to enhance the protections described in sub-paragraph (G) to ensure –
(i) The appropriate use and dissemination of DNA information;
(ii) The accuracy, security, and confidentiality of DNA information;
(iii) The timely removal and destruction of obsolete, expunged, or inaccurate DNA information; and
(iv) That any other necessary measures are taken to protect privacy.

Britain has Criminal Justice and Public Order Act, which provides for forcible testing of blood samples[199].

### 2.4 Law in United Kingdom/England

The U.K has also recognized the importance of DNA technology and has enacted Data Protection Act, 1998. In U.K DNA developed as an investigative tool. A boy from Ghana, born in U.K wanted to join his family in U.K, the authorities denied his entry because they were not satisfied that he was the son of alleged mother. Through DNA test it was found that he was the son of alleged mother and thus he was allowed to stay with his mother.

In England the question of blood test and constraints under law has been a subject matter of heated debates. In several cases the British Courts had occasion to consider the powers of a Court vis-à-vis the parties for carrying out blood test against the will of a person. In other cases where the person was a lunatic or of unsound mind or under the age of sixteen years or otherwise unable to consent, from whom such consent should be taken also came up for consideration before the Courts.[200]

Justice Ward in Rc. H. said, "This Court will not order a blood test to be carried out against the will of a parent." To the similar tune were the observations of Justice Pal comb in another case. In an earlier decision, the House of Lords speaking through

[199] See, National DNA Data Bank Advisory Committee, Royal Canadian Mounted Police, 2004-2005 *Annual Report* , rcmp-grc.gc.ca/dnaac-adncc/annurp/2004-2005-annurp-eng.htm(Last Accessed on 28th November 2007)
[200]See,PoojaVadodaria,M.S.University,Vadodara,"DNA Test in paternity Dispute" http://www.lawyersclubindia.com/articles/DNA-Tests-in-Paternity-Disputes-3388.asp(last Acessed on February 2011)

Lord Reid observed. There is no doubt that a person of full age and capacity cannot be ordered to undergo a blood test against his will. The real reason is that English law goes to great lengths to protect a person of full age and capacity from interference with his personal liberty.

This being the proposition. It appears to be impermissible under law to direct the taking of a blood sample from a minor. Lord Hudson in an earlier decision had observed. "The position of a child is different. Here the Court is occupying the position of a parent, hence must act as the judicial reasonable parent." Likewise, in a minor's case, Lord Donaldson M. R. observed, "The parents owe a child and duty to give or withhold to consent in the best interests of the child and without regard to their own interest. The Court when exercising the parents patriae jurisdiction takes over the rights and duties over the parents. Although this is not to say that the parents will be excluded from the decision making process. Nevertheless in the end the responsibility for the decision, whether to give or to withhold consent is thus of the Court alone.[201]

In England the propositions of law were further developed on account of some provisions under the children Act, 1980. The Courts in England were empowered to exercise their inherent jurisdiction rigorously and creatively in other, often-graver circumstances. These included involving the use of compulsion in respect of a heart transplant against the wishes of a teen-ager, a liver transplant, blood transfusion against the wishes of teen – age Jehovah witness, blood testing to a baby for HIV against parent's wishes; and directions for medical/psychiatric treatment against the wishes of a teen-ager. In another blood test case. Justice Hale observed that the mechanism to obtain a blood sample may be to order the delivery of the child to the care and control of the Official Solicitor at aparticultimeand and place for that purpose and to make its plan that the official Solicitor is permitted to consent on the child.

In England the question of blood test and constraints under law has been a subject matter of heated debates. In several cases the British Courts had occasion to consider the powers of a Court vis-à-vis the parties for carrying out blood test against the will of a person. In other cases where the person was a lunatic or of unsound mind or

[201] Ibid 200

under the age of sixteen years or otherwise unable to consent, from whom such consent should be taken also came up for consideration before the Courts.[202]

Justice Ward in Rc. H. said, "This Court will not order a blood test to be carried out against the will of a parent." To the similar tune were the observations of Justice Pal comb in another case. In an earlier decision, the House of Lords speaking through Lord Reid observed. There is no doubt that a person of full age and capacity cannot be ordered to undergo a blood test against his will. The real reason is that English law goes to great lengths to protect a person of full age and capacity from interference with his personal liberty.

This being the proposition. It appears to be impermissible under law to direct the taking of a blood sample from a minor. Lord Hudson in an earlier decision had observed. "The position of a child is different. Here the Court is occupying the position of a parent, hence must act as the judicial reasonable parent." Likewise, in a minor's case, Lord Donaldson M. R. observed, "The parents owe a child and duty to give or withhold to consent in the best interests of the child and without regard to their own interest. The Court when exercising the parent's patriae jurisdiction takes over the rights and duties over the parents. Although this is not to say that the parents will be excluded from the decision making process. Nevertheless in the end the responsibility for the decision, whether to give or to withhold consent is thus of the Court alone.[203]

### a. Legislative Foundation

1. The foundation of the Database system's success is the series of Parliamentary Acts establishing the right of law enforcement to collect and profile individuals arrested for or suspected of committing a crime. Empowering police to obtain DNA from arrestees and to use the database during the investigative process, rather than subsequent to any possible conviction, provides numerous advantages. It allows them to:

[202] ibid

- solve cases faster,
- consolidate cases (and thus valuable resources) before trial,
- detain dangerous individuals arrested on a minor charge but identified as having committed a much more serious offense,
- Exonerate innocent suspects more quickly.

2. Legislation also establishes the ability of law enforcement to obtain DNA profiles for individuals arrested for or suspected of "any recordable offense." With this legal authority, the Home Office has established the goal of DNA databasing the "entire active criminal population."iv Currently, the database population stands at approximately two million individual profiles. By nature of its size, the database matching potential increases. However, it is the ability to profile individuals arrested for relatively minor offenses which provides police the ability to solve more serious crimes.

**Funding**

3. The National DNA Database (NDNAD) is well funded

In England and Wales, the DNA expansion funds are provided directly to police departments. While allowing investigating agencies the flexibility to apply grant monies for DNA testing as they see appropriate, direct funding also forces departments to make better decisions about which samples are forwarded to the laboratories for analysis. Smarter submission decisions result in better resource management.

England is widely recognized as having the most effective and efficient approach to the use forensic DNA technology in the world. Since the establishment of the National DNA Database (NDNAD) on April 10, 1995, England has become a world leader in discovering innovative ways to use DNA to identify suspects, protect the innocent, and to convict the guilty. DNA technology and DNA databasing has become central to the process of criminal investigation. The decision to integrate DNA technology so thoroughly and the subsequent success of the National DNA Database can be attributed to three major factors: the political will of the Home Office, the

technical capability of the Forensic Science Service and the operational desire of the Police.

The foundation of DNA driven investigations in England and Wales is its expansive DNA database. Many factors however, contribute to the success of the UK's approach to forensic DNA applications.

### b. Conclusion

DNA technology is used more effectively in England and Wales than elsewhere because it is no longer considered simply another forensic tool available to law enforcement. Rather, it is considered to be an integrated and routine part of the investigative process. It is not a technology to be used in special or particularly serious cases. It is a process invested in so as to become a routine part of every investigation in which biological material may be left by the perpetrator. Commitment to the use of DNA to solve volume crime and to the rapid analysis of crime scene evidence is key to this effort.

The progression of DNA data banking laws has helped that process by allowing police to utilize the profiles of individuals arrested or suspected of less serious crimes. Realizing that serious offenders commit less serious offenses too, the UK database laws take advantage of offender's likelihood to commit minor offenses. And realizing that offenders often commit more than one crime, allowing the use of suspect profiles empowers law enforcement to identify perpetrators sooner and to consolidate evidence and cases more effectively.

The Government has also followed up its expectations of the technology with the appropriate amount of funding. Not only is the technology funded well, but that funding is distributed wisely. By allocating the money directly to the law enforcement agencies themselves, they encourage the police to be thoughtful about their evidence collection and submission policies.

## 2.5 Law in United States

In United States of America, Otterbein published Paternity Exclusion tests as early as in 1921, even prior to Dyke, which did it in England in 1922, Weiner did exclusion

test in a paternity case in 1933. There after, relying upon a decision by Italian Supreme court of Cassation Justice Steinbrink of the New York Supreme Court ruled that blood test can be performed in a disputed paternity action. There after several states passed laws empowering courts with statutory authority to order blood testing in disputed paternity cases. In USA, the law is fully developed, and blood group serology, using proven genetic marker system and other accurate scientific methods are being displayed in matters concerning paternity.[204]

In US, DNA Technology has developed as a prosecutorial tool. It developed as a way to prove cases in the courtroom. In 1986, DNA as evidence was introduced for the first time in a Criminal Court. Now, America is implying huge resources and tremendous amount of attention in DNA Labs. There are more than 130 Labs both at State and local level that can conduct DNA analysis on forensic evidence. The National Commission on the future of the DNA evidence was established in 1998 in response to number of cases in which individuals were essentially being freed from prison, who were shown to be convicted wrong by nature of DNA testing. There is some exclusive legislation like:[205]

DNA Identification Act, 1994,Transplantation of Human Organs Act,1994 and Advancement of Justice through DNA Technology Act, 2003. In Doubter Vs Merrell Dow Pharmaceuticals[206], the Court laid down that for a scientific evidence to be admissible it must be shown scientifically valid and must be relevant to at least one issue in the case.

### a. Admissibility

As we discussed in Chapter –II In the United States, there are two main tests for admissibility of scientific information from experts. One is the ***Frye*** test, enunciated in ***Frye v. United State[207]s***.The other is a "helpfulness" standard found in the Federal Rules of Evidence and many of its state counterparts We must introduce and enact the laws that essentially mandate the admission of DNA typing evidence and emphasis on

---

[205]Peruml Gounder vs Pachappan AIR 1990 Mad 110, 121 National Law Enforcement Summit, Washington.
[206] 509, US 579, 59 (1993)
[207] 293 F. 1013 (D.C. Cir. 192

use of these two methods in addition to other favourable methods in this regard. Which we have discussed at length in chapter -2.

### i. The Frye Test

*Frye* rule is used by almost all courts in U.S.A. although a growing number have adopted variations on the helpfulness standard suggested by the Federal Rules of Evidence. Admissibility depends on the quality of the science underlying the evidence, as determined by scientists themselves. Theoretically, the court's role in this preliminary determination is quite limited: it should conduct a hearing to determine whether the scientific theory underlying the evidence is generally accepted in the relevant scientific community and to determine that the specific techniques used are reliable for their intended purpose[-].

When a process is new and complex, a court should recognize that the expertise of more than one discipline might be necessary to explain it. That is the case when the admissibility of DNA evidence is judged as a matter of first impression. Among the issues raised is the validity of the assumptions that:

(1) except for identical twins, each person's DNA is unique, (2) the technique used allows one to determine whether two DNA samples show the same patterns at particular loci, and (3) the statistical methods used and the available population databanks allow one to assess the probability that two DNA samples from different persons would by chance have the same patterns at the loci studied. Even if those assumptions are accepted, there is the important question of whether (4) the laboratory's procedures and analyses in the case in question were performed in accordance with accepted standards and provide reliable estimates of the probability of a match.

Assumption 1—that, with the exception of identical twins, each person's DNA is unique—is so well established in human molecular genetics that a court is justified in judicially noticing it, even in the context of a *Frye* hearing.

Assumption 2—concerns the validity of procedures for extracting DNA from samples of blood, semen, and other materials and analyzing it for the presence and size of

polymorphisms. With regard to application in scientific research, the validity is sufficiently well established in the case of RFLP analysis with Southern blots that judicial notice is also appropriate.

With regard to the application in forensic science, however, additional questions of reliability are raised. For example, forensic DNA analysis frequently involves the use of small, possibly contaminated samples of unknown origin, such as a dried blood stain on a piece of clothing. Some experts have questioned the reliability of DNA analysis of samples subjected to "crime scene" conditions. In addition the details of the particular techniques used to perform DNA typing and to resolve ambiguities evoke a host of methodological questions. It is usually appropriate to evaluate these matters case by case in accordance with the standards and cautions contained in earlier portions of this report, rather than generally excluding DNA evidence. Of particular importance once such a system of quality assurance is established would be a demonstration that the involved laboratory is appropriately accredited and its personnel certified. Some aspects (such as the validity of the theory underlying RFLP analysis) might be so well established that judicial notice is warranted.

Assumption 3—related to the adequacy of statistical databanks used to calculate match probabilities—rests on unproven foundations. Many experts question the adequacy of current databanks for making probability estimates, and the use of multiplicative modes of combining probabilities are also open to serious question (see Chapter 3). The solution, however, is not to bar DNA evidence, but to ensure that estimates of the probability that a match between a person's DNA and evidence DNA could occur by chance are appropriately conservative (as described in Chapter 3).

The validity of assumption 4—that the analytical work done for a particular trial comports with proper procedure—can be resolved only case by case and is always open to question, even if the general reliability of DNA typing is fully accepted in the scientific community. The DNA evidence should not be admissible if the proper procedures were not followed. Moreover, even if a court finds DNA evidence admissible because proper procedures were followed, the probative force of the evidence will depend on the quality of the laboratory work. More control can be exercised by the court in deciding whether the general practices in the laboratory or the theories that a laboratory uses accord with acceptable scientific standards. Even if

the general scientific principles and techniques are accepted by experts in the field, the same experts could testify that the work done in a particular case was so flawed that the court should decide that, under *Frye*, the jury should not hear the evidence.

### ii. Admissibility According to the Helpfulness Standard

The Federal Rules of Evidence, without specifically repudiating the *Frye* rule, adopt a more flexible approach. Rule 702 states that,

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.

Rule 702 should be read with Rule 403, which requires the court to determine the admissibility of evidence by balancing its probative force against its potential for misapplication by the jury. In determining admissibility, the court should consider the soundness and reliability of the process or technique used in generating evidence; the possibility that admitting the evidence would overhwelm, confuse, or mislead the jury; and the proffered connection between the scientific research or test result to be presented and particular disputed factual issues in the case.

The federal rule, as interpreted by some courts, encompasses *Frye* by making general acceptance of scientific principles by experts a factor, and in some cases a decisive factor, in determining probative force. A court can also consider the qualifications of experts testifying about the new scientific principle, the use to which the new technique has been put, the technique's potential for error, the existence of specialized literature discussing the technique, and its novelty.

### iii. Cases on Admissibility of DNA Evidence under the Federal Rules

As with the *Frye*[208] rule, courts applying the federal rules or conforming state rules must consider whether the particular techniques used in a particular case pass scientific muster. Three federal courts have now conducted thorough hearings on the

[208] *Frye v. United States,* 293 F.2d 1013, 104 (D.C. Cir. 1923)

admissibility of DNA evidence, with two courts finding it admissible and one ruling it inadmissible.

The U.S. District Court for the District of Vermont conducted a detailed analysis in *United States v. Jakobetz*[209]. It reviewed the literature and FBI practices. Despite a strong attack from the defense and its experts, the court found that the DNA evidence was "highly reliable" and that its probative value outweighed the potential for prejudice. Strict application of the *Frye* test was rejected in accordance with Second Circuit standards.

Most recently, the Superior Court for the District of Columbia reached the opposite conclusion and held DNA typing inadmissible. In *U.S. v. Porter*, the court ruled that the technical reliability of DNA typing was generally accepted, but that the FBI's method for calculating the probability of a coincidental match was not. The court ruled that the scientific foundation of these probability calculations bears on the admissibility (and not simply the weight) of the evidence. Applying the *Frye* standard, the court found that "there is a controversy within the scientific community [on this issue] which has generated further study, the results of which will soon be available for scrutiny. It is after these studies and others … when the court should be called upon to admit DNA evidence."

In addition, a number of state courts that apply analogues of the federal rules have considered the admissibility of DNA evidence. In *Andrews v. State*[210], a Florida court of appeals (the first higher-level state court to consider DNA evidence) determined that the relevance approach was applicable under the Florida evidence code that tracks the federal rules. The court admitted the evidence presented by the plaintiff's three scientific experts, two of whom worked for a private testing laboratory; the defense called no experts. The court concluded that the DNA typing evidence offered by the plaintiff was clearly helpful to the jury. With respect to the possibility of prejudice, the court found that DNA typing is not particularly "novel," in that it had been used in nonforensic applications for 10 years. The issue of differences between scientific applications and forensic applications were not raised by the defense. The court also noted the existence of specialized literature about the technique. As for the possibility

[209] 747 F.Supp. 250
[210] 2008-Ohio-625

of erroneous test results, the court credited testimony that an error in the testing process would mean that there would be no result, rather than a false-positive or false-negative result. The court also credited the efficacy of the laboratory's control runs and approved the use of statistical data to determine the probability of a match.

In *Spencer v. Commonwealth*[211] the Supreme Court of Virginia affirmed a trial court's finding that evidence derived from RFLP analysis was sufficiently reliable to be admitted. The trial court heard testimony from three experts for the prosecution in molecular biology and genetics. The defense called no expert witnesses. The trial court credited testimony that there is no risk of false positives, that the testing techniques are reliable and generally accepted in the scientific community, and that the particular test was conducted in a reliable manner[212].

**Admissibility Statutes**

Since 1987, the admissibility of DNA typing evidence was raised repeatedly in the courts, largely in the context of *Frye* hearings. Challenges to admissibility have become more sophisticated over the last 2 years. State legislatures have recently begun to address the matter. Several states have enacted laws that declare that appropriately performed DNA tests are admissible. Although they do not specify what an appropriate test is, the statutes must have been passed with single-locus RFLP analyses by Southern blotting in mind. Arguably, some of them should not be interpreted as applying to technologies that were not in general use and therefore could not have been evaluated by the legislatures that passed the statutes. Such technologies could be validated by amended statutes or by courts in *Frye* or Rule 702 hearings. For most purposes, states with such laws have statutorily resolved disagreements over the scientific reliability of DNA testing, although the questions of whether tests were performed properly in a given case and of the adequacy of statistical calculations based on test results probably remain subject to challenge.

[211] 238 Va. 275, 384 S.E.2d 775 (1989) *Virginia Law Review* Vol. 76, No. 4 (May, 1990), pp. 853-876,Available at www.courts.state.va.us/scndex.htm (Last Accessed on 27th Dec. 2007)

[212] 238 Va. 275, 384 S.E.2d 775 (1989) ,*Available at* ,caselaw.findlaw.com/va-supreme-court/1558154.html – (Last Accessed on 28th Dec. 2007)

The state laws are of two types. A number of states—including Arkansas, Connecticut, Michigan, Montana, and New Mexico—now specifically admit DNA evidence to assist in the resolution of paternity—noncriminal—cases (and, by inference, probably other disputes concerning biological relationships). Louisiana, Maryland, Minnesota, Virginia, and Washington have enacted laws that recognize the admissibility of DNA evidence in criminal cases.

Maryland requires that the DNA report be delivered to the defendant 2 weeks before the criminal proceeding and specifies that the defendant may require a witness who analyzed the sample to testify as to the chain of custody. The Minnesota statute states that in any civil or criminal trial or hearing DNA evidence is admissible without "antecedent expert testimony that DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material upon a showing that the offered testimony meets the standards for admissibility set forth in the Rules of Evidence"; a companion provision specifically permits the admission of "statistical population frequency evidence … to demonstrate the fraction of the population that would have the same combination of genetic markers as was found in a specific human biological specimen." Louisiana provides that "evidence of deoxyribonucleic acid profiles, genetic markers of the blood, and secretor status of the saliva offered to establish the identity of the offender of any crime is relevant as proof in conformity with the Louisiana Code of Evidence."

Legislative interest in DNA evidence remains active, and it is likely that other states will enact laws generally favorable to its admissibility.

### 2.6 The Australian Law

Reforms Commission recently published the results of the inquiry conducted jointly with NHMRC's Australian Health Ethics Committee, "Essentially Yours: The Protection of Human Genetic Information in Australia", a two volume, 12,00 page report, containing 144 recommendations about how to deal with ethical, legal and social implications of the "New Genetics".[213] The report covers a wide range of areas,

[213] See, NHMRC's Australian Health Ethics Committee , "Essentially Yours: The Protection of Human Genetic Information in Australia",Available at http://www.nhmrc.gov.au/your_health/egenetics/practitioners/education.htm(Last Accessed on 2nd Jna. 2008)

including human genetic research and genetic databases, genetic privacy and discrimination, and regulating the use of genetic testing and information in employment, insurance, immigration, parentage testing, sport and other contexts. The report has been described as "an extraordinary accomplishment", providing a "world - leading platform for policy development". It is a comprehensive and instrumental report producing a number of welcome recommendations.

a. The following are the main recommendations made by the A.L.R.C. Final Report:

(i) The establishment of a standing Human Genetics Commission of Australia (HGCA) to provide high-level, technical and strategic advice about current and emerging issues in human genetics, as well as providing a consultative mechanism for the development of policy statements and national guidelines in this area.

(ii) Discrimination laws should be amended to prohibit discrimination based on a person's real or perceived genetic status.

(iii) Privacy laws should be harmonized and tailored to address the particular challenges of human genetic information, including extending protection to genetic samples, and acknowledging the familial dimension of genetic information. For example, doctors might be authorized to disclose confidential information to a genetic relative where it is necessary to avert a serious threat to an individual's life, health, or safety.

(iv) Ethical oversight of genetic research should be strengthened by: ensuring that all genetic research complies with National Health and Medical Research Council, (NHMRC) Standards; better supporting Human Research Ethics Committees; providing more guidance to researchers and research participants about best practice; developing new rules to govern the operation of human genetic research databases; and tightening reporting requirements[214].

(v) Employers should not be permitted to collect or use genetic information except in those rare circumstances where this is permitted under anti-discrimination laws or is

[214] See,Aritle on DNA ,available at www.findlaw.com.au/.../research-into-human-genetics.aspx(Last Accessed on 5th Jan 2008)

necessary to protect the health and safety of workers or third parties, and the action complies with stringent HGCA standards.

(vi) The insurance industry should be required to adopt a range of improved consumer protection policies and practices with respect to its use of genetic information (including family history) for underwriting purposes. New laws and practices should ensure that: genetic information is only used in a scientifically reliable and actuarially sound manner; reasons are provided for any unfavorable underwriting decision; industry complaints-handling processes are strengthened and extended to cover underwriting decisions; and industry education and training about genetics are improved.

(vii) A new criminal offence should be created to prohibit someone submitting another person's sample for genetic testing knowing that this is done without consent or other lawful authority (e.g. a court order, or the statutory authority given to police officers).

(viii) Lack of harmonization is threatening the effectiveness of any national approach to sharing DNA information for law enforcement purposes. The governments should develop national minimum standards for the collection, use, storage, destruction and matching of DNA samples and profiles. No inter-jurisdictional sharing of information should be permitted except in accordance with these minimum standards.

(ix) DNA parentage testing should be conducted only with the consent of each person sampled, or pursuant to a court order. Where a child is unable to make an informed decision, testing should proceed only with the consent of both parents, and a court order.

In late 1999, Australia's federal government decided to fund a national forensic DNA database as part of a fifty million dollar national criminal investigation system. Currently, only a few of the territories have legislation that allows for the police to build up a DNA databank. The push for the national database, however, has caused the other territories to begin to review and model similar legislation.

The Model Criminal Code Officers Committee of the Standing Committee of Attorneys-General published the Model Forensic Procedures Bill in May 1999 to act as a guide for the territories to develop or enhance their DNA legislation. The territory of Victoria closely follows the model by authorizing police to seek court orders to secure DNA samples from convicted murderers and rapists. The legislation in the Northern Territory, however, is more closely modeled after the British legislation Because the police do not classify the sample as intimate, they are able to secure samples without obtaining consent or a court order. In addition, the Northern Territory legislation is more like the British model in that it allows for sampling from a broader class of convicts, including those guilty of some driving offenses. The Privacy Commissioner has urged the government to consider a number of issues before passing any legislation, including deciding who will be sampled, who will have access, what kind of auditing will be done, and the procedures for expansion.

### 3. Indian Legal Scene: A Comparative-study/Analytical Study

However, in India, we don't seem to have realized how vast the potential of science technology is. DNA technology has made a drastic improvement in the methodology of providing different types of disputes of civil and criminal cases. Established in the middle of 19th century, today in India there are about 21- well-established forensic labs, 4 of them being administered by the Central Government. The scientific methods are being adopted in crime investigation in India in an organized way from 1849 onwards. Despite having DNA Technology in India, it is not seen used in the administration of Criminal Justice System[215].

There is no special enactment dealing with DNA profiling as is there in other countries. However, there are few legal provisions in Indian Constitution,

The Indian Evidence Act, 1872, The Code of Criminal Procedure, 1973 and in The Identification of the Prisoner's Act, 1923 which deems to deal with DNA Profiling. Many criminal as well as civil cases has been decided by the different courts taking into consideration the DNA evidence, but still it can be said that DNA technology is not widely used in India.

[215] See,Article on develpoement of Science in India, Available at www.indianscience.org(Last Accessed on 7th Jan 2008)

Quite early, the Kerala High Court in Vasu v. Santa, [216] had held that taking of a blood sample is a constraint on personal liberty and cannot be carried out without consent. The Madras High Court relying upon a very old case had lain down that it appears doubtful whether such a compulsion can be made even under legislation. It also questioned the power of a guardian ad litem to give consent in such cases.

Realizing the value of such tests for determining paternity, maternity, and fixing identities, a Bench of Allahabad High court in Bharu Raj v. Sumesh Sachdeo, [217]held that such a test puts a child on the anvil of legitimacy and illegitimacy and therefore it would be unjust and not fair either to direct a test for collateral reason to assist a litigant in his or her claim. He Hon'ble Allahabad High Court further held that the child could not be allowed to suffer because of his incapacity and that if in a case the Court has reasons to believe that the application for blood test is of fishing nature or was made for some ulterior motive it would be justified in not acceding to such a prayer.

### 3.1 Position in Civil Law:

It may be mentioned at the very outset that dealing with civil cases, Courts in India [218] have adopted a trend that a party cannot be compelled to give sample of blood for blood group tests. Therefore such a sample cannot be collected against the will of such a person Courts in India have adopted this general trend, in the absence of any statutory law in the field.

In Hargovinda Soni v. Ram Dularey, [219](Ram pal Singh.J.) The Madhya Pradesh High Court was categorically of the opinion that no person can be compelled to give a sample of blood against consent. In a case where a party does not consent for giving his sample for blood or DNA fingerprint test, the maximum the Courts can do is to draw an adverse inference against that party for such refusal. Indicating a gap in law on such question, a single Judge of Madras High Court had, however, held it long

[216] 1975 Ker LT 53
[217] AIR 1986 All 259
[218] See, State v.Sheshappa Dudhappa Tambade , AIR 1964 Bom. 253 and Bipin Chandra Shantilal Bhattv. Madhuriben Bhat AIR 1963 Gujrat 250. And Krishna Murthi Aiyer v. Govind Swami Palley , AIR 1966 Mad.443.
[219] AIR 1986 Madh Pra 57

back [220], that "there is no procedure either in the Civil Procedure Code or the Evidence Act which empowers the Court to enforce" the taking or giving of blood samples. However, in some cases it has been held that the Courts are seized to inherent powers, which can be exercised ex debito justitiae. Following Madras High Court, the Bombay High Court[221] was also of the considered opinion that though a Court can direct respondent to give blood sample, it cannot compel her to do so. Bombay High Court, however, clearly held that the Court lacked powers in enforcing the giving of blood samples in case of failure to do so, even inspite, of the directions by the Court. It ultimately favored for merely drawing an adverse inference in case there was a clear dental for giving such samples. Yet, in another case R.P. Uloganambi v. K. C. Loganayaki,[222]. The Madras High Court has gone to the extent holding that a party having consented to give such a sample on one stage of the proceedings can validly make a withdrawal of such an offer and the principle of estoppels (Section 115 of Evidence Act) would not come across.

The Hon'ble Supreme Court in Goutam Kundu finally considered this matter [223]in a proceeding under Section 125, CPC (Maintenance), wherein after considering the entire legal scene it was held:

1. That Courts in India cannot order blood test as matter of course:
2. Wherever applications are made for such prayers in order to have roving inquiry, the prayer for blood test cannot be entertained.
3. There must be a strong prima facie case in that the husband must establish non-access in order to dispel the presumption arising under Section 112 of the Evidence Act.
4. The Court must carefully examine as to what would be the consequence of ordering the blood test; whether it will have the effect of branding a child as a bastard and the mother as an unchaste woman.
5. No one can be compelled to give sample of blood for analysis.

The Apex Court upholding Madras High Court observed that it required to be carefully noted no person can be compelled to give sample of blood for analysis

[220] Polavarupu Venkataswarlu v. Polavarappu Subbaya, AIR 1951 Madras 910.
[221] Sadashiv Khedarkar v. SMT. Nadinee sadashiv Khedarkar and others , 1995 Cr. L. J. 1995.
[222] 1986 Cr LJ 1522
[223] AIR 1993 SC 2295, See also Kantideve v. Poshiram. AIR 2001 SC 2226

against (his or) her will and that no adverse inference can be drawn against (him or) her for such a refusal.What weighed the mind of the Apex Court appears to be the effect over the paternity of a child, since there was likelihood for terming him bastard. Supreme court relying upon its earlier judgment in Smt. Dukhlar Jahan [224] observed that such a test should not be directed for upholding the legitimacy of a child unless the facts are compulsive and clinching as to necessarily warrant a finding that a child could not at all have been begotten to the father and such a legitimation of the child would result in rank injustice to the father. The Apex Court further remarked Courts have always desisted from lightly or hastily rendering a verdict and that too on the basis of slender materials which will have the effect of branding a child as a bastard and its mother unchaste woman.

It may be observed that in given circumstances, simply an adverse inference may not be of any consequences since such a process would tantamount the prevention of positive evidence before the Court. The law as laid down by Madras High Court in Subayya Gounder v. Bhoopala Subramaniam[225], was considered in the light of these circumstances, but that view was not disturbed by the Apex Court in Gautam Kundu . Quite recently the Supreme Court in divorce proceedings again considered the question of compulsion to undergo medical examination and held that it was well within the power of the Court to compel such examination.[226]

### 3.2 Position in Criminal Law:

It is again interesting to observe that the Criminal Law is also significantly silent on such a power of a "Court to direct the talking of blood samples for blood/DNA analysis.

A single Judge of Gujarat High Court in Najabhai v. State of Gujarat, [227]has held that the bar of Article 20(3) of the Constitution of India would extend with regard to compelling the accused to submit himself to medical examination also. However, this proposition runs contradictory to a decision by Apex Court in State of Bombay v.

[224] AIR 1987 SC 1049
[225] AIR 1959 Madras 396 : 1959 Cri LJ 1087
[226] Sharad v. Dharmapal AIR 2003 SC 3450.
[227] 1972 Cr. LJ 1605

Khthikalu, [228]wherein, such examinations were held not included within the meaning of becoming a witness. Referring to the powers conferred under Section 53, Cr. P.C. the Andhra Pradesh High Court [229]has held that although there is no clear provision in Cr. P.C. for taking such blood samples yet there is no prohibition for taking such blood samples of an accused by exercising powers under Section 53 Cr. P.C. The Court observed that taking samples of blood and semen would come within the scope of examination of the person of the arrested person and therefore, "examination of a person by a medical practitioner must logically take in examination by testing his blood, sputum, semen, urine etc. The Court further held that Section 53 provides the use of such force as it reasonably necessary for making such an examination. Therefore, it held that whatever discomfort might be caused, when samples of blood of semen are taken from an arrested person, would be justified under the provision of Section 53 and 54 of Cr. P.C.

On the other hand a Division Bench of Allahabad High Court[230] dealing with a criminal case, was of the view that though there was no specific provision in Indian Law permitting taking of blood yet in a criminal case, an examination of person can be made under Section 53(1) of the Cr. P.C. which shall include the taking of blood samples, including an examination of an organ inside the body. The Court drew the aforesaid conclusion per force the provisions of Section 367 (1) and Section 482 of the Cr. P.C. It also held that there is nothing repulsive of shaking to conscience in taking the blood of an accused person in order to establish his guilt and so far as the question of causing hurt is concerned, even causing some pain may be permissible under Section 53, Cr. P.C.Quite recently Delhi High Court considered the question of privacy (in relation to fetus) and DNA test and held that such directions cannot be issued which forces

[228] 1961 (2) Cr LJ 856 SC: AIR 1961 SC 1809
[229] Ananth Kumar v. ST. of A.P.1997, CR. L.J. 1797
[230] Jamshed v. st. of U.P. 1760 CR. LAW. J.1680

### 3.3 Legislative Responsibilities[231]

- To make proper panel and advisory body for maintaining uniformity on DNA identification records, storage and DNA analyses
- State wise contributory funding for DNA Databanks
- Relevant state and central acts to safeguard public interest
- Establishment of DNA Data bank and introducing legislations to regularize the same
- Draft DNA Profiling Bill 2006
- Need for large expansion in DNA Profiling services in country
- Possibility of incorporating this expansion as part of a larger reform of separating "investigative" and "law and order" wings, The National Police Mission etc.
- Need also for an enabling legislation to regulate the provision of DNA Profiling services for lawful purposes
- Experience in and examples from other countries

[231] See more on this topic in conclusion part-chapter-vii of the Research work

# Chapter-VI

## Judicial Response & DNA Technology

This section will analyze various important decisions of the Supreme Court and High courts of India in order to provide a comprehensive understanding of the application of the DNA technique in matters of evidence and the law in its present scenario in India.

### 1. Judgement delivered by supreme court of India

(1) Goutam Kundu v. State of West Bengal (A paternity dispute)[232]

Legal provisions involved:

Section 112 of Indian Evidence Act

Section 125 of Code of Criminal Procedure

In this case the appellant claimed a DNA test in order to establish that he was not the father of the child in order to consequently absolve him of paying maintenance to mother and child under Section 125 of the Criminal Procedure Code.

The Court held:

- That Courts in India cannot order blood tests as a matter of course;
- Wherever applications are made for such prayers in order to have roving inquiry, the prayer for blood test cannot be entertained.
- There must be a strong prima facie case in that the husband must establish non-access in order to dispel the presumption arising under section 112 of the Evidence Act.
- The Court must carefully examine as to what would be the consequence of ordering the blood test; whether it will have the effect of branding the child illegitimate and the mother an unchaste woman?
- No one can be compelled to give a sample of blood for analysis.

[232] AIR 1993 SC 2295, 1993 Cri. LJ 3233, 1993 SCC 418, 1993 AIR SCW 2325

**2)** In Mr. X v. Hospital [233](conflict between right to life and right to privacy)

Constitution of India- Article 21

The Supreme court was confronted with the task of striking a balance between two conflicting fundamental rights; the AIDS patient's right to life which included his right to privacy and confidentiality of his medical condition, and the right of the lady to whom he was engaged to lead a healthy life.

The Supreme Court concluded that,

Since the life of the fiancés would be endangered by her marriage and consequent conjugal relations with an AIDS victim, she was entitled to information regarding the medical condition of the man she was about to marry and that there was no infringement of the right to privacy.

**3**) Sharad v. Dharmapal[234] (divorce proceeding and medical examination/DNA testing/power of the court to compel medical examination)

In a very important and recent judgment delivered by the Hon'ble Supreme court of India in the case of Sharda v. Dharampal, where the core question was, whether a party to a divorce proceeding can be compelled to a medical examination. In this case the Respondent on the ground that such an order violates his right to privacy opposed an order for DNA test. The three Judge Bench of the Hob'ble Supreme court held that: "If for arriving at the satisfaction of the Court and to protect the right of a party to the lis who may otherwise be found to be incapable of protecting his own interest, the court passes an appropriate order, the question of such action being violative of Art. 21 of the Constitution of India would not arise. The court having regard to Art, 21 of the Constitution of India must also see to it that the right of a person to defend himself must be adequately protected." It further held that if respondent avoids such medical examination on the ground that it violates his/her right to privacy or for a matter right to personal liberty as enshrined under Art. 21 of the constitution of India, then it may in most of such cases become impossible to arrive at a conclusion. It was

[233] AIR 1999 SC 495 ;1998 SCW 3662
[234] AIR 2003 SC 3450.

also said that if despite an order passed by the Court, a person refuses to submit himself to such medical examination, a strong case for drawing an adverse inference would be made out. Section 114 of the Indian Evidence Act enables a Court to draw an adverse inference if the party does not produce the relevant evidences in his power and possession.

Provisions of law discussed:

Hindu Marriage Act 1955, Section 5, 12(1) (b) and 13(1) iii.

Civil Procedure code 1908 Section 151 and order XXXII, RULE 15.

Lunacy Act 1912 section 41.

Constitution of India Article 21 –Right to Privacy (in matrimonial proceeding, read with section 12 and 13 of Hindu Marriage Act)

Legal issues involved: whether a party to divorce proceeding can be compelled to a medical examination?

Whether there is a breach of right to privacy guaranteed by Indian Constitution under Article 21?

Judicial interpretation:

However, as a corollary to the decision in Goutam Kundu[235] in this case the Supreme Court held that:

Supreme Court in divorce proceedings considered the question of compulsion to undergo medical examination and held that it was well within the power of the Court to compel such examination

- A matrimonial Court has the power to order a person to undergo a medical test. Either at the instance of a party or suo motu. Party not entitled to Constitutional protection under Article 20 of constitution of India in civil litigation

[235] AIR 1993 SCC 2295

- Inherent power of court to be exercised for complete justice to parties(though the specific provision In this regard has not been mentioned in C.P.C. and Evidence act-in the interest of child it is to be made)
- Passing of such an order by the Court would not be in violation of the right to personal liberty or the right to privacy under Art.21 of the Constitution.
- Order for test may be passed if strong prima facie case is made out.
- It is pertinent to note here that through no person can be compelled to give a sample of blood against his or her will and no adverse inference can be drawn against him for this refusal, in case of divorce proceeding before a matrimonial Court, the Court can order an individual to submit himself to medical examination and in case of refusal, can draw an adverse inference from his refusal.

Judicial pronouncement: Appeal dismissed.

**5)** Kamalnath and others v. St. Of Tamilnadu [236]

(Reliability /admissibility of expert evidence/rape and murder case)

One instance of the application of DNA profiling/fingerprinting evidence being used to convict the accused persons can be seen in this sensational case involved the rape and murder of several teenage girls in the Ashram of a god-man Premananda alias Ravi,

In a lengthy judgment the Madras High Court considered 4 important questions:-

1. Whether the DNA evidence is generally accepted by the scientific community?

2. Whether the testing procedure used in this case is generally accepted as reliable, if performed properly?

3. Whether the tests were performed properly in this case?

4. Whether the conclusion reached in this case is acceptable?

[236] 2005 (2) SCC (cri.) 1121, 2005(4) SCJ 724 SC

In answering the first question the Court relied on the extent to which Courts in the United States had relied on evidence of DNA analysis. The 2nd, 3rd and 4th questions were all answered in the affirmative and the accused persons were convicted on various counts on the basis of the evidence of experts on DNA fingerprinting/profiling and other evidence.

Provisions of law discussed:

Indian Evidence Act –section 5, 45, and 133 –Relevency of fact

Indian Penal Code- Section 376,354, 119 and 120-B

Code of Criminal Procedure- Section 165, 464, 465, 31

Legal Issues:

Victims were orphans and destitute, dependent on accused and on Ashram for shelter, food and clothes. Accused had physical, mental and spiritual dominion control over the prosecutrix. Rape committed on them. Statement of girls whether requires corroboration?

Held, no corroboration required for rape victims, though corroboration is present from medical reports and other contemporaneous documents.

Section 133: Whether Rape victims Accomplice?

Held, Rape victim is not an Accomplice.[237]

Section 5 of Indian Evidence Act, relevancy of Facts

Plea of Accused was that, victim gave statement against accused due to torture and beating by police.[238]

Held-the statement of the girls be examined under the facts and in the context and circumstances of the case, no coercion took place.

[237] Para 35 of judgment.
[238] Para 53 of judgment

Judicial pronouncement: Appeal dismissed.

"……..having regarded to the amplitude of gravity of the offence, perpetrated in the organized and systematic manner, the nature of the offence and its deleterious effect not only against the victim, but the civilized society at large needs to be curb by strong judicial hands. We are inclined to confirm the sentence and conviction as recorded by the trial court and confirmed by the High court..."[239]

Judicial interpretation: Section 45 Indian Evidence Act:

1) DNA test conducted. Evidence of the private doctor not acceptable in the phase of DNA test.
2) DNA test carried out by Expert Accepted. Dr. Lalji Singh , Deputy Director, C.C.M.B.Hyderabadwas examined as P.W. 59 as an Expert in this case.

The Supreme Court has relied on the expert evidence on DNA evidence that has stated that out of 3.3 billion base pairs only about 3 million vary from person to person. i.e. % DNA is useful for analysis.

The accused were convicted and sentenced to imprisonment.

(6) Kamti Devi v. Poshi Ram.[240](Civil dispute relating to paternity)

Legal provisions involved:

Section 112 of Indian Evidence Act

In the facts of this case the respondent was the husband of the appellant. After fifteen years after marriage the appellant gave birth to a child. The respondent filed a civil suit for declaration that he was not the father of the said child. Though the issue was not directly in issue in the instant case, the Supreme Court opined that even a DNA test that indicated that the respondent was not the father of the child would not be

[239] Para 79 of Supreme Court Judgment in Kamalnantha's case.
[240] AIR 2001 SC 2226 (The first reported paternity case of DNA typing is in re Baby Girl. Another important case of inheritance is Alexander Valexander where an illegitimate child claiming an inheritance permits it to disinterment for a DNA test. Similar enthusiasm to resolve questions of paternity have embrace DNA analysis in King v. Tanner where the Court granted summary judgment for defendant alleged to have slandered married man by asserting that he fathered her child.)

enough to rebut the conclusiveness of the marriage as proof of legitimacy of the child. The Court held that the only way of rebutting the conclusive proof provision would be to adduce evidence of non-access. [241]

That case concerned DNA evidence but the Supreme Court refused to permit the evidence on the ground that except non-access no other evidence is permissible to prove that a person is not the father.

Judicial Interpretation:

Permissibility of DNA test unless non-access proved

DNA test results are scientifically accurate.

Appeal was dismissed.

7) Dwarika Prasad Satpathy v. Bidyut Prava Dixit.[242]

(An adverse inference could be drawn if the party refuses to undergo a DNA test)

This decision of the Supreme Court has also been followed in the case of K. Selvaraj v. P. Jayakumari [243]

And it was also stated that an adverse inference could be drawn if the party refuses to undergo a DNA test. The point of adverse inference is also referred to in another case Sadashiv Mallikarjun Kheradkar v. Nandini Sadashiv Mallikarjun Kheradkar[244]. This seems to be a preferable interpretation and strikes a balance between the two extremes. The Court does not have the power to direct the giving of a sample, but if it is not given the Court may draw an adverse inference.

Section 125 of Cr.P.C.

---

[241] See Arukumar v. Turaka Kondalal 1998 Cri. L. J.4279 Where a single locus probe RFLP AND STR analysis was carried out to prove the paternity of the child in Kanti Devi v. Poshi Ram, AIR 2001 SC 2266: 2001 Cri LJ 2615. Judgment of the Supreme Court in 1993 also highlighted the fact that there is no provision in Indian laws to force or compel people to undergo blood tests or any other type of DNA testing. (Ibid AIR 2001 SC 2266: 2001 Cri LJ 2615

[242] 2000 Cri LJ 1 : AIR 1999 SC 3348, 1999 (3) ACR 732 SC

[243] 2000 Cri LJ 4748 (Kerala

[244] 1995 Cri LJ 4090 (Bom

Claim of maintenance was made by wife for herself and child, Petitioner disputed on paternity of child.

Wife asked for DNA test. Petitioner showed unwillingness for the same.

Court observed that if the Magistrate is prima facie satisfied regarding performance of marriage the maintenance is payable.

Judicial Interpretation:

Unwillingness for DNA test means appealant was disentitled to dispute paternity.

8) Smt. Dukhlar Jahan [245]

Supreme court relying upon its judgment in Smt. Dukhlar Jahan observed that such a test should not be directed for upholding the legitimacy of a child unless the facts are compulsive and clinching as to necessarily warrant a finding that a child could not at all have been begotten to the father and such a legitimating of the child would result in rank injustice to the father.

The Apex Court further remarked Courts have always desisted from lightly or hastily rendering a verdict and that too on the basis of slender materials which will have the effect of branding a child as a bastard and its mother unchaste woman.

9) Banarsi Das V. Mrs. Teeku Dutta and Others[246]

(Succession dispute and DNA test)

Legal issues:

Evidence Act Section 45-DNA Test-order for propriety,

Case under section 372 Indian Succession Act-Parentage of daughter- Applicant denied- Applicant seeking blood test of alleged daughter.

[245] AIR 1987 SC 1049
[246] 2005 (52) A Cri C 481 SC

Application allowed by the trial court Set aside by High Court. (No one can be compelled to give evidence against himself. It violates Article 20(3) of the constitution. Article 21, right to privacy).no compulsion to give sample of blood for analysis.[247]

Petition to Supreme Court was filed.

Held, Grant of succession certificate does not establish the title of grantee as the heir of the deceased, but only furnishes the authority to collect his debts.

It is for parties to produce evidence to prove their claims.

The core question involved in the appeal was whether a direction for DNA test can be given in a proceeding for issuance of succession certificate under Indian Succession Act, 1925

Provisions of law discussed:

Indian Evidence act 1872. Section 45,112, 4

Indian Succession Act 1925- Section 372

Code of Civil Procedure 1908, Section 151

Judicial pronouncement:

Direction for DNA test as was given by Trial court is clearly unsuitable and High Court has rightly set it aside.

Appeal Dismissed.

"……..We may remember that Section 112 of Indian Evidence Act was enacted at a time when the modrn scientific advance ment with DNA and RNA test were not even in contemplation of Legislature .The result of the genuine DNA test is said to be scientifically accurate . But that is not enough to escape fro the conclusiveness of the secion 112 of the Act, e.i. if a husband an wife were living together during the time of

[247] AIR 2004 del 205

conception, but the DNA test reveals that the child was not born to the husband, the conclusiveness in law would remain irrebuttable……..( see Komti devi v.Poshiram, 2001, (5) SCC 311)……..”

Judicial interpretation: DNA test to be directed only in deserving cases and not as a matter of routine.

10) Narinder Singh Bogarh V. State Of Punjab[248]

(A murder case)

Section 166-B of Criminal procedure Court

Narinder singh was suspected of murdering his wife Mrs. Sminder Kuar in Canada.Blood of suspect found during the investigation in Canada. Request made by the Canadian Government to obtain statement of suspect residing in India as well as taking his blood sample voluntarily for DNA analysis. Suspect was not volunteering.

Held, that if the appellant is not willing to make any statement to give his blood samples, the C.B.I. can not take the recourse to section 166-B of t Code of Criminal Procedure because that is not the request of the Canadian Government.

Order of the lower Court for giving statement and blood test was set aside and Petition was allowed.

Judicial Interpretation: Taking of blood sample voluntarily for DNA analysis and if suspect not volunteering C.B.I. can not ask the recourse to section166-B, Cr.P.C. 1973.

11) Nirmaljit Kaur V. State Of Punjab and Others[249]

Provisions of law discussed : Guardians and Wards Act 1890 Section 25

Hindu succession Act 1925 Section 63, 192, 193, 194

Hindu Minority and Guardianship Act, 1956

[248] 2004 (2)Crimes 166, 2004, Cri.LJ 1446 SC
[249] (2005) 8 SLT 755

DNA test proved that the child produced before the court was not the child of the petitioner.

## 2. High court decisions

12) In the case of CBI v. Santosh Kumar Singh[250] (rape and murder case)

DNA evidence was sought to prove that the deceased had been raped.[251] There existed a possibility of tampering with the samples that were sent for DNA testing. The burden was on the State to show that the samples had not been tampered with.

13) M. V. Mahesh v. State of Karnataka [252] (malpractices or irregularities in the scientific processes)

The Court acquitted the accused, one of the grounds being that the requisite amount of DNA of high molecular weight was not present so as to make the test results sufficiently conclusive and accurate. The Court further went on to say that the DNA test was not a fool proof one and also commented on the fact that there were no national standards set or established for DNA testing in India.

Such scrutiny of the DNA testing procedure is commendable and any benefit of doubt arising from malpractices or irregularities in the scientific processes involved ought to go to the accused.

14) Sadashiv Mallikarjun Khedarkar v. Nandini Sadashiv Khedarkar, [253] (case of adultery, maintenance and paternity, court can direct and cannot compel a person to give blood sample)

---

[250] AIR 1994 SC 786

[251] The defense submitted that it was a malicious attempt to connect the accused with the DNA profile. When the science and other evidences are present at the scene of the crime were not suggestive of sexual intercourse, the presence of the semen on the vaginal swab and the underwear of the deceased was not believable. , When the underwear was sent for the testing, white stains were found on it, but during the post-mortem examination the report had clearly indicated that no such stains had been found on the underwear The absence of the stains during the post mortem and presence during the examination at the laboratory was caused for further doubt. The state had to satisfy the court that correct laboratory procedure , protocol and quality control had been exercised .The DNA evidence adduce in the case was held inadmissible and was rejected.

[252] 1996 Cri LJ221 (Kant),

[253] 1995 Cri. L. J. 4090(Bom) 4093

Bombay High Court in the case of Sadashiv Malikarjun Kheradkar v. Smt. Nandini Sadashiv Kheradkar, it was further held that the Court has power to direct blood examination but it should not be done as a matter of course or to have a roving inquiry. The Bombay High court even felt that there should be a suitable amendment by the Legislature and after nothing that no body can be compelled to give blood sample, it was held that the Court can give a direction but cannot compel giving of blood sample.

R.J. Vidyanath J.Observed as under –

"There may be instances where the husband and wife are living together and the wife may have gone astray and then delivered a child through illicit connection. But in the view of legal presumption under sec-112 of Indian Evidence Act the husband cannot be allowed to prove that the child is not born to him since husband and wife are living together, even if it is proved that wife had some illicit relationship with another person. What should be done in such a case is a question death has cropped up in my mind … but if we go by rigor or presumption under Sec-112 of the Evidence Act no husband can be permitted to prove that the child born to the wife is not his, if the husband and wife ere together even if wife is proved to be living in adultery. in some cases it has been held that the Courts are seized to inherent powers, which can be exercised ex debito justitiae."

Bombay High Court has also lamented the absurdity of having only proof of non-access when DNA evidence can decide the matter in a more scientific manner.

15) Arukumar v. Turaka Kondalal Ro[254]

(Where a single locus probe RFLP AND STR analysis was carried out to prove the paternity of the child)

The court pronounced that…..

"……In India DNA fingerprinting and analysis has been widely used in paternity cases in this section of the project, several interesting issues will be dealt with.

[254] 1998 Cri.L. J.4279

Prominent among these is the effect of the new developments in forensic in the form of DNA profiling/fingerprinting and the case for an amendment to S.112 of the Indian Evidence Act dealing with conclusive proof in paternity cases. The other major issue with respect to paternity cases, on which there is much conflicting case, law deals with whether the Courts can direct one of the parties to give a sample of DNA and the effect of refusal to undergo a DNA test. This has obvious constitutional implications……."

16) Syed Mohammad Ghouse v. Noorunnissa Begum[255]

Section 125 of Criminal Procedure Code.

Claim for maintenance of wife and child was made.

The Andhra Pradesh High Court held that the respondent in this case was under no compulsion to submit to a DNA test.

Before ordering the blood test either for DNA or other test court has to consider the facts and circumstances of the given case and the ramification of such an order.

But the court cannot compel a person to give the sample of blood. However if that person refuses to give blood sample without any valid reason the court is at liberty to draw the inference as a necessary corollary in sequel there of.

17) Kanchan Bedi v. Gurpreet Singh Bedi[256]

(Parents patriea jurisdiction of Court was invoked)

However there have been several High Court cases that have distinguished Kundu's case while dealing with cases of DNA testing and paternity.

In the case of Mrs. Kanchan Bedi v. Shri Gurpreet Singh Bedi Where the parentage of the *infant was in question*, and the application filed by the mother for conducting DNA test was vehemently opposed by the father contending that it would violate his rights.

[255] 2001 Cri LJ 2028
[256] 2003 (103) Delhi LT 165, AIR 2003 Delhi 446

The defendant denied that any marriage had taken place between him and the plaintiff, and therefore he was not the father of the child. A DNA test was demanded to determine the paternity of the child and the direction of the Court with respect to the DNA test was challenged. Kundu's case was distinguished on facts[257] and on the ground that the future of a minor infant was in question and the Court's parens patriae jurisdiction had been invoked in this regard.

Hon'ble Vikramjit Sen, J. held that: "it-appears to me to be difficult to resist that the law, as it presently stands, does not contemplate any impediment or violation of rights in directing persons to submit themselves for DNA test, especially where the parentage of a child is in controversy for the grant of maintenance. It was further held that where the parentage of a child is I controversy for the grant of maintenance, parties submitting themselves for the DNA test is not violation of rights…."

18) Geeta Daha v. NCT of Delhi (DB)[258]

(DNA test was conducted on the fetus of the rape victim)

Hon'ble Supreme Court in the case of Geeta Daha v. NCT of Delhi (DB), where a Division Bench of Hon'ble Supreme Court had ordered that a DNA test be conducted on a foetus of a rape victim. Hon'ble Vikramjit Sen. J. distinguished this case from the case of Goutam Kundu v. State of West Bengal, [259], where it was held that "wife cannot be forced to give blood sample and no adverse inference against her for this refusal"

19) Sajeera v. P.K. Salim[260]

*A direction to undergo a DNA test was given*.

Paternity dispute.

Section 112 of evidence Act.

---

[257] The difference being that in the facts of Kundu's case the marriage of the spouses was admitted in the possible reason for the decision was that the legitimacy of the child was presumed and the subjection of the wife to a test was an attempt to "outrage her modesty".
[258] 1997(1) JCC 101
[259] 1993 Cri LJ 3233: AIR 1993 SC 2295
[260] 2000 Cri L J 1208 (Ker).

For proof of paternity, blood test is an important piece of evidence to determine paternity. Negative finding in blood test is definite. Positive finding indicates a possibility. But no person can be compelled to give blood for testing.

Blood test is ordered if strong prima facie case of non-access by husband to wife is established.

However in this case it was already admitted by the mother that the child was born out of wedlock and there had been an illicit relationship. (With the brother of the husband residing in the same house, husband living in foreign country.)Moreover the Respondent had expressed willingness to undergo the test at the petitioner's cost and there was no question of compulsion.

20) Alika Khosala v. Thomas Mathew [261]

No, question of compulsion would arise in case of preserved foetus and directions to conduct paternity test can be made.

It has been held by the Supreme Court that refusal to undergo a paternity (DNA) test would bar a party from challenging the paternity of the child.

21) K. Selvaraj v. P. Jayakumari [262] (Adverse inference can be drawn when the party refuses to under go the DNA test)

An adverse inference could be drawn if the party refuses to undergo a DNA test.[263]. This seems to be a preferable interpretation and strikes a balance between the two extremes. The Court does not have the power to direct the giving of a sample, but if it is not given the Court may draw an adverse inference.

22) Perumal Nadar v. Ponnu Swami[264]

[261] 2000 cri.l.j. 1208(ker) manu/de/2001,
[262] 2000 Cri LJ 4748 (Kerala)
[263] 1995 Cri LJ 4090 (Bom) (The point of adverse inference is also referred to in another case Sadashiv Mallikarjun Kheradkar v. Nandini Sadashiv Mallikarjun Kheradkar v. Nandini Sadashiv Kheradkar
[264] Air 1971 Sc2352 and Amathyeev. Kumare Sain Air 1967 Sc 549 and Baldev raj Meghani v. Urmila Meghani Air 1979 sc 879

It was held that……..Irresistible inference is a presumption juris at de jure and being little less than "shall presume" under sec-3 of the Indian Evidence Act.

"Blood test cannot show positively any man is the father but can show positively that a given man could or could not be the father. It is obviously the latter aspect that puts the blood test as the most valuable in determining the paternity.

23) Raghunath v. Shardabai [265]

Bombay H.C. observed that blood grouping tests have their limitations, as they cannot possibly establish paternity, but can only indicate possibilities.

24) Vasu v. Santha,[266]

The Kerala High Court Had held that taking of a blood sample is a constraint on personal liberty and cannot be carried out without consent. The Madras High Court relying upon a very old case had laid down that it appears doubtful whether such a compulsion can be made even under legislation. It also questioned the power of a guardian ad litem to give consent in such cases.

25) Bharu Raj v. Sumesh Sachdeo[267]

Realizing the value of such tests for determining paternity, maternity, and fixing identities, a Bench of Allahabad High court in Bharu Raj v. Sumesh Sachdeo, held that such a test puts a child on the anvil of legitimacy and illegitimacy and therefore it would be unjust and not fair either to direct a test for collateral reason to assist a litigant in his or her claim. He Hon'ble Allahabad High Court further held that the child could not be allowed to suffer because of his incapacity and that if in a case the Court has reasons to believe that the application for blood test is of fishing nature or was made for some ulterior motive it would be justified in not acceding to such a prayer.

[265] AIR 1986 Bombay 386
[266] 1975 Ker LT 533
[267] AIR 1986 All 259

26) State v. Sheshappa Dudhappa Tambade[268]

"…….the true character of the legislation has to be ascertained when a provision of law is impugned on the ground that it is ultra virus, the power of the legislature which enacted it or that it is violation of the rights guaranteed by the constitution, having regard to the nature of enactment as a whole to its objects.

27) Bipin Chandra Shantilal Bhattv. Madhuriben Bhat[269]

(Forced medical test cannot be ordered.-Article -21)

No adverse inference can be drawn against a person refusing to submit for blood test.

'…….an individual can be deprived of his life or personal liberty only by action of the state either under the provision of any penal enactment or in the exercise of any other coercive process vested in it under law……..". Further it was held that there must be some statutory provisions under which it would be open to the court to compel medical examination of a party thus restricting the enjoyment of personal liberty of that person.

28) krish Murthi Aiyer v. Govind Swami Palley [270]

It may be mentioned at the very outset that dealing with *civil cases,* Courts in India have adopted a trend that a party cannot be compelled to give sample of blood for blood group tests. Therefore such a sample cannot be collected against the will of such a person Courts in India have adopted this general trend, in the absence of any statutory law in this field.

29) Hargovinda Soni v. Ram Dularey,[271](Person can be compelled to give a sample of blood against consent)

(Rampal Singh.J.) The Madhya Pradesh High Court was categorically of the opinion that no person can be compelled to give a sample of blood against consent. In a case where a party does not consent for giving his sample for blood or DNA fingerprint

[268] AIR 1964 Bom. 253
[269] AIR 1963 Gujarat 250
[270] AIR 1966 Mad.443
[271] AIR 1986 MP 57(62)

test, the maximum the Courts can do is to draw an adverse inference against that party for such refusal.

Indicating a gap in law on such question, a single Judge of Madras High Court had, however, held it long back [272], that "there is no procedure either in the Civil Procedure Code or the Evidence Act which empowers the Court to enforce" the taking or giving of blood samples.

However, in some cases it has been held that the Courts are seized to inherent powers, which can be exercised ex debito justitiae. Following Madras High Court, the Bombay High Court[273] was also of the considered opinion that though a Court can direct respondent to give blood sample, it cannot compel her to do so.

Bombay High Court, however, clearly held that the Court lacked powers in enforcing the giving of blood samples in case of failure to do so, even inspire, of the directions by the Court. It ultimately favored for merely drawing an adverse inference in case there was a clear dental for giving such samples.

30) R.P. Uloganambi v. K. C. Loganayaki [274]

*(No person can be compelled to give blood against his/her will )*

The Madras High Court has gone to the extent holding that a party having consented to give such a sample on one stage of the proceedings can validly make a withdrawal of such an offer and the principle of estoppels (Section 115 of Evidence Act) would not come across.

The Apex Court upholding Madras High Court observed that it required to be carefully noted no person can be compelled to give sample of blood for analysis against (his or) her will and that no adverse inference can be drawn against (him or) her for such a refusal . What weighed the mind of the Apex Court appears to be the effect over the paternity of a child, since there was likelihood for terming him bastard.

31) Najabhai v. State of Gujarat[275] :

[272] olavarupu Venkataswarlu v. Polavarappu Subbaya, AIR 1951 Madras 910.
[273] Sadashiv Khedarkar v. SMT. Nandidni sadashiv Khedarkar ,Cr.L.J.1995 4090
[274] 1986 Cr LJ 1522.

A single Judge of Gujarat High Court has held that the bar of Article 20(3) of the Constitution of India would extend with regard to compelling the accused to submit him to medical examination also.

32) Ananth Kumar v. State [276](Section 53 0f Cr. P.C. was discussed)

Referring to the powers conferred under Section 53, Cr. P.C. the Andhra Pradesh High Court has held that although there is no clear provision in Cr. P.C. for taking such blood samples yet there is no prohibition for taking such blood samples of an accused by exercising powers under Section 53 Cr. P.C. The Court observed that taking samples of blood and semen would come within the scope of examination of the person of the arrested person and therefore, "examination of a person by a medical practitioner must logically take in examination by testing his blood, sputum, semen, urine etc. The Court further held that Section 53 provides the use of such force as it reasonably necessary for making such an examination. Therefore, it held that whatever discomfort might be caused, when samples of blood of semen are taken from an arrested person, would be justified under the provision of Section 53 and 54 of Cr. P.C.

33) Jamshed v. st. of U.P.[277]

On the other hand a Division Bench of Allahabad High Court dealing with a criminal case, was of the view that though there was no specific provision in Indian Law permitting taking of blood yet in a criminal case, an examination of person can be made under Section 53(1) of the Cr. P.C. which shall include the taking of blood samples, including an examination of an organ inside the body. The Court drew the aforesaid conclusion per force the provisions of Section 367 (1) and Section 482 of the Cr. P.C. It also held that there is nothing repulsive of shaking to conscience in taking the blood of an accused person in order to establish his

Guilt and so far as the question of causing hurt is concerned, even causing some pain may be permissible under Section 53, Cr. P.C.

---

[275] ST1972 Cr. LJ 1605
[276] Ananth Kumar v. ST
[277] 1760 CR. LAW. J.1680

34) Polavarrappuvenkatasvarallu And OthersV. Polavarrappu Subbaiya[278]

The Madras High Court relying upon a very old case had laid down that it appears doubtful whether such a compulsion can be made even under legislation. It also questioned the power of a guardian ad litem to give consent in such cases. It may be mentioned at the very outset that dealing with civil cases. [279]

35) Subayya Gounder v. Bhoopala Subramaniam[280]

It may be observed that in given circumstances, simply an adverse inference may not be of any consequences since such a process would tantamount the prevention of positive evidence before the Court. The law as laid down by Madras High Court in Subayya Gounder v. Bhoopala Subramaniam, 1959 Cri LJ 1087 was considered in the light of these circumstances, but that view was not disturbed by the Apex Court in Gautam Kundu.

36) State of Bombay v. Khthikalu[281]

Apex Court in State of Bombay v. Khthikalu wherein, such examinations were held not included within the meaning of becoming a witness.

37) Patangi Balrama Venkata Ganesh And Others V. State Of A.P.[282]

Admissibility of Expert evidence in DNA test, Precaution must be taken while conducting DNA test in laboratory, need for quality control

Section 45 of Indian Evidence act.

Section 302,120-B, 449,307,149,138, 506, 397 of Indian Indian PENAL CODE.

Section 27(2), 25 (1-A) of Arms Act.

---

[278] AIR 19951 Madras
[279] State v. Sheshappa Dudhappa Tambade, AIR 1964 Bom. 253 and Bipin Chandra Shantilal Bhattv. Madhuriben Bhat AIR 1963 Gujrat 250. And Krishna Murthi Aiyer v. Govind Swami Palley , AIR 1966 Mad.443.
[280] AIR 1959 Madras 396:
[281] 1961 (2) Cr LJ 856 SC : AIR 1961 SC 1809
[282] 2003 Cr. LJ4508(A.P.)

This case is related to murder of two persons, one the Member of Parliament and the other his gunman, the assistant left his pink shirt on the place of occurrence. The said shirt was sent to DNA expert to find out whether the shirt belonged to the suspected accused or not.The DNA expert's opinion was that blood stain found on the shirt tallied with the accused who also sustained injuries in the commission of crime.

It was held by the Court that report of the DNA expert (holding MS.C. Ph.d., POST DOCTORAL DEGREES IN Criminology and DNA technology) was fully admissible in evidence as it is a perfect science.

38) Anil Kumar V. Turaka Kondala Rao And Others[283]

Section 125 of Criminal Procedure code.

In this case the responden thad illicit relations with the mother of petitioner and the petitioner born out of their relations. Later on respondent denied his father hood of petitioner and made the allegation of respondent being in illicit relations of other person.

DNA test proved respondent –father to be a biological father of the petitioner.

Maintenance was granted from the date of petition on the basis of DNA Test.

39) Shaikh Fakruddin V. Shaikh Mohhamad Hasan and Others[284]

Section 112 of Evidence Act.

Birth of a child during continuance of valid marriage. Suit for perpetual injunction was filed. First defendant claiming to be the son of second defendant.second defendant denied such relationship.First defendant requested for the DNA test of second defendant to establish his alleged relationship with second defendant. Second defendant alleging that first defendant was born after divorce of a mother of first defendant.

[283] 1998 Cr.LJ 4279 (AP)
[284] 2005 (4) ccc 522(AP)

Held that dispute was purley of property and not of paternity.Paternity was an ancillary issue.

Judicial interpretation :

DNA test would amount to permitting the parties to lead evidence to rebut the conclusive proof.

40) Dharma Deo Yadav V. State Of U.P.[285]

Expert Evidence admitted, death penalty held Constitutional.

Legal provisions involved: section 235(2),354(3), 366,313 cr.P.c.

Section 27, 45 Indian Evidence Act

Murder of a foreigner lady Diana Clare Routley by a guide. skeleton of deceased recovered, blood sample of alleged father was tested and compared with the humerus and fumer bones of the deceased.it was found biologically related to the boneds of deceased.

Use of STR DNA test Technique.

Judicial interpretation:

1. Scope of error in DNA fingerprinting including malfunctioning of the instrument, human error and use of chemicals beyond expiry date, is one in 32 billion. Chief of the DNA fingerprinting laboratory had adopted test as Short /tandem Space repeats Analysis. Blood sample of alleged father was biologically related to the sources of humerus and fumer bones of the deceased. Because life imprisonment is rule and capital sentence is an exception, it was held as possible to prove murder, death penalty was held constitutional.
2. Brutally murder of a foreign tourist in India has tarnished and disgraced the image of country.
3. Death penalty be awarded when collective consequences of community is shocked.

[285] 2005 (2) DNR(HC)675

41) Shailesh Munjal And Others V. All India Institute of Medical Science And Others.[286]

Consumer protection Act 1986, Section 2(1)(o) and 14.

Complainant's son was suffering from thalassaemia major. Mother advised by AIIMS doctors to under go chronic Villus Biopsy test. Mother was advised to go ahead with pregnancy on the basis of Fetal Dignosis Reports. Son born was also suffering from same ailment. Contention of doctors that DNA technology may commit error up to 1-2 %Complaint was made against the AIIMS doctors for erroneous foetal diagnosis report. Complaint against doctors was maintainable in consumer court under Consumer Protection Act and all India Institute of Medical sciences act 1956.

Judicial interpretation:

When error or imperfection has been crept in, in bifurcation of feutal tissues from mother's tissues, but it could not amount to negligence... direction issued for giving medicine free of charges, getting son periodically examined and blood transfusion be alone without any reservation.

42) Rajesh Chaudhary V. Nirmala Chaudhary [287]

(paternity dispute, maintenance, DNA test)

Constitution of India Article 227

Indian Evidence act Section 112

Civil procedure Code Order XXVI, Rule 10-A and section 151

Section 125 of Criminal Procedure Code.

Proceeding by wife for maintenance under section 125 against her husband was filed. Husband filed divorce petition. Wife claimed interim maintenance. Husband denied

[286] 2004 Consumer Protection Reporter 27(NC) (Del).
[287] 205(2) Divorce and Matrimonial cases delhi 814

that he had fathered the child. Application for DNA test by husband was rejected.( case covered by reported decision of 2005, 4, SCC 499)

Held, Husband could not prove non-access to wife. Woman's dignity should not be violated on ill-founded allegations.

Minor child cannot wait for maintenance amount and interim maintenance must be granted till the legitimacy issue is finally decided.

Judicial interpretation: Evidence of non-access is necessary in seeking DNA testing paternity dispute

43) Chandan Pannala Jaiswal V.State Of Gujarat[288]

Offences punishable under sections 376, 324, 328, 323, 342, 114 of Indian Penal Code .

Sec. 66(1) and 85(1)(3) of Bombay Prohibition Act.

Whether the investigating agency can be conferred with authority to resort to DNA test in absence of any special law enacted by the legislature?

The power of the police to investigate into the cognizable offence is ordinarily not to be interfered with by the judiciary. The legal position is absolutely clear and also settled that the court would not interfere with the investigation. Such an attempt would mean from the time of lodging of FIR till the submission of reports by office in-charge of investigation in the court under section 173 (2) of Criminal Code. This field is being exclusively reserved for the investigating agency.

Care should be taken to seal and label samples properly to ensure the future integrity and the identification of the samples.

Under section 156 of Cr. P.C. the prosecution applied for the DNA test of the accused. Which was allowed by the court? Request made by then accuses to permit joint forensic examination by experts of prosecuting agency as well as forensic

[288] 2004 Cri.LJ 2992 (Guj)

examiners and DNA expert were engaged by accused to give their own opinion was not allowed. Plea of alibi was raised by accused.

It would amount to interference in the process of investigation.

Code of criminal Procedure, section 156 for DNA fingerprinting necessary directions were issued as under.

1) Blood is collected in jail itself by a responsible medical officer.
2) If necessary blood of accused may be collected in civil hospital by a responsible medical officer-accused remaining in custody of jail authorities.
3) Expert of Forensic laboratory to ensure that crime exhibits remain intact and not lost totally. It may be required for re-testing.

44) Haribhai Chanabhai Vora And Others V. Keshubhai Haribhai Vora[289]

Constitution of India Article 20, 21, 22

Property dispute, suit was filed for the declaration; defendant denied that plaintiff is his son. Plaintiff applied for the DNA test of the parties. Trial court allowed the petition.. Writ against the trial court's order was filed by defendant.

Held, since defendant has not given consent for DNA testing he cannot be compelled for the same. Such order would amount to interference with personal liberty. At the most adverse inference can be drawn against him at the end of the final conclusion.

Judicial interpretation:

Consent of the parties is must in DNA testing.

45) Abdul Salam V. Chalil Sajid And Others.[290]

Section 112 of Evidence Act

Section 125 of Criminal procedure code.

[289] AIR 2005 GUJ. 157
[290] 2003, 1 DMC 774

Paternity and, maintenance dispute

Judicial interpretation

Even though the result of genuine DNA test is said to be scientifically accurate, but that is not enough to escape from the conclusiveness of section 112 of Indian Evidence Act, 1872.

46) Mathew V. Annamma Mathew[291].

Indian Divorce Act 1896, Section 10, 18, 19

Section 2, 112 of Indian Evidence Act.

Petition filed for declaring marriage null and void .Husband filed divorce suit after 12 years of marriage and denying paternity of child.

Husband alleging that on very first night wife told him that she was already pregnant and husband did not have sexual intercourse with her.

Husband seeking blood test of mother, child and himself for deciding paternity of child.

Held:

Child born while valid marriage is continuing, between husband and wife is conclusively proved to be legitimate child of the husband, and no evidence in rebuttal can be allowed to be given and further that "access" means opportunity to have sexual intercourse. petition was dismissed.

47) Geetha V. State Of Kerala And Others[292]

Section 125 and 293, expert evidence admissible under section 293 of code of Criminal Procedure.

[291] 1994 (1) DMC 524 (ker)
[292] 2005 Divorce and Matrimonial cases286 (ker)

Petitioner claiming maintenance for her child born due to illicit relationship. Respondent denied the paternity.DNA test was found in favor of the petitioner. Report was not admitted without examining scientific expert. Petition to high court was filed.

Held, Order unsustainable.

Report of DNA Expert is admissible under section 293 of Cr.P.C. However respondent father may examine expert at his expense.

48) K.Selvarjan Alis Surendan V.P.Jayakumri[293]

Section 125, 127-Maintenance of destitute wife.

Refusal to DNA test by husband. Inference of marriage can be drawn.

Held, defiant stand of the appellant in refusing to undergo DNA test lead to a strong prima facie satisfaction as to the existence of marriage between appellant and respondent.

49) Kunhiraman V. Manoj[294]

Section 125 Cr.P.C. maintenance of child , paternity denied. Law allows an illegitimate son also to be maintained by father though the mother who cannot claim to be the wife , is not entitled to get maintenance.

Held, the results of DNA test by itself could be taken as conclusive in deciding paternity.

50) Sajitha V. State Of Kerala[295]

Evidence act section 112, paternity dispute.

The result of genuine DNA test is said to be scientifically accurate, thus conclusiveness not affected by DNA test.

[293] 2001 (2) DMC13 KER. DB
[294] 1991(3) CRIMES 860 (ker)-first case to accept DNA test as EVIDENCE IN COURT.
[295] 2003 (1) DMC 222 ker

51) S. Thangavelu V. Kannammal[296]

Section 45 of Evidence Act.

After 10 years of birth of the child. It was held by the court that petitioner did not make out a prima facie and bona fide case and petition was rightly rejected by the lower court.

In this case, the marriage was solemnized in 1984 and the child was born in 1988.Dispute arises when husband filed an application for divorce on the ground that he had no sexual intercourse with his wife and he also requested to court for DNA test of his wife and disputed child, he had never intercourse with wife. And the child is not his offspring. After 14 years of marriage and 10 years of birth of son. Wife filing suit for partition of property due to attempt b husband to alienate it for wayward wife.

Held: Though the court has ample power to direct the parties to undergo to give sample of blood for DNA test. but, the party who sought for such relief should have strong and prima facie case..

DNA test was not allowed after 10 years of birth of child.

52) Bommi And Others V. Munirathinam[297]

Indian Constitution Article 226,

Evidence Act section 112, C.P.C. Order XXVI Rule 10(a)

Paternity f child and mirage denied.

Held, DN test could be ordered proved paternity of child which doe not amount to torture.

[296] 2005 (25)AIC 496, AIR 2005 Mad 106
[297] 2004 (2) HLR 517 9Mad)

53) D. Rajeswari V. Stte Of Tamilnadu And Others[298].

Medical Termination of Pregnancy Act 1971. Section 3, 4

Indian penal Code section 376

Major girl kidnapped and rapped several times by several persons at different interval before her escape from their clutches. The girl became pregnant. Police officers not listening her not taking action. She approached to court for allowing termination of pregnancy.

The court deemed it fit to direct the chairman and superintendent, Government Kasturba Gandhi Hospital for women and children Madras 5 to conduct medical termination of pregnancy to ask for DNA test, which would be helpful to prove the case of rape alleged by the petitioner, against the persons, during the course of trial.

Judicial interpretation: In a case of rape court deems it fit to conduct medical termination of pregnancy and preserve fetus to enable the investigation agency to ask for DNA test.

54) Thogorani Alias K.Damayanti V. State Of Orissa And Others[299].

Code of Criminal Procedure 1973, section 53 , 173 (8),

Section 114 of Indian Evidence Act.

Article 20(3), 21 of Indian constitution.

In this case it was held that, DNA evidence is now a predominant forensic technique for identifying criminals where biological tissues are left at the crime scene. DNA testing on sample such as saliva, skin, blood hair or semen not only helps to convict but also serves to exonerate.

The sophisticated technology makes it possible to obtain conclusive results in case in which the previous testing has been inconclusive. Moreover DNA sampling may also

[298] 1996, Cri. L J3795(Mad)
[299] 2004 Cr. L J4003 (Ori.)

impingent familial privacy where information obtained from one person's sample provides information regarding his or her relatives.

Though section 53 of Cr.P.C. refers only to examination of accused by medical practitioner at the request of the police officer, there is no reason the court should not have a wider power for the purpose of doing justice in criminal cases by issuing the direction of the police officer to collect blood sample for the accused and conduct DNA test for the purpose of further investigation under section 173(8) of the Code.

Power of the court to direct DNA test of the accused is discretionary. Discretion exercised if strong prima facie case is made out.

In this case two children were born out afer the sexual intercourse with her on promise of marriage. Strong prima facie case was made out, refusal to DNA test not proper. Investigating officer directed to take sample of blood of accused for DNA testing.

If accused refused to give blood sample then adverse inference can be drawn.It is not violative of Article 20(3) and 21.court has to do balancing act between public interest and rights mentioned under above articles.

Participation of the accused in commission of crime , gravityof offence, age , health both physical and mental of accused, avaibility of the evidence through other means are relevant factor ad are to be considered before ordering DNA test.

1. Power of the court is discretionary to grant DNA test when strong prima fasci case is made out.

2. Adverse inference may be drawn on refusal by accused to give blood sample for DNA testing.

55) Vishal Motising Vasava V. State Of Gujarat[300]

Section 293 Of Cr.P.C. Paternity dispute.

Section 45 and 122 0f Indian Evidence Act.

[300] 2004 Cri.L J 3086 (guj)

Judicial interpretation

1) In case of second DNA testing of accused and child, it was held permissible.

2) But complainant cannot insist for conducting DNA testing at a particular laboratory.

56) Amarjit Kaur v. Harbhajan Singh[301]

In this case , it was held that even though the DNA test is said to be scientifically accurate, even that it is not enough to escape from the conclusiveness of Section 112 of the Evidence Act, for example, if a husband and wife were living together during the time of conception, but the DNA test revealed that the child was not born to the husband, the conclusiveness in law would remain irrebuttable and that this may look hard from the point of view of the husband, who would be compelled to bear the fatherhood of a child of which he may be innocent; and that but even in such a case the law leans in favour of the innocent child from being bastardised, if his mother and her spouse were living together during the time of conception.

57) Venkatachalam v. Anandha Jothi @ Rasathi[302] and another in Minor Shanmugam v. Karuppiah @ Karuppannan[303].

In both the cases, it has been held that compelling minor to give sample of his blood for analysis, is absolutely illegal and not permissible in law and the same is without jurisdiction. Paternity could be proved only at the time of trial after examination of witnesses, on perusal of the documents filed by the parties and the evidence deposed by the witnesses.

58) Sunil Eknath Trambake v. Leelavati Sunil Tambake[304]

Identical view has been echoed by the Bombay High Court also in Sunil Eknath Trambake v. Leelavati Sunil Tambake, wherein, it is held that DNA test can be ordered only in exceptional and deserving cases, and even it is in the interest of the child and it cannot be directed as matter of routine and the Court, while ordering DNA

[301] 2003 (10) SCC 228
[302] reported in 1997 (II) CTC 763
[303] reported in 1998(1) MLJ 454
[304] AIR 2006 Bombay 140

test, has to record its reasons in writing. It is also observed that Courts should record reasons as to how and why such test is necessary to resolve the controversy and is indispensable cases and that result of such test being negative will have an effect of branding a child as a bastard and the mother as an unchaste women, which may also adversely affect the child psychologically and that the Courts have however should not hesitate to direct DNA test, if it is in the best interest of a child.

59) Jothi Ammal v. K.Anjan[305]

The Division Bench decision of this Court in Jothi Ammal v. K.Anjan ), in which, a decision of the Supreme Court in Kanti Devi v. Poshi Ram[306], has been referred and followed, in which, it is held that the expression "access" used in Section 112 of the Indian Evidence Act had been held by courts as "opportunities to reach" and that therefore, the court must have materials to come to the conclusion that during the period when wife conceived, husband had opportunities to approach her or vice-versa and only in this context, it is stressed on the need for definite pleading and proof from either side and if it is shown that the parties had no access to each other at the time when the child could have been begotten, as held by the Supreme Court in Kanti Devi's case referred to above, the presumption under Section 112 of the Indian Evidence Act stands rebutted.

Delhi High Court quashed the lower court's decision and accepted demand for DNA test. Justice Vipin Sanghi, while ordering for DNA test, observed that 'The parentage of the child can only be determined by a DNA test. The liability to pay maintenance under section 125 CrPC can be avoided by the petitioner with respect to this child only if it is established that he is not the biological son of the petitioner'.

Firstly, Justice Sri Vipin Sanghi has brought India into modern world of jurisprudence with one stroke of pen. We must hold this great judge in awe and respect he commands for his courage and dedication to the truth. he Delhi HC allowed DNA tests to establish paternity. This is a landmark judgment for victims of paternity fraud in India.

[305] I (2007) DMC 756 (DB
[306] in 2001 (5) SCC 311

60) V.K.Bhuvaneswari v. N.Venugopal[307] and M.Karthika vs. R.Manohar[308]-

Civil Revision Petition is filed under Article 227 of the Constitution of India against the fair and decreetal order of the learned Principal Family Court, Chennai in I.A.No.2246 of 2007 in F.C.O.P.No.1981 of 2005, dated 10.01.2008.

The petitioner is the wife of the respondent. Their marriage was solemnized on 09.07.1995 at Trichy. Heartburns arose between them, broke their nuptial life. On 06.05.1997, a female child was born and named as Vyshali. The love lost between them, culminated in filing of F.C.O.P.No.1981 of 2005 by the respondent on the file of the Principal Family Court, Chennai, for dissolution of marriage. A male child was born on 28.08.2004 and this respondent disclaims paternity of the child. The petitioner filed her counter. Matter came up for enquiry and presently, it is in part-heard stage. The respondent filed I.A.No.2246 of 2007 under Section 10 of the Family Court Act, 1984 r/w. Order 26 Rule 10A CPC. Praying the Court to pass appropriate orders for DNA test to be conducted on the male child born on 28.08.2004.

To sum up, both the cases the conclusions are:

1. A matrimonial Court has the power to order a person to undergo medical test.

2. Passing of such an order by the Court would not be in violation of the right to personal liberty under Article 21 of the Indian Constitution.

3. However, the Court should exercise such a power if the applicant has a strong prima facie case and there is sufficient material before the Court

"If despite an order passed by the Court, a person refuse to submit himself to such medical examination, a strong case for drawing an adverse inference would be made out. S.114 of the Indian Evidence Act also enables a Court to draw an adverse

[307] dated: 15/12/2006, c.r.p.pd.no.776 of 2006
[308] in the high court of judicature at madras, dated : 23.04.2009,coram,the honorable Mr. justice s.palaniveluc.r.p.(pd)no.1528 of 2008,m.p.no.1 of 2008

inference if the party does not produce the relevant evidence in his power and possession."

61) Ms. X V. Mr. Z And Others [309](Under divorce proceeding husband and wife alleging adultery against each other. DNA Test on fetus was directed by H.C.)

Constitution of India -Article 20(3), 21-Right to privacy. Section 3 of Indian evidence Act

In this case wife alleged adultery by husband. Husband alleged illicit relation of wife with another person. Pregnancy of wife was terminated. Slides of the tubular pregnancy were preserved. Husband asked for DNA test of the slides. Wife opposed on the grounds of Right to privacy.

Held, Right to privacy is not an absolute right. DNA test on slides was permitted.

A single Judge of Delhi High Court had allowed a similar application and had directed that at the cost of husband, the Pathology Department of All India Institute of Medical Sciences should conduct the DNA test. The DNA test was to be conducted of a fetus.

62) N D Tiwari paternity case, Supreme Court order, N D Tiwari DNA test[310]

The Supreme Court has held that DNA test in a paternity suit cannot be ordered by courts in a routine manner but should be directed only in exceptional cases as it would otherwise be an invasion of a person's privacy.

"In our view, when there is apparent conflict between the right to privacy of a person not to submit himself forcibly to medical examination and duty of the court to reach the truth, the court must exercise its discretion only after balancing the interests of the parties and on due consideration whether for a just decision in the matter, DNA test is eminently needed.

[309] AIR 2002 Delhi 217

[310]See, The Indian Express, New Delhi, Mon Mar 14 2011 ,Available at,www.indianexpress.com/news/paternity-case-no-relief.../762146/

"DNA test in a matter relating to paternity of a child should not be directed by the court as a matter of course or in a routine manner whenever such a request is made," a Bench of Justices Aftab Alam and R M Lodha said in a judgement.

The apex court passed the judgement while setting aside an Orissa High Court order which had upheld the direction of the Orissa State Women's Commission for conduct of a DNA test to determine the paternity dispute of a couple.

63) Nurse alleges rape, Supreme Court stays DNA test against doctor who claims innocence[311]

[311] www.dnaindia.com

# Chapter-VII

# Conclusion

## 1. Introduction

### 1.1 DNA Databank: An Over View

DNA Data Banking is a need of the time. Every country must take a step ahead to establish DNA Data bank in their respective jurisdiction where no such establishment has yet been introduced.

While dealing with DNA Data Bank establishment one should take into consideration the following aspects[312]:

- What is DNA data banking?
- What should be the Object-purpose of creating DNA data banking?
- Useful to whom and how
- What type of data is preserved?
- What should be there in DNA data base?
- What is the condition in foreign countries
- DNA data banking and India. Why is there a need of creating DNA data bank in India?
- Functioning of DNA data banking.
- Why is there a need of legislation?
- How should it be prepared?

[312] See, Allison Puri and Mike Redmayne, "An International DNA Database: Balancing Hope, Privacy and Scientific Error", "DNA evidence probability and the courts"1995 *criminal law review* available athttp://www.met.police.uk/history/fingerprints.htm,http://www.pbs.org./wnet/redgold/innovators/bio_landsteiner. (accessed on 26th july 2009 )
See also-Gill.peter.Alec J.Jeffery And David J. werret *"Forensic application of DN fingerprinting"*, Available at http:/www.pbs.org./wgbh/pages/frontlineshows/case/revolution /wars.html. and http://web.utk.edu/ and (accessed on 26th July 2009) and http://www.mslawyer.com. (accessed on 26th July 2009)
-See also Pandit M., W. AND Dr. Lalji Singh 'DNA testing, Evidence Act and Witness testing' *The Indian Police Journal* dec-2000 p.100 (Cr.L.J. 2004) H.C Articles Available at MANU/tn/2335/2002.

- Who are the persons authorized to maintain data bank, to regularize functions of DNA data bank
- DNA data and privacy issue.
- Creation of DNA advisory board by legislatures.
- Standard created by DNA advisory board should be made responsible for declaring national standard of forensic DNA analysis.
- What should be the functions of DNA data banking in India
- Laboratory, organization-personal qualification, documentation, materials and equipments, validation of analytical procedure.
- Creation of CODIS[313].
- Laboratories have to prepare their special DNA analysis program according to the need of the country.
- Case study, research-development-technology, data preparation and maintenance, computerizing DNA index system.
- How the DNA data base should be prepared?(at District, State, National level)
- In case of need of DNA evidence role of judge, police officer, lab system, the investigation agencies
- Considering australian law while DNA index, crimes act….other foreign laws while establishing DNA Data bank.
- Utility, advantages and disadvantages, limitations of DNA index, profiling, data banking should also be considered.
- rules applicable for all

### 1.2 Forensic Laboratories

The crime lab systems in operation across the country vary in structure. Public crime labs may be Federal-, State-, county-, or city-sponsored. Many public labs are

[313] The development and expansion of databases that contain DNA profiles at the local, State, and national levels have greatly enhanced law enforcement's ability to solve cases with DNA. Convicted offender databases store hundreds of thousands of potential suspect DNA profiles, against which DNA profiles developed from crime scene evidence can be compared. Given the recidivistic nature of many crimes likelihood exists that the individual who committed the crime being investigated was convicted of a similar crime and already has his or her DNA profile in a DNA database that can be searched by the Combined DNA Index System (CODIS) software. Moreover, CODIS also permits the cross-comparison of DNA profiles developed from biological evidence found at crime scenes. Even if a perpetrator is not identified through the database, crimes may be linked to each other, thereby aiding an investigation, which may eventually lead to the identification of a suspect.

associated with a law enforcement entity; some are associated with a district attorney's office, while others are independent government entities. Some forensic laboratories are privately held companies.

Not all laboratories are capable of providing comprehensive and complete forensic services. Some do not have the capability to conduct DNA testing and may need to contract out their DNA cases to other agencies or private corporations.

Not all laboratories are capable of the same DNA testing either. Most DNA labs have the capability to conduct testing on nuclear DNA, which is the single copy of DNA that exists in every cell nucleus. A select few specialize in Y-STR testing, which is DNA conducted on the Y-chromosome, which is found only in males.

Others specialize in testing mitochondrial DNA (or mtDNA), which is found in every cell of the body regardless of the presence of a nucleus[314].

- Criteria for entry of DNA profiles into databank vary from country to country e.g., Belgium has no Suspects' database, Austria limits it only for suspects of "serious offences", UK has it for all suspects
- Likewise, criteria for removal of DNA profiles from databank also vary e.g., in time of retention for convicted offenders as well as for suspects; in the UK, the law allows for indefinite retention of suspects' profiles even if the suspect is released or acquitted
- DNA databank shall have following indices for various categories of data (DNA identification records):

  - A crime-scene index;
  - A suspects' index;
  - An offender's index;
  - A missing persons' index;
  - An unknown deceased persons' index; and
  - A volunteers' index

[314]See,Article, "Advancing Justice Through DNA Technology",Available at http://www.dna.gov/basics/laboratory/ (accessed on 7th august 2009)

- No person who receives the DNA profile for entry in the DNA data bank shall use it or allow it to be used for purposes other than for the administration of this Act.
- Criteria specified for removal of information (e.g., when a conviction has been set aside on appeal) or retention of DNA Profiles
- Post-conviction DNA testing for establishment of innocence

### 1.3 DNA Profiling Board

- Offer advice on the size, location, creation/ up gradation of DNA Laboratories
- Monitor, conduct, and audit training programmes and be responsible for quality control and assessment of DNA laboratories
- Supervise and inspect the equipment and material facilities
- Authorize communication of DNA profiles to National law enforcement agencies and for crime investigation
- Make recommendations for maximizing the use of DNA techniques and technologies
- Identify potential scientific advances that may assist law enforcement agencies in using DNA techniques
- Ethical, Legal, and Social Concerns about DNA Databanking must be considered while making legislations on DNA
- DNA patterns may not be neutral
- Fairness in the use of genetic information in the database by insurers, employers, courts, schools, adoption agencies, and the military, among others. Who should have access to personal genetic information, and how will it be used?
- Privacy and confidentiality of genetic information who owns and controls genetic information?
- Psychological impact and stigmatization due to an individual's genetic differences
- How does personal genetic information affect an individual and society's perceptions of that individual?
- How does genomic information affect members of minority communities?

### 1.4 Use of DNA Data Base:

DNA Data Base is used in other foreign countries to enhance the ability of law enforcement agencies by using local state and national DNA Database.

Databases contain thousands of DNA profiles which can be matched by evidentiary items collected from places of occurrence. Convicted offender database is used to solve crimes like burglary, murder. Sexual offences. Deterrent for criminals who intend to repeat crimes.i.e. They can be apprehended at any time[315].

**Filing the information: DNA profile database**

- CODIS Combined DNA Index System[316]
  - run by FBI
  - contains profiles of convicted offenders
  - contains unidentified DNA taken from crime scenes
  - CODIS allows identifying possible suspects when no prior suspect exists

**DNA profile databases: Invasion of privacy**

- Some groups are worried that DNA samples will get in hands of insurance companies or potential employers use to identify genetic defects that might cost them $$
- Is this concern invalid?
- DNA profiles are different from fingerprints, which are useful only for identification. DNA can provide insights into many intimate aspects of a person and their families including susceptibility to particular diseases, legitimacy of birth, and perhaps predispositions to certain behaviors and sexual orientation.
- Some groups are demanding that DNA samples be destroyed after investigation is complete. Stored DNA contains much more information than

[315] See, Article on DNA Data Base ,Available at http://www.legislation.gov.uk/ukpga/2003/42/contents and http://www.cps.gov.uk/news/fact_sheets/sexual_offences/ (accessed on 1oth August 2009)

[316] visit CODIS website to see how it works -www.fbi.gov/hq/lab/codis/index1.htm (accessed on 3rdApril 2009)

simple physical features, and thus provides much more raw material for information.

- Who is chosen for sampling is a concern.
- Suspects can be forced to provide a DNA sample. Arrestees --regardless of the degree of the charge and the possibility that they may not be convicted--can be compelled to comply. This empowers police officers to 'investigative arrests'.
- Would it be against human rights? Practicality also is a concern.
- An enormous backlog of over half a million DNA samples waits to be entered into the CODIS system. The statute of limitations has expired in many cases where the evidence would have been useful for conviction

**Multiple roles of Police: Coercion and tutored reporting**

Public Policy Issues

- Who should & shouldn't be in the DNA Database?
- Who should have access to the DNA Database?
- How can the information in the DNA Database be used?
- How long is a DNA sample retained?
- Should 'Right to Information' be more secured and restricted for DNA based information
- Legislative Responsibilities
- To make proper panel and advisory body for maintaining uniformity on DNA identification records, storage and DNA analyses
- Federal funding for DNA Databanks
- Relevant federal acts to safeguard public interest
- Forensic DNA Databanks and Privacy of Information:

DNA typing in the criminal-justice system has so far been used primarily for direct comparison of DNA profiles of evidence samples with profiles of samples from known suspects. However, that application constitutes only the tip of the iceberg of potential law-enforcement applications. If DNA profiles of samples from a population were stored in computer databanks (databases), DNA typing could be applied in

crimes without suspects. Investigators could compare DNA profiles of biological evidence samples with a databank to search for suspects.

In many respects, the situation is analogous to that of latent fingerprints. Originally, latent fingerprints were used for comparing crime-scene evidence with known suspects. With the development of the Automated Fingerprint Identification Systems (AFIS) in the last decade, the investigative use of fingerprints has dramatically expanded. Forensic scientists can enter an unidentified latent-fingerprint pattern into the system and within minutes compare it with millions of people's patterns contained in a computer file. In its short history, automated fingerprint analysis has been credited with solving tens of thousands of crimes.

This examines whether similar databanks of DNA profiles should be created and, if so, how and when.

### 1.5 Comparison of DNA Profiles and Latent Fingerprints

To identify key issues pertinent to the establishment of DNA databanks, it is instructive to compare DNA profiles and latent fingerprints.

- Latent fingerprints are found at crime scenes much more commonly than are body fluids that contain DNA. Latent-fingerprint analysis can be useful in a wide range of crimes, including many murders, rapes, assaults, robberies, and burglaries. However, the probative value of latent fingerprints is often limited to establishing that a suspect was present at a location—and that does not automatically imply guilt. DNA analysis will be useful in more limited settings. DNA analysis will be useful primarily in rapes (because semen is often recovered) and murders (those in which either the perpetrator's blood was spilled at the crime scene or the victim's blood stained the perpetrator's personal effects—only the former will assist in identifying an unknown suspect). Where it exists, DNA evidence will often be more probative than fingerprints, in that the presence of body fluids is harder to attribute to innocuous causes. That is especially true in rape cases, in which positive identification of semen in the vagina is virtual proof of intercourse (although it leaves open the issue of whether it was consensual). Consequently, the potential utility of a DNA profile

databank must be evaluated in terms of the particular crimes to which it is primarily suited.

- Fingerprints have a defined physical pattern independent of the method of visualization, whereas DNA profiles are derived patterns that can be constructed with various protocols (e.g., different restriction enzymes to cut the DNA and different probes to examine different loci) that produce completely different patterns that cannot be readily interconverted. The advance of DNA technology will see the development of new protocols that offer technical advantages but produce different and incompatible patterns.
- In a sense, current DNA profiles can be thought of as extremely small bits of a person's fingerprints on all or some of the fingers. Different methods look at different fingers or different locations on a finger. Only when DNA technology is capable of sequencing the entire three billion basepairs of a person's genome could a DNA pattern be considered to be as constant and complete as a fingerprint pattern. Consequently, the development of DNA databanks is tied to the standardization of methods. A national DNA profile databank can function only if participating laboratories agree on standardized methods. However, the creation of a databank with current methods could discourage the conversion to newer, cheaper, and more powerful methods.
- The amount of information provided by latent fingerprints in an evidence sample is essentially fixed—it depends primarily on the portion of the finger(s) or palm found—and the forensic scientist uses all of it. DNA typing of an evidence sample yields information in an amount determined by the number of loci studied, so the forensic scientist has substantial control over the amount of information to be obtained from a sample. Consequently, the creation of a DNA profile databank would require decisions about the extent of the DNA profile to be recorded.
- Fingerprints are more highly individualized than DNA profiles based on the RELP technology being used in forensic laboratories. Consequently, a match between an evidence sample and an entry in a DNA profile databank should not automatically lead to the assumption of identity, but should be confirmed by the examination of additional loci that are not in the databank.
- Obtaining an inked fingerprint from a person is much less intrusive, costly, and difficult than drawing a blood sample for DNA typing.

- Collection of fingerprints from known persons is inexpensive and relatively easily accomplished by someone with minimal technical background and training. In contrast, development of a DNA profile from a blood sample is time-consuming and expensive and requires extensive education, training, and quality-assurance measures. Consequently, the number of people who can be included in a DNA profile databank might be limited by economic considerations. Categories of persons to include must be selected with due consideration of costs and benefits.
- The computer technology required for an automated fingerprint identification system is sophisticated and complex. Fingerprints are complicated geometric patterns, and the computer must store, recognize, and search for complex and variable patterns of ridges and minutiae in the millions of prints on file. Several commercially available but expensive computer systems are in use around the world. In contrast, the computer technology required for DNA databanks is relatively simple. Because DNA profiles can be reduced to a list of genetic types (i.e., a list of numbers), DNA profile repositories can use relatively simple and inexpensive software and hardware. Consequently, computer requirements should not pose a serious problem in the development of DNA profile databanks.
- Fingerprints provide no information about a person other than identity. DNA typing can, in principle, also provide personal information—concerning medical characteristics, physical traits, and relatedness—that carries with it risks of discrimination. Consequently, DNA typing raises considerably greater issues of privacy than does ordinary fingerprinting.
- In short, ordinary fingerprints and DNA profiles differ substantially in ways that bear on the creation and design of a national DNA profile databank

### 1.6 Confidentiality and Security:

Confidentiality and security of DNA-related information are especially important and difficult issues, because we are in the midst of two extraordinary-nary technological revolutions that show no signs of abating: in molecular biology, which is yielding an explosion of information about human genetics, and in computer technology, which is moving toward national and international networks connecting growing information resources.

Molecular geneticists are rapidly developing the ability to diagnose a wide variety of inherited traits and medical conditions. The list already includes simply inherited traits, such as cystic fibrosis, Huntington's disease, and some inherited cancers. In the future, the list might grow to include more common medical conditions, such as heart disease, diabetes, hypertension, and Alzheimer's disease. Some observers even suggest that the list could include such traits as predispositions to alcoholism, learning disabilities, and other behavioral traits (although the degree of genetic influence on these traits remains uncertain).

Obviously, such information could lead to discrimination by insurance companies, employers, or others against people with particular traits. In general, the committee feels that DNA profile databanks should avoid the use of loci associated with traits or diseases. That avoidance is the best guarantee against misuse of such information. Current forensic RELP typing markers are not known to be associated with particular traits or medical conditions, but they might be in the future. Current PCR typing uses the HLA DQ locus, which is in a gene that controls many important immunological functions and is associated with diseases.

Even simple information about identify requires confidentiality. Just as fingerprint files can be misused, DNA profile identification information could be misused to search and correlate criminal-record databanks or medical-record databanks. Computer storage of information increases the possibilities for misuse. For example, addresses, telephone numbers, social security numbers, credit ratings, range of incomes, demographic categories, and information on hobbies are currently available for many of the citizens in our society from various distributed computerized data sources. Such data can be obtained directly through access to specific sources, such as credit-rating services, or through statistical disclosure. "Statistical disclosure" refers to the ability of a user to derive an estimate of a desired statistic or feature from a databank or a collection of databanks. Disclosure can be achieved through one query or a series of queries to one or more databanks. With DNA information, queries might be directed at attaining numerical estimates of values or at deducing the state of an attribute of a person through a series of Boolean (yes-no) queries to multiple distributed databanks.

Several private laboratories in already offer a DNA-banking service (sample storage in freezers) to physicians, genetic counselors, and, in some cases, anyone who pays for the service. Typically, such information as name, address, birth date, diagnosis, family history, physician's name and address, and genetic counselor's name and address is stored with the samples. That information is useful for local, independent bookkeeping and record management. But it is also ripe for statistical or correlative disclosure. Just the existence of a sample from a person in a databank might be prejudicial to the person, independently of any DNA related information. In some laboratories, the donor cannot legally prevent outsiders' access to the samples, but can request its withdrawal. A request for withdrawal might take a month or more to process. In most cases, only physicians with signed permission of the donor have access to samples, but typically no safeguards are taken to verify individual requests independently. That is not to say that the laboratories intend to violate donors' rights; they are simply offering a service for which there is a recognized market and attempting to provide services as well as they can. Much has been written on statistical databank systems and associated security issues.

Guidelines for release of DNA samples and disclosure of DNA typing information must be designed to safeguard the rights of persons who, for one reason or another, get involved in a DNA typing[317] without burdening law-enforcement agencies and civil investigative authorities with unnecessarily protective policies.

Although that is a good start, state laws should state explicitly the types of uses that can be authorized. In particular, in addition to the points made in the opinion just quoted, investigation of DNA samples or stored information for the purpose of obtaining medical information or discerning other traits should be prohibited, and violations should be punishable by law.

### 1.7 Methodological Standardization:

Because of the incompatibility between DNA typing methods, Central, state, and local laboratories that wish to use a national DNA profile databank must all adopt a single standardized method for analyzing samples—both databank specimens and evidence specimens. Accordingly, the development of a national DNA databank has the

[317] see Chapter 7 for further discussion

potential advantage of acting as a driving force for standardization in forensic DNA typing, but the potential disadvantage of ossifying a rapidly moving technology.

Before even pilot projects can be begun, the degree of interlaboratory reproducibility—which is essential to the success of a databank—should be thoroughly documented. So far, there have been only a few interlaboratory-reproducibility studies to compare the ability of different laboratories to measure the same DNAs accurately under different circumstances.

### 1.8 Costs versus Benefit:

An analysis of the costs and benefits of establishing DNA databanks is problematic at best. Costs will depend on a number of variables, such as methods, numbers of loci used, and types and numbers of samples to be tested. Benefits will depend on the populations included in the databank and the likelihood of finding matches. Moreover, costs and benefits must be reckoned in both monetary and nonmonetary terms.

*Non monetary* costs can include the risk of loss of privacy and the misuse and abuse of genetic information. Nonmonetary benefits can include prevention of future crimes. Those diverse elements cannot be weighed except in the context of societal values.

Concerning monetary costs, it is helpful to recall the comparison between latent fingerprints and DNA profiles. Collection of fingerprints from identified persons is inexpensive and relatively easily accomplished by persons with minimal technical training and background. Samples cost perhaps a few dollars; the cost reflects the personnel time involved in taking and filing the fingerprints. Although sample collection is simple, fingerprint databanks require sophisticated and expensive computer hardware and software. A typical state automated fingerprint identification system can cost $10 million.

In contrast, DNA typing is time-consuming, is expensive, and requires extensive education, training, and quality-assurance measures[318]. However, DNA typing

[318] . With current RFLP methods, blood must be obtained by venipuncture at an estimated cost of $20/sample. Storage methods and costs depend on the number of samples and the form in which they are preserved (liquid or dried blood, extracted DNA pellet, buffy coat, etc.). In any case, freezers, cry

databanks do not require highly sophisticated or expensive computer hardware and software.

In short, ordinary fingerprints and DNA profiles have opposite economic characteristics. Ordinary fingerprint databanks have low variable costs and high fixed costs, and DNA typing databanks have high variable costs and comparatively low fixed costs. Those considerations imply that different decisions could be appropriate as to whether, when, and how to develop each kind of databank. For example, because of the high variable cost per sample, considerable thought must given to whose DNA profiles should be stored. To maximize the "return per sample," one should concentrate on persons convicted of crimes with documented high rates of recidivism, such as rape, as discussed below.

Cost analysis is made more difficult by the rapidity of change in DNA typing technology. For example, PCR-based methods might greatly reduce DNA typing costs: blood samples might be replaced with simple buccal swabs (i.e., cheek scraping); Southern blots might be replaced with non-gelbased formats; complicated scoring of the problematic continuous allele system used in RFLP analysis might be replaced with discrete mechanical allele scoring. Accordingly, today's cost assessments must be viewed as tentative.

### 1.9 Whose samples should be included?

In deciding whom to include in a DNA profile databank, it is necessary to consider the likely forensic utility of the data and the protection of individual privacy. It is helpful to consider six categories of people.

- **Samples from Convicted Offenders**
- **Samples from Suspects**

DNA typing profiles of suspects might also be useful in associating a person with open or unsolved cases pending in other jurisdictions or states. Although a suspect's DNA profile might ultimately be entered into a convicted-felon databank, there would

---

tubes, and labor can cost another $20/sample for storage. The cost of RFLP analysis can be estimated from fees charged by private laboratories: about $100-150/sample. Thus, a single DNA profile can cost about $120-170, and constructing 10,000 DNA profiles could cost $1.2-1.7 million

no doubt be a substantial period during which a suspect might engage in other criminal activities. Thus, in the case of a serial rapist, a person under suspicion and investigation for one offense, might be responsible for several later offenses for which he is not suspected. Therefore, if a DNA profile of a suspect is entered into a databank, it would be available to be searched against future unsolved cases.

- **Samples from Victims**

To protect their privacy, victims' DNA profiles should never be entered into a national databank or searched against such a databank, with the possible exception of cases of abduction, in which it might be desirable for the victim's information to be stored and accessible to law-enforcement officials. In any exceptional case, prior permission of the victim, the victim's legal guardian, or a court should be required, and the victim's DNA should be removed from the databank when it can no longer serve the purpose for which it was entered.

- **Samples from Missing Persons and Unidentified Bodies**

This portion of the databank would contain DNA profiles from unidentified bodies, body parts, and bone fragments. These would provide the greatest benefit when DNA profiles from immediate relatives (parents) could be used to reconstruct the DNA profile of a missing person for comparison. Although there would be immediate benefits from the development of these types of data, the actual number of relevant cases would be small, compared with the number of sexual assaults by unknown persons.

- **Crime-Scene Samples from Unidentified Persons**

DNA profile evidence found at the scene of a crime should be stored and accessible to legally authorized investigators. Such samples might be useful for recognizing serial or multiple crimes even before a perpetrator is found and will be equally useful once a perpetrator has been identified. It might be useful to have additional cross-referenced information accessible at the national level, including modus operandi or other attributes for correlation as part of an investigation.

- **Samples from Members of the General Population**

Some observers have suggested that a DNA profile databank should not be limited to criminals, but should aim, at least in the long term, to store DNA profiles from the entire general public. It is argued that many groups in the general public are already required to be fingerprinted for various security and identification purposes and the same justification could be applied to DNA profiles; furthermore, if the databanks contained everyone, rather than just previous offenders, the chance of identifying perpetrators would be much greater.

- **Samples from Anonymous Persons for Population Genetics**

The committee notes that statistical databanks of random population samples are required for estimating allele frequencies, as described in Chapter 3. To protect the privacy of persons whose only role is to make up a statistical sample, their identities should never be retained in a databank, and the databanks should never be searched for matches in connection with investigations.

- **Sample Storage**

Another difficult issue is the storage and maintenance of DNA samples themselves (or any reusable products of the typing process), as opposed to DNA profiles. In principle, retention of DNA samples creates an opportunity for misues—i.e., for later testing to determine personal information. In general, the committee discourages the retention of DNA samples.

However, there is a practical reason to retain DNA samples for short periods. Because DNA technology is changing so rapidly, we expect the profiles produced with today's methods to be incompatible with tomorrow's methods. Accordingly, today's profiles will need to be discarded and replaced with profiles based on the successor methods. It would be extremely expensive and inefficient to have to redraw blood samples for retyping. We are therefore persuaded that retention of samples after typing should be permitted for the short term—only during the startup phase of DNA profile databanks. As databanks become established and technology stabilizes somewhat, samples should be destroyed promptly after typing.

### 1.10 Information to Be Included and Maintained In a Databank :

It is worth commenting on the nature of the information that should be stored in a DNA profile databank.

- Submitting-agency information should include the location of the agency, its telephone number, names of the analysts who conducted the DNA typing, the name of the person who entered the data into the databank, and agency contact information.
- Sample information should include entries that describe the type of sample (body-fluid stain, tissue, or known blood sample) and a unique sample identifier, the condition of the sample, unusual handling and storage, and other factors that might affect the quality of the DNA and the evaluation of partial patterns.
- The DNA type at a locus must be entered in standard nomenclature. For example, for RFLP typing, fragment-size data from each locus successfully probed should be entered as the number of base pairs determined for each fragment. Sizing data for the human-DNA control should also be entered.
- Entries into the convicted-offender files should include the name of the offender, dates of offenses and convictions, and DNA profile data. Only the profile index should be centrally stored. Case data should be stored locally, and their distribution should be under the control of the local agency.

### 1.11 Rules on Accessibility:

Computer security should be ensured through use of the best available practices and technologies. Access to the databank should be limited to a small number of legally authorized persons and should be limited to what is required for specific official investigations. All instances of access should be audited and archived. An excellent discussion of computerized audit-trail systems is available.

If the computer system and associated databank are to be made available for remote access by cooperating state and federal agencies, such as by telephone or networked by other means, the access mechanism (i.e., the network switch) should be made available only for specific, authorized remote-access sessions; that is, the system

should not be continuously available to remote users. This type of limited access can be achieved either administratively or physically; it is a simple and inexpensive means of safeguarding sensitive information and is common practice in many national security situations. For example, secure computers are virtually never connected to unsecured computers at national defense laboratories; when newspaper headlines make statements that computers at these facilities have been breached, it has been the case that the computers were unsecured and not connected to the secure computers. In many cases, these unsecured computers have telecommunication connections available to employees for routine use, but they do not contain security information.

**1.12** Status of Databank Development

local\district level-

State Level

Central level

The national databanks would reference the sources of the profiles, but case data would be secured and controlled by the state and local agencies.

It would coordinate quality assurance with a technical advisory group to implement appropriate guidelines; coordinate with other agencies that have a law-enforcement interest in the development of the databank; provide hardware and software for the databank server and for state access to the databank; provide hardware to store and back up the databank server; provide training for states in forensic DNA technology, quality control, and databank access; determine formats for databank input and output; update index with new state and federal submissions; assemble population data for all probes used and calculate and disseminate population frequencies; and modify the system to accommodate new DNA typing methods[319].

State and local agencies would be responsible for performing DNA analyses of samples with consensus methods; submitting new information in a specified format for incorporation into the databanks; guaranteeing the quality of their new

[319]See "DNA Technology in Forensic Science",National Academic Press, Available at http://www.nap.edu/openbook.php(Last accessed on 23rd Sept. 2009)

submissions; providing hardware and software for state image-analysis workstations for telephone access to centralized index; maintaining centrally indexed case files for as long as they remain in the index; and providing relevant information from case files that are indexed centrally to other law-enforcement agencies, which subscribe when requested.

Local autonomy as to databank structure and function is recommended, for several reasons: a databank can be tailored to meet local needs, the local databank administrator will not have to rely on outside entities for maintenance and change, and security can best be managed with smaller, discrete, well-understood databanks. That is not to say that standards and guidelines should be avoided. On the contrary, very strict regulations, standards, and guidelines for all aspects of the operation should be enforced and monitored. Databank requirements involve determining what a system must accomplish; there are typically many alternative implementation details that can accomplish the same goals.

**1.13** Summary of Recommendations:

- In principle, a national DNA profile databank should be created that contains information on felons convicted of violent crimes with high rates of recidivism. The case is strongest for felons who have committed rape, because perpetrators typically leave biological evidence (semen) that could allow them to be identified. The case is somewhat weaker for violent offenders who are most likely to commit homicide as a recidivist offense, because killers leave biological evidence only in a minority of cases. The wisdom of including other offenders depends primarily on the rate at which they are likely to commit rape, because rape is the crime for which the databank will be of primary use.
- There are a number of scenarios that illustrate the point that the databank need not be limited to persons convicted of specified crimes.
- The databank should also contain DNA profiles of samples from unidentified persons collected at the scenes of violent crimes.
- Databanks containing DNA profiles of members of the general population (as exist for ordinary fingerprints for identification purposes) are not appropriate, for reasons of both privacy and economics.

- DNA profile databanks should be accessible only to legally authorized persons and should be stored in a secure information resource.
- Legal policy concerning access and use of both DNA samples and DNA databank information should be established before widespread proliferation of samples and information repositories. Interim protection and sanctions against misuse and abuse of information derived from DNA typing should be established immediately. Policies should explicitly define authorized uses and should provide for criminal penalties for abuses.
- Although the committee endorses the concept of a limited national DNA profile databank, we doubt that existing RFLP-based technology provides a wise long-term foundation for such a databank. We expect current methods to be replaced soon with techniques that are simpler, easier to automate, and less expensive—but incompatible with existing DNA profiles. Accordingly, we do not recommend establishing a comprehensive DNA profile databank yet.
- For the short term, we recommend the establishment of pilot projects that involve prototype databanks based on RFLP technology and consisting primarily of profiles of violent sex offenders. Such pilot projects could be worthwhile for identifying problems and issues in the creation of databanks. However, in the intermediate term, more efficient methods will replace the current one, and the forensic community should not allow itself to become locked into an outdated method.
- State and central laboratories, which have a long tradition and much experience with the management of other types of basic evidence, should be given primary responsibility, authority, and additional resources to handle forensic DNA testing and all the associated sample-handling and data-handling requirements.
- Private-sector firms should not be discouraged from continuing to prepare and analyze DNA samples for specific cases or for databank samples, but they must be held accountable for misuse and abuse to the same extent as government-funded laboratories and government authorities.
- Discovery of a match between an evidence sample and a databank entry should be used only as the basis for further testing using markers at additional loci. The initial match should be used as probable cause to obtain a blood

sample from the suspect, but only the statistical frequency associated with the additional loci should be presented at trial.

## 2. Advantage of DNA:

The main advantage of this technique is its ability to analyze small and environmentally challenged samples and to accurately establish their origins with a high degree of certainty. One of the major advantages of DNA typing is that DNA is much resistant to degradation caused by the environmental conditions. Moreover, DNA is somatically stable. It generates the same genetic pattern irrespective of the biological material like hair, seminal stains, fresh blood, soft tissue, hard tissue, etc. In fact, this unique feature of DNA makes it a powerful tool in forensic identification DNA can be successfully obtained from blood and blood stains, vaginal and anal swabs, oral swabs, well worn clothing, bone, teeth, most organs and to some extent urine, Salova per se has few nucleated cells, but beer and wine bottles, drinking glasses, beer cans, soda cans, cigarettes, stamps and envelope flaps have all been found to provide varying amounts of DNA. This show DNA finger printing can connect the crime scene or from a body to another particular individual.

Except DNA, other markers get degraded very soon. The main factors of degradation include temperature, time, and humidity – which lead to the growth of microorganisms, exposure to ultra violet sunlight and various chemical substances, which are often found together the environment. But DNA is much more resistant to these factors caused by the environment conditions. It is reported that even if biological material gets degraded, it is possible to conduct DNA it remains stable except it gets broken into smaller fragments. Report on forensic application of DNA tests are emerging which seems to work with even dried blood stains as sperms making it potentially valuable in criminal investigation.

## 3. Reliability on the technique:

Now question arises whether we can rely on this technique. By giving emphasis on following points we can believe in its reliability.

(i) Extensive use of the technique in medical science for a longer period.

(ii) Nobody argues against its reliability.

(iii) The probability result is so high and positives that it leads to certainty.

(iv) A further component of reliability is the frequency with which a technique leads to erroneous results. But in DNA fingerprinting as testimony if there was something wrong with the process, it would ordinarily lead to no result being obtained rather than erroneous result.

(v) Control samples are provided with main sample to avoid error. These prove its reliability.

DNA evidence will be in its success path with strong and rebuts legislation and reputed laboratories with standardized operational procedures. Laboratory must be well equipped and technicians must be highly skilled. Laboratory must function in collecting samples properly and promptly with proper documentation authorized by law and proposed legislation. These will leave no space for dispute; rather will help in eliminating the scope for disputes. Giving emphasis on this point is that carelessness or ignorance of proper handling process during collection, preservation and transportation of biological samples from the crime scene to the DNA analysis laboratory can render a specimen unfit for analysis. Each sample should be labeled carefully with proper sealing and identification marks. The DNA analysis report was not accepted by the Court of law in case of a very famous football player. OJ Simpson and the suspect were acquitted on the ground that samples were not collected and handled properly.

**4. Challenges for DNA investigators-**

- Requires that collection of evidence must be systematically recorded and access to evidence must be controlled Special challenges for DNA samples.
- Crime scene may have DNA from people other than perpetrators of crime.
- DNA collected from victims in a morgue can become contaminated by DNA of other bodies previously on autopsy table.
- Lack of standardization of DNA procedures.
-

**(a) What every Law Enforcement Officer should know about DNA Evidence?**

-What is DNA?Can DNA be wrong ?

-Identifying DNA Evidence

-Evidence Collection and Preservation

-Database of DNA profiles

-Common Problem-

**(b) Identifying DNA Evidence**

Some common items of evidence, the possible location of the DNA on the evidence, and the biological source containing the cells should be known.

**(c) Evidence Collection and Preservation**

Every officer should be aware of important issues involved in the identification, collection, transportation, and storage of DNA evidence. Given the sensitive nature of DNA evidence, officers should always contact their laboratory personnel or evidence collection technicians when collection questions arise.

**(d) Database of DNA profiles**

Just as fingerprints found at a crime scene can be run through in search of a suspect or link to another crime scene, DNA profiles from a crime scene can be entered into the database.

Therefore, law enforcement officers have the ability to identify possible suspects when no prior suspect existed.

**(e) Common Problem**

- Band shifting May lead to wrong conclusions

We need to be careful, sensitive and aware DNA is unchangeable information about an individual or population, therefore can be used or misused.

We should be sensitive to ethical and social outcome of the information. It should not lead to discrimination to minorities, crime prevention discrimination, forceful DNA sampling etc.

Storage of DNA and DNA test results should be highly secured

Storage of authorization, national boundaries and legal limits should be chalked out carefully

**(D) Abuse and Misuse of DNA Information**[320]**-**

Even if a technology is scientifically sound and its use is ethically permissible, it is necessary to seek to prevent abuses and misuses in practice. Examples of abuses of DNA technology are unauthorized access to databanks and unauthorized disclosure of information. An example of misuse is the use of DNA information for purposes other than forensic—in other words, going beyond the intended purpose of collecting and storing the information.

A major issue is the preservation of confidentiality of information obtained with DNA technology in the forensic context. When databanks are established in such a way that state and federal law-enforcement authorities can gain access to DNA profiles, not only of persons convicted of violent crimes but of others as well, there is a serious potential for abuse of confidential information.The victims of many crimes in urban areas are relatives or neighbors of the perpetrators, and these victims might themselves be former or future perpetrators. There is greater likelihood that DNA information on minority-group members, such as blacks and Hispanics, will be stored or accessed. However, it is important to note that use of the ceiling principle removes the necessity to categorize criminals (or defendants in general) by race for the purposes of DNA testing and storage of information in databanks.

Maintaining DNA samples or information about ex-offenders and parolees might be permissible, but requires justification. Even in a felon databank, protections must be

[320] Ibid 319

instituted. For example, a person's permission should be obtained for the use of his or her DNA information outside the forensic context. If there are no witnesses to a crime, law-enforcement agencies are likely to go directly to the felon databank in their quest for probable suspects. The tendency to use efficient and cost-effective means to solve crimes could result in reducing safeguards, thereby eroding rights of ex-offenders and parolees.

Storage of DNA records of people who have not been convicted of a crime raises ethical questions about the proper "ownership" of such information. DNA information is personal and so should be treated as private, like information in a person's medical record. Outside the forensic context, DNA information should be stored in databanks and released only with the knowledge and explicit permission of the person who is the subject of the information. As for storage of forensic DNA information in databanks, some disagreements remain about propriety and about the prospects for abuse).

Even when the use of criminal databanks is limited to the local or regional level, the potential for expansion raises questions of misuse. For example, should a whole local population be subject to DNA typing when it is strongly suspected that someone in the population left blood or other fluids at the scene of the crime? Should this be seen as similar to a "frisk" or a simple search that requires a warrant or as an intrusion into someone's body that requires a strong showing of need? The potential for expanded

uses of DNA technology that would constitute serious intrusions into the privacy of ordinary citizens requires the setting of guidelines that separate proper use from misuse of the technology.

The release of DNA information on a criminal population for purposes other than law enforcement also constitutes misuse. Employers and insurance companies will certainly have an interest in DNA information on potential employees or customers. Biomedical and behavioral scientists are likely to want to screen felon databanks and develop new databanks to study various characteristics of convicted offenders. Legal sanctions should be established to deter the unauthorized dissemination or procurement of DNA information that has been obtained for forensic purposes.

**(E) Suggestions for Use of DNA Evidence**[321]

Whatever statute or rule of evidence is applicable, some standards for admissibility seem sound to the committee. In view of the importance of DNA typing in both civil and criminal cases, the judge should determine, before allowing DNA evidence to be introduced, that appropriate standards have been followed, that tests were adequately performed by a reliable laboratory, and that the appropriate protocols for DNA typing and formulation of an opinion were fully complied with. In states without relevant statutes, the committee recommends that the court judicially notice the appropriateness of the theoretical basis of DNA typing by using this report, similar reports, and case law. As new methods are used, the courts will have to assure themselves of their validity.

The problem that a court will have to focus on when a standard testing approach is used is not general scientific theory, but actual application. *In limine* hearings can be shortened considerably by stipulations, exchange of data by the parties, and pretrial hearings to avoid unnecessary delay in trials. In the absence of specific objections to laboratory procedures, a court may rely on evidence of accreditation and certifications, a history of adequacy of testing by the laboratory, and other assurances of careful practice. It is not necessary, at this stage of development of DNA typing, to hold extensive admissibility hearings on the general validity of the scientific techniques, although cases will still arise in which the procedures used to report a match will be questioned.

It also might be necessary in a particular case to decide in advance whether an expert will be permitted to characterize the probability of a match in mathematical terms. the use of the product rule (which assumes the independence of the frequency distribution of the single-locus probes and is the method by which the likelihood statement is generated) is controversial. At present, courts should take a conservative approach concerning the assumptions underlying the use of the product rule. A considerable degree of discretion and control by the courts in these cases is recommended.

[321] Ibid 319

As a general matter, so long as the safeguards we discuss in this report are followed, admissibility of DNA typing should be encouraged. There is no substantial dispute about the underlying scientific principles. However, the adequacy of laboratory procedures and of the competence of the experts who testify should remain open to inquiry. Ultimately, DNA typing evidence should be used without any greater inconvenience than traditional fingerprint evidence.

## 5. Barriers to Realizing the Potential of DNA Evidence:

Despite the exciting promise of DNA Technology, a number of barriers remain, to realizing its full potential. One of these barriers is the frequent failure of law enforcement to identify and collect appropriate DNA evidence from the crime scene. Many law enforcement agencies have not been properly trained to recognize and collect potential DNA evidence, and this situation leads to an unnecessary disadvantage for the investigation prosecution, specially in sexually assault cases: [322] For Example:- A recent FBI survey revealed that of all sexual assault cases, less than 10% had DNA evidence submitted to Crime Laboratories [323] Other barriers include the failure to effectively evaluate DNA evidence for analysis, lack of communication between enforcement and crime personnel, limited resources, and the use of incompatible systems for DNA analysis. The major barrier in India is that of corruption, faking of forensic reports, production of false reports for evidence and most importantly the political influence of the accused as was seen in sensational Madhumita Shukla case of Uttar Pradesh[324]

**Failure to effectively evaluate DNA evidence:** When analyzing DNA evidence, processing a pure sample, such as blood or saliva. Swab is only a small part of process. Much of the evidence with DNA potential is not pure but rather collected from crime scene (from clothing or bedding etc.). The problem with this type of evidence is that it requires effective evaluation by Law Enforcement in order to provide information to assist crime lab personnel in their analysis. Unfortunately, Law

[322] Sushil Sharma Vs. State of ( Delhi Administration) 1996 Cr. L.J. 3944
[323] 509, US 579, 59 (1993) Weedn & Hicks (1997)
[324] Madhumita Shukla Murder Case where state politician Amarmani Tripathi was the accused 2002 Cr.L.J. 396

Enforcement has traditionally received very little training in how to evaluate potential evidence in this way.

**Lack of communication between Law Enforcement & Crime Laboratory:** Just as police officers often fail to understand how effectively collect and evaluate evidence for analysis, a traditional lack of communication and interaction with crime lab personnel has also limited the contribution of DNA Technology. Absence of forensic science expert or crime lab personnel at the crime scene at the time of collecting DNA evidence also adds up to one of the barriers of DNA Technology.

**Limited Resources**:

In addition to these problems that result primarily from a lack of appropriate training and communication, both law enforcement agencies and crime laboratories suffer from limited resources that further hinder the contribution of DNA technology. This situation is especially pronounced for sexual assault, as these cases typically make up the majority of the DNA work performed. This is evident from the fact that in India there are only 4-Central Forensic Science Labs, 20-State forensic Labs, 3-Central Document Examination Labs

**Use of incompatible systems for DNA analysis:** To further complicate matters, even when evidence is appropriately collected, screened and analyzed for DNA, it can be limited in its contribution by the use of incompatible systems. Forensic laboratories have used different DNA testing systems, including DQAJ, Polymarker, RFLP ; PCR and STR. Labs will sometime even utilize one analytic system for trying scene evidence and another for the suspect's reference standard. Results are therefore frequently found to be incompatible with Each other and/or with the state databanks or CODIS15

Perpetua Lex Est Nulluum Legem Humanum Ac Positivam Perpetuam Esse Et Clausula Quae Abrogationem Excludit Ad Initio Non Valet- No Law Can Be Permenant And A Law Which Takes Always A Power Of Repeal Is Abinitio Void

## 6. Overcoming the Barriers (Suggestions):

To overcome the barriers those are hampering the development and extensive use of the DNA Technology in crime investigation and detection, following are the steps, which can help in overcoming the barriers in realizing the potential of DNA evidence.

. Requisite training should be imparted to the law enforcement officers involved in collecting the DNA evidence at the crime scene. They should be taught about collection of the samples from crime scene and preservation of the same. Frequent fresher courses should be held in this connection to impart latest technology in the line.

- Steps should be taken to bring forensic science in the forefront of criminal justice administration. So the presence of Forensic Lab Personnel at the time of collection of DNA evidence at the crime scene should be made compulsory under the Law.
- Since there is possibility of delay in collecting DNA samples from the place of occurrence, Submission of the same to the laboratories for test or the samples being tempered during transit, evidence should be lead to rule out these possibilities.
- DNA tests may be preferably be got conducted under the orders of the Court.
- A network of standardized Forensic Laboratories should be laid down in the country, which should be well equipped and must function with proper documentation authorized by the Legislation.
- Provision should be made to make a National DNA Databank, on the basis of CODIS maintained by FBI. Initially to start with the samples of DNA of prisoners should be collected as their finger impressions are taken and record maintained by the Govt. after their convictions under Identification of Prisoner's Act, 1920.
- As recommended by the Malimath Committee in its report, that 'DNA expert be included in the list of experts' and also recommended that an amendment should be made in Cr.P.C, 1973. And the same needs to be done.

## 7. Amendments in Law -Some suggestions

Fortior Et Potentior Est Dispositio Legis Quam Hominis- Law Is Stronger And More Powerful Then Any Man

Nova Constitio Futuris Forman Imponere Debet, Non Proteritis –New Laws Are Prospective Not Rtrospective

The proposition of law laid down by the Andhra Pradesh was followed by Calcutta High Court. However, Bombay High court in a latter decision considered the entire proposition of law and was of the opinion that it as high time that law be made specific on the question by amending the Evidence Act. A single Judge of Bombay High Court in this case held thus.

Then the law makers also may examine whether a special provision should be made in the Evidence Act to provide for taking blood samples of the parties concerned and the child concerned in order to decide about the paternity or maternity of the child. In the very nature of things, even if such a provision is made and the Court directs a party to give blood sample and the party refuses, the Court cannot enforce the individual to give blood who refuses to give sample blood. In such a case, the law may also provide as to how the order of the Court should be complied with or as to what should happen if the order to the Court is not complied. One consequence will be that the Court may draw an adverse inference from the conduct of the party who refuses to give blood sample in spite of the directions of the Court, then the law makers may also consider the question whether the pleading of a party who refuses to obey the order of the Court ma be struck off or may be prevented from prosecuting the case or from defending the case."

The Bombay High Court directed the Central Government, Law Commission of India, Ministry of Law and others for amending the Evidence Act to provide the circumstances under which blood samples can be taken from the spouse and their

child or others to test the disputed paternity and for any other test like DNA or any other scientific test and the circumstances in which such tests can be taken[325].

Since DNA test can also be successfully carried out of any part or tissue of body, hair, bone, skin, tooth or even saliva taken while one as alive or even dead, the question would arise as to what rules should govern the taking of DNA sample from a dead body or mummy, even taking it from grave.

Recently the Indian Evidence (Amendment) Bill, 2003 has been proposed on the recommendation of the 185th Law Commission Report. The bill provides for DNA tests in paternity disputes. Scientific evidence frequently plays a key part in both civil and criminal trials and the scientific investigation of evidence left at the crime scene can seem more persuasive to a Court than the testimony of eyewitnesses. The Scientific and Technological proceeds in the process of identification of an individual are of paramount importance predominantly in a forensic set up. Several techniques have been developed for this purpose, simple example of which is fingerprints of an individual. One of the newest forms of forensic evidence is DNA Fingerprinting, which uses material from which chromosomes are made to identify individuals positively. The use of DNA evidence is anticipated to become a universal place in the 21st century. It is considered to be a major breakthrough in forensic science in this century. It has been subjected to the most comprehensive, scientific examination as no there twig of forensic science, and has currently established itself as one of the best with mounting applications. It is now a well-recognized technique, which is not only used in numerous areas of research in modern molecular biology and genetics but also finding prospective applications in our day-to-day life. DNA fingerprinting is based on the principle that the genetic make up of every individual is different from the others but is unique and idiosyncratic to an individual. DNA fingerprinting is the only definite, positive and permanent identification method of a person as one's lifetime. DNA testing takes advantage of the fact that, with the exception of identical twins, the genetic material – DNA – of each person is unique. DNA evidence, like fingerprint evidence, offers prosecutors important new tools for the identification and apprehension of some of the most violent perpetrators. At the same time, DNA aids

[325] See, Article Available at http://www.answeringlaw.com/php/displayContent.php(Last accessed on 2nd May 2009)

the search for truth by exonerating the innocent. DNA fingerprints are useful in several applications of human health care research, as well as in the justice system. They are used to diagnose inherited disorders in both prenatal and newborn babies in hospitals around the world. Research programs to establish inherited disorders on the chromosomes depend on the information contained in DNA fingerprints. They are also used to link suspects to biological evidence. Another use of DNA fingerprints in the court system is to establish paternity in custody and child support litigation. Advances in technology are leading to novel uses of DNA fingerprinting almost every day.

## 7.1 Drastic changes required in India……

Summum Jus Summa Injuria – A Strict Law Causes Most Harm;

Summum Jus Summa Injuria – A Strict Law Causes Most Harm[326]

There should be no shame in errors made by well-meaning jurors, because human error is inevitable. But what is deeply shameful is when these Judges feel helpless in taking any decision in the absence of any legislation providing for DNA examination and also because of the non-existence of any provision providing for the same in the Indian Evidence Act. For the successful in corporation of this technique in this country various scientific and legal reforms are required. This is high time that the suitable amendments must be made in the Indian Evidence Act. Legislature should craft a worthy piece of legislation that primarily would maximize the use of DNA evidence to punish the guilty and protect the innocent, as has done in Canada, USA and UK. There is no been point in lagging far behind the advanced countries because of the lack of scientific awareness. Step has been taken by proposing The Indian Evidence (Amendment) Bill, 2003. In Sec. 112, i.e. section regarding paternity disputes, apart from the sole exception of 'non-access', other exceptions by way of blood-group tests, DNA have been proposed but subject to very stringent conditions. The bill provides for DNA tests conducted in the cases of paternity disputes by the consent of the man and in the case of the child by permission of the court, that man is not the father of the child. It also provides that in case the man refuses to undergo the

[326]See, Article available on http://www.forensic-evidence.com/site/EVID/DNAexonerations.html (visited on 6th February 2010)

DNA test then he shall be deemed to have waived his defense to any claim of paternity made against him. According to this proposed amendment, DNA tests can result in proving definitely that a person is not the father, where the samples do not match. But where the samples match, the controversy remains. If the DNA data is less and does not cover the whole population of a country, the matching is weak evidence. Where the DNA data is available for a larger population or for the whole country; naturally, the probability about the identity of the person will be far less than in a smaller population. Therefore, as in the case of blood-group tests, science has progressed to this extent that where the samples of the male and the child do not match, it is certain that the male is not the father. But, where they match, it leads us to a theory of probability. It has been proposed that as in the case of blood tests, there can be evidence by way of DNA tests to prove that a person is not the father. But DNA evidence cannot be used to say that a person is the father.[327] I think that 'match' must also be given the same treatment because the probability is same in the cases, being it 'match' or 'miss-match'.

Many a time the Courts have expressed their inability in giving any order for DNA examination or even for blood test because as according to the law in India one cannot be forced to give his blood sample and a number of times objections have been raised to such an order, in many cases it has been contended that such an order would violate the rights of an individual enshrined under Art, 21 of the Indian Constitution. Through such an objection has been well answered and has been rightly rejected by the Hon'ble Supreme Court in the recent of Sharda v. Dharampal, [328]If a person has committed an offence, then why will he volunteer to give a specimen of blood knowing fully well that it will convict them? Such a law, which prohibits taking blood, samples forcibly without the wishes of an individual, for medical examination is rather protecting the offenders, which from no angle of vision can be the purpose of law. Even in well developed countries like Canada and Britain forceful blood examination is permitted to serve the ends of justice. It also cannot be said that proof coming out from DNA cannot be self-incriminatory because it is naturally present in the body, thus any proof derived from it cannot be self-incriminatory.

[327] 19th Law Commission's Report
[328] AIR 2003 SC 3450.

There is a need for the enactment of a legislation providing for DNA examination and establishment of a National Commission, which will keep abreast of all new technological developments for scientists and lawyers alike. The commission will formulate the procedure, standards and quality control and will provide official approval to the testing laboratories.

The legislation must provide that:-……

- DNA evidence should not be collected from a suspect unless the information is relevant to a specific crime in question and it must not be collected from suspects as a matter of routine.
- There should be reasonable grounds for suspecting that the person committed the offence before taking the DNA sample.
- As a privacy safeguard, DNA evidence should be collected from a suspect only if a judge authorizes the collection.
- The legislation should also provide for the eligibility of the scientists conducting the DNA tests.
- The legislation should also authorize collection of DNA samples from persons convicted of specified felony offences which, military offenders, and terrorism related offences. Because of their DNA record it would be much easier to trace the criminal and also it would save a lot of time of police.
- The legislation should also provide that the police officers must be properly trained for collecting samples for DNA test, from the crime scene.
- The legislation should also permit storage and maintenance of DNA data of crime scene Specimens, unidentified human remains and relatives of missing persons.
- Interest Republicae Ne Matifia Remaneant Impanita –In The Interest Of the Republic Crime Should Not Go Unpunished

The crime scenario in the 21st century has become very complex. The *modus operandi* of crime has become scientific; hence it is essential to use science and technology in apprehending the criminals. Improved testing technologies are emerging, that provides efficient and effective DNA evidence possessing which promise to widen the use of DNA evidence and thus aids in search of truth by

exonerating the innocent. The development of DNA technology furthers the search for truth by helping police and prosecutors in the fight against violent crime. Through the use of DNA evidence, prosecutors are able to conclusively establish the guilt of a defendant. So, the importance of DNA technology in the administration of Justice in any form of society and in any part of the world cannot be denied. With reference to India there is no adequate legislation enacted by the Government on DNA technology. It is imperative to incorporate DNA technology in an Indian Legislation or to draft an exclusive independent enactment on the use of DNA technology in Indian Courts. In India, The Code of Criminal Procedure, 1973, Indian Evidence Act, 1872 are too old. An exclusive law or Act (other than the amendments in the provisions of Cr.P.C and the Indian Evidence Act) as in America, England, and New Zealand and in Canada should be legislated by our Parliament, so that this technique could be effectively used as valuable evidence in the administration of Criminal and Civil Justice.

The Parliament has already established Advisory Committee to look into some of these aspects. One hopes this is sorted out at the earliest so that we can proceed with full swiftness on this path in the furtherance of truth. Then only the real meaning of "Satyamev Jayate" can be really manifested is appropriate to quote Austrian Jurist Eugene Ehrlich, "Positive Law, which is enacted, cannot be effective law, if it were at odds with the cultural pat tern of people (Living Law) "[329]

## 7.2 The Need for Judicial Education

Evidence based on genetic test results is a form of opinion evidence, which is admissible if it is from an expert. DNA evidence that is relevant to a fact in issue is admissible in civil proceedings unless it is barred under an exclusionary rule, or by judicial discretion. To illustrate judicial discretion, we may refer to the decision of the Supreme Court of India in Gautam Kundu v. State of W.B[330], in which, in context of maintenance of a child under Section 125 of the Code of Criminal Procedure, the father disputed paternity and demanded blood grouping test to determine parentage, the Court held that, where purpose of the application was nothing more than to avoid payment of maintenance, without making out any ground whatever to have recourse

[329] 34 Dr.P.C.Shekharan, Forensic Science in Criminal Investigation, Encyclopedia of Police in India, Pg1862

[330] (1993)3 SCC 418

to the test, the application for blood test cannot be accepted. It was also held that no person can be compelled to give sample of blood for analysis against his / her will and no adverse inference can be drawn against him / her for such refusal.

In the light of the often highly scientific nature of genetic test results, judges will need to balance the probative value of genetic evidence against its potential prejudicial effect when considering whether to admit such evidence. Once the evidence is admitted, the expert scientific witness must explain the science and technology involved in the genetic test, the interpretation of the results, and their significance to the Court. In addition, each party's counsel must have sufficient understanding to examine or cross-examine the expert witnesses appropriately. The judge must also have sufficient understanding to evaluate the evidence. Justice Ming Chin of the Supreme Court of California has commented in the following terms on the potential implications where genetic evidence is admitted in court proceedings:

"The use of genetic information in court raises new evidentiary challenges. DNA evidence is often complicated and laborious to present, and those without a scientific background – including most judges and jurors – often have difficulty understanding it. A courtroom is not an ideal forum for resolving conflicts between scientific theories, yet judges will constantly be asked to referee battles among lawyers and scientific experts over the acceptance of DNA evidence. The complexity and rapid development of genetic science will exacerbate the problem. Scientists need ongoing dialogue and continuous re-examination to test their theories. In courtrooms, decisions must be made at the close of the evidence. This reality creates a natural tension between science and the law."[331] In the United States, an organization known as the Einstein Institute for Science, Health and the Courts (EINSHAC) provides education to judges, courts and court-related personnel in relation to a number of scientific and technical areas, including genetic evidence.

"Our calling is to make science accessible to the instruments of justice. Our mission is to provide judges, courts and court-related personnel with knowledge tools related to

[331] NHMRC's Australian Health Ethics Committee,
"Essentially Yours: The Protection of Human Genetic Information in Australia Available at http://www.nhmrc.gov.au/your_health/egenetics/practitioners/education.htm(See Para 46.23 of the ALRC Report – 96 )

criminal and civil justice proceedings involving evidence from the genetic sciences – genetics, molecular biology, biotechnology and molecular medicine – and from new discoveries and technologies in the environment and neuro-sciences. In sum, we emphasize the science and impacts of … technologies in judicial system proceedings."

Therefore, the National and State Judicial Academies and the Bar Councils should develop and promote continuing legal educational programmes for judges and legal practitioners, respectively, in relation to the use of genetic information in the courts.

### 7.3 Social awareness about the issue

We have recently advanced our knowledge of genetics to the point where we can manipulate life in a way never intended by nature.

We must proceed with the utmost caution in the application of this new found knowledge[332].Time for legal system and science to work together

The gene revolution is forcing judges to deal with science in a way they never had to before.Questions about the legal relationship between an egg donor, her husband, person being cloned, a surrogate mother and the resulting Child, legal rights , privileges and immunities a cloned child could claim in a jurisdiction that bans human reproductive cloning.

### 7.4 Transportation and Storage

The first responding officer may be called upon to transport evidence from a crime scene. As with any evidence, the officer should ensure that the chain of custody is maintained. In addition, they should be aware that direct sunlight and warmer conditions may degrade DNA, and avoid storing evidence in places that may get hot, such as the trunk of the police car. To best preserve DNA evidence, store in a cold environment.

[332]See,Article,Availble at http://www.agbioworld.org/biotech-info/articles/agbio-articles/gm-crop-role.html (Last Accessed on 5th May 2010)

Any probative biological sample that has been stored dry or frozen, regardless of age, may be considered for DNA analysis. Nuclear DNA from blood and semen stains more than 20 years old has been analyzed successfully using polymerase chain reaction (PCR). Samples that have been stored wet for an extended period of time should be considered for testing only using PCR and may be unsuitable for DNA analysis. Mitochondrial DNA analysis has been performed on very old bones, teeth, and hair samples.

Samples generally considered unsuitable for testing with current techniques include embalmed bodies (with the possible exception of bone or plucked hairs), pathology or fetal tissue samples that have been immersed in formaldehyde or formalin for more than a few hours (with the notable exception of pathology paraffin blocks and slides ), and urine stains. Other samples such as feces, fecal stains, and vomit can potentially be tested, but are not routinely accepted by most laboratories for testing.

## 8. DNA evidence and the various parties in the legal system- role of various agencies

### 8.1 Role and Duties of DNA Forensic Laboratories

An appropriate standard for the operation of testing laboratories and the collection and analysis of DNA samples is very important. Uniformity in reporting, completeness of reporting (including laboratory protocols and written criteria for interpretation), and stringent quality assurance of laboratories are essential. The court and the jury should have no reason to doubt the accuracy of the processing of information. Laboratories and experts have a particular responsibility to ensure that they are open and candid with the courts. Any reservations about inadequacies or errors should be promptly revealed, and failure to do that should be dealt with seriously. The court should not hesitate to exercise contempt powers and exclude experts who have misled deliberately in the past. Private trade associations and other appropriate groups should also apply pressure to ensure accuracy and candor.

(i) Interpreting DNA Test Results. : No matter which type of DNA testing is used, the technicians performing the test must interpret the results in some way. First, the examiner must decide whether the DNA fragments in the crime scene sample match

the suspect's DNA. Second, the examiner must estimate the probity of the match; in other words, is the DNA pattern so common that it could have come from any number of people or is it so uncommon that it could have come from only a few individuals?

(ii) Declaring a Match. : In both PCR-based and VNTR profiling, the analyst compares the location and size of the bands on the autorad to see whether any of the bands resemble each other. Labs impose two conditions for declaring a match: First, the examiner must believe that the suspect's fragments have migrated the same distance on the gel; second, computerized measurements must confirm that the difference in migration distances is less than some standard deviation of a set of independent measurements of fragments taken from one sample.

(iii) Evaluating the Probity of the Match: Principles of Population Genetics. Evidence that the suspect's DNA matches DNA taken from the crime scene is not the end of the evaluation. Declaring a match would not be particularly probative if the suspect's DNA were so common that it was very likely to match the crime-scene DNA. The analyst should be able to estimate the chance of a match if the suspect is the source of the sample compared to the chance of a match if someone other than the suspect is the source.

To make this comparison, the examiner must estimate the relative frequency with which the incriminating DNA fragments appear in the relevant population. That frequency usually is determined by comparing the crime-scene DNA profile with some reference data set. But because available databases contain only a very small proportion of the trillions of possible profiles, the frequency of a given profile must be estimated based on the frequencies of individual alleles. Making that estimate involves assumptions about the mating structure of the population.

Obviously, populations do not mate at random. Many people are more likely to choose a mate from the same geographic area, ethnic group, or religion. Furthermore, in some societies people choose mates based on physical and behavioural attributes, such as height and personality. In fact, empirical studies have shown that the population of the United States includes different population groups and subgroups with different allele frequencies. Thus, estimates of the frequency with which an allele appears in the population at large must take into account slight differences among

various populations. The National Research Council's second report, discussed in more detail in section III(D), suggests procedures that take into account such deviations from Hardy-Weinberg proportions.

A related concept is that of *linkage equilibrium*. If mating and selection were truly random, and the entire population therefore had the same allele frequencies, then an analyst could calculate the frequency of a certain genotype simply by multiplying together the frequencies of each of the individual alleles that compose the genotype. Population geneticists would say that such a population is in linkage equilibrium. But in fact we know that loci on some chromosomes tend to be inherited together and thus are in *linkage disequilibrium.* What effect does that fact have on calculating the frequency with which certain genotypes appear in the population? The answer is complex and, like the concept of *Hardy-Weinburg equilibrium,* has contributed to much of the controversy concerning DNA profiling. The National Research Council's second report examined empirical data on linkage disequilibrium suggested formulae for calculating frequencies that it claims are correct to within a factor of about ten-fold in either direction.

### 8.2 Crime Laboratory Managers:

Funding to further automate and improve the infrastructure of State, and local crime labs so they can process DNA samples efficiently and cost-effectively. Access to the latest training, information, and resources for the forensic scientists who work in our Nation's crime laboratories is critical to ensuring the most effective use of this technology

#### i. Recommendations for Laboratory Personnel-

A DNA testing laboratory may be requested to serve as a consultant to the attorneys, the defendant, or the judge. The laboratory also has an obligation to perform quality DNA tests and to interpret and report the results accurately and without bias.

The laboratory should test only the amount of sample needed to obtain reliable test results and retain untested samples for possible future testing.

The public or private laboratory skilled in DNA testing can assist in the post conviction process in a number of ways, including:

- Agreeing to conduct some pro bono testing at the request of a judicial officer, prosecutor, defense counsel, or project.
- Making its personnel available to assist participants in a post conviction preceding who lack adequate technical expertise.
- Victim, reference, and kinship samples are accessioned into the laboratory system and documented by proper chain of custody.
- DNA is extracted and genotyped, and that analysis of the genotype data, including matching and statistics, is performed.
- Samples are reaccessioned and accounted for, if they have been outsourced.

Final administrative review—comparing the DNA results to non-DNA metadata—is conducted and, if necessary, reconciled. [Note: Metadata for a kinship sample, for example, include the kin's name, biological relationship to the victim, and when and where the sample was collected.

- Victim, reference, and kinship samples are accessioned into the laboratory system and documented by proper chain of custody.
- DNA is extracted and genotyped, and that analysis of the genotype data, including matching and statistics, is performed.
- Samples are recession and accounted for, if they have been outsourced.
- Final administrative review—comparing the DNA results to non-DNA metadata—is conducted and, if necessary, reconciled. [Note: Metadata for a kinship sample, for example, include the kin's name, biological relationship to the victim, and when and where the sample was collected

Special attention is required for:

- Sample collection, preservation, shipping, and storage.
- Tracking and chain of custody issues.
- Clean, secure laboratory facilities.
- Quality assurance and quality control practices.
- Managing the work.

- DNA extraction and typing.
- Interpretation of results.
- Automation.
- Use of software for sample tracking and data management.
- Use of an advisory panel of experts.
- Public education and communication.
- Privacy issues.

## 8.3 Forensic Scientists

The application of forensic DNA evidence is increasingly vital to ensuring accuracy and fairness in the criminal justice system. Access to the latest training, information, and resources for the forensic scientists who work in our Nation's crime laboratories is critical to ensuring the most effective use of this technology.

Tools for Forensic Scientists-

This list of tools and information is provided to aid forensic scientists working in Nation's crime laboratories.

- Standard Reference Materials (NIST)
- Population Data from STR Systems
- Published STR Multiplexes
- List of Three-Banded Allele Patterns
- List of Variant Alleles

## 8.4 Role of Expert

While interpreting the DNA evidence the expert has to take due care of using his all expertise and experience. He should not undergo mal practice. Give false evidence under any pressure, inducements and any sort of influence.

Cuilibet In Sua Artepertio Est Credendum –Credence Should Be Given To An Expert

Imperitia Culpae Adnumeratur –In Expert Wont Of Skill Is Culpable

- **Availability And Cost of Experts**

Wide use of forensic DNA typing will have considerable costs. Laboratories will be required to be funded by many states and the federal government. The Commonwealth of Virginia, for example, has committed several million dollars to its DNA forensic activities. Costs will be associated with upgrading the databanks when new procedures replace old ones. Increased costs will also be associated with the control, licensing, and oversight of laboratories and technicians. Many experts will need to be available. The defense cost will be substantially increased. Moreover, as DNA typing becomes more generally available, jurors might expect it in situations where it is impossible to produce. A failure to introduce DNA typing evidence could lead to an inference of spoliation, i.e., the destruction or alteration of evidence.

Of course, the early exclusion of suspects who have been cleared by DNA typing evidence will reduce other costs to the judicial system. DNA evidence might also obviate trials in some cases by proving identity fairly conclusively. In general, however, the costs of the criminal-justice system will be increased.

We cannot now accurately estimate the cost of the widespread use of DNA typing, but it can be expected to run into the tens of millions of dollars a year. However, relative to the cost of operating the entire system, the cost of using DNA evidence is minuscule. The quality of justice will be increased by full use of DNA typing. In general, we believe that the expenditures are warranted by the advantages to be expected.

## 8.5 Researchers

Forensic DNA has played a crucial role in the investigation and resolution of thousands of crimes. The demand for tools and technologies for DNA testing far exceeds the current capabilities of the field. The forensic DNA community would greatly benefit from technical tools and innovations that can be appropriately validated, quality-controlled, quality-assured, and implemented for forensic use.

## 8.6 Officers and Investigator

DNA technology is enabling cases to be solved previously thought unsolvable. Investigators with a fundamental knowledge of how to identify, preserve, and collect DNA evidence properly can solve cases in ways previously seen only on television. Evidence invisible to the naked eye can be the key to solving a residential burglary or child's murder. It also can link different crime scenes to each other in a small town, within a single State, or across the Nation.

### Chain of Custody

The chain of custody of evidence is a record of individuals who have had physical possession of the evidence. Documentation is critical to maintaining the integrity of the chain of custody. Maintaining the chain of custody is vital for any type of evidence. In addition, if laboratory analysis reveals that DNA evidence was contaminated, it may be necessary to identify persons who have handled that evidence.

In processing the evidence, the fewer people handling the evidence, the better. There is less chance of contamination and a shorter chain of custody for court admissibility hearings. Because extremely small samples of DNA can be used as evidence, greater attention to contamination issues is necessary when identifying, collecting, and preserving DNA evidence. DNA evidence can be contaminated when DNA from another source gets mixed with DNA relevant to the case.

## 8.7 role/duties of judges Crime Scene Integrity-Duty of Investigating Agency

Boni Judicis Est Judiciam Sine Diletione Manclare Excecutioni- A Good Judge Should Have A Judgement Without Delay

Boni Judicis Est Lites Crilimare Ne Lix Ex Lite Oriture, Et Interest Reipublicae Ut Sini Fines Litium- A Good Judgeshould Put On End To Litigation That Suit May Not Grow Out Of A Suit As It Concern The Welfare Of State

Judicias EST Jus Decere Non-Dare – the Judge’s Duty Is to Decide according To the Allegation and Proof.

Protection of the crime scene is essential to the protection of evidence[333]. Safeguarding and preserving evidence is fundamental to the successful solution of a crime. Remember, while documenting evidence at the crime scene, to include descriptions of whether evidence was found wet or dry. An example of this documentation would include blood spatters.

The risk of contamination of any crime scene can be reduced by limiting incidental activity. It is important for all law enforcement personnel at the crime scene to make a conscious effort to refrain from smoking, eating, drinking, littering or any other actions which could compromise the crime scene. Because DNA evidence is more sensitive than other types of evidence, law enforcement personnel should be especially aware of their actions at the scene to prevent inadvertent contamination of evidence.

When probability statements are admissible, the judge should not be expected to instruct the jury in detail on probabilities is computed or how probabilities available from an analysis of DNA material should be combined with probability estimates based on more traditional testimony and other evidence. Those matters are better left to the experts and to the lawyers on summation. The court should encourage the use of charts, written reports, and duplicates of materials that are relied on by the experts, so that the jury can be as well educated as possible in the evaluation of DNA typing evidence. To that end, the court should insist that technical terms be reduced to understandable lay language and that scientific information be presented to the jury in the least confusing form possible.

DNA typing may be assessed within the framework of normal forensic laboratory work and can be readily handled with the present rules and forms of charges.

Judges may feel compelled to take a proactive stance to protect the inmate seeking relief if the prosecution and defence are refusing to cooperate. A court may be especially likely to exercise its discretion in the interests of justice in a potential category 1 case, particularly if the court fears that the passage of time may make it impossible to ascertain the validity of a claim of actual innocence.

[333]See, Article, "Advancing Justice through DNA Technology", available at http://www.dna.gov/basics/evidence_collection/crime-scene-integrity and see also http://www.forensicmag.com/tips-sub/1006 (Last visited on 7th July 2010)

The judge's assistance may be sought in connection with such matters as locating and preserving evidence, obtaining discovery from laboratories, and compelling third parties to provide samples for elimination testing. The court might also consider whether to exercise its discretion to appoint an expert to assist the court in a case that presents disputed, complex, technical issues relating to DNA testing or interpretation.

- Trial courts will likely be involved in category 1 and category cases. By issuing orders, the court can play an important role in helping obtain access to evidence prior to testing, which is part of the screening process and helps determine if DNA evidence will be irrelevant to the case.

In the retesting stage, it is recommended that the court set an informal conference with counsel to discuss issues such as the type of DNA analysis to be used, whether it will be necessary to test the victim's relatives or third parties, and whether additional samples need to be obtained from the vitim. Once post conviction DNA test results have been obtained, if the results are favorable to the inmate and no alternative explanations exist, the court should be prepared to grant a joint request to vacate the conviction. In the absence of a joint motion, an evidentiary hearing should be set to determine if there is a reasonable probability of a change in the verdict or judgment of conviction.

### 8.8 Law Enforcement and Officers of the Court:

Cooperation on the part of law enforcement officials may be crucial; materials needed for testing or retesting may be in their possession.

Consequently, they can assist in:

- Finding the evidence that was sent to the laboratory for testing.
- Identifying and locating other evidence that is now testable.
- Preserving the evidence.

DNA has become an invaluable instrument in the search for justice. DNA evidence may play a significant role at various points throughout the life of a criminal case, from the initiation of a criminal investigation through post-conviction confirmation of

the truth. As the "end users" of DNA evidence, Officers of the Court must understand both the science and technology of DNA evidence.

## 8.9 Victim's Advocates

DNA evidence is playing a larger role than ever before in criminal cases throughout the country, both to convict the guilty and to exonerate those wrongly accused or convicted. This increased role places greater importance on the ability of victim service providers to understand the potential significance of DNA evidence in their clients' cases.

Role of the Victims' Advocate in Post conviction Testing-

The role of the victims' advocate in postconviction proceedings is essential and complex. The advocate's usual role is to provide support, which will likely be needed during a postconviction proceeding as it may be extremely traumatic for surviving victims and their families to learn that a person found guilty is now attempting to vacate the conviction. The early involvement of victims' advocates lessens the chance of victims and their families making this discovery through the media and ensures that they are kept informed and treated with appropriate concern and respect.

In cases in which biological evidence was collected and still exists—and if the evidence is subjected to DNA testing or retesting, exclusionary results will exonerate the petitioner—advocates may also have to prepare their clients for the possibility that the inmate will be exonerated. If this occurs, advocates face the difficult task of providing support for the person whose misidentification of the culprit may have been the chief evidence leading to the original guilty verdict.

Advocates will at times be called upon to persuade a victim to agree to DNA testing even though the victim is convinced of the accuracy of the identification he or she made at the inmate's trial. For exclusionary purposes, samples may also have to be tested from persons who were engaged in sexual relations with the victim at the relevant time. Victims may be reluctant to provide names or to urge these persons to cooperate. In order to expedite postconviction proceedings, victims' advocates must make victims appreciate the desirability of cooperating because DNA testing

may lead to the apprehension of the person who was truly guilty and prevent future criminal acts.

It is important to note that a number of States passed victims' rights statutes that require notification of victims, including notification of appeals proceedings, prison release, and application for pardon or commutation of sentence. Agencies involved in postconviction DNA cases should make certain they are complying with any applicable State statutes. (See a summary of DNA post conviction statutes prepared by the American Society of Law, Medicine & Ethics.)

It is extremely important that crime victims and their family members are provided with information and approached with great sensitivity regarding postconviction issues. Notification of requests for DNA testing should be made by the prosecutor through a victim assistance specialist.

Avoid unreasonable and intrusive sample collection. Explain technical aspects of testing and the significance of the samples request. Ensure that information about the location of victims and family members remains confidential. Provide information about testing results in a timely fashion, in person if possible.

### 8.10 The Prosecutor

The prosecutor will work closely with the investigators and will normally have access to adequately staffed and organized forensic laboratories. The prosecutor should carefully supervise the investigation activities to ensure that DNA typing evidence will be admissible, if it proves relevant.

The prosecutor has a strong responsibility to reveal fully to defense counsel and experts retained by the defendant all material that might be necessary in evaluating the evidence. That includes information on tests that proved inconclusive, on retesting, and on the testing of other persons. Adoption of rules or statutes that require the prosecutor to involve the defense in analysis of DNA samples at the earliest possible moment is highly recommended.

The committee recommends going beyond what is required by the federal rules of criminal procedure and of civil procedure in regard to disclosures concerning DNA

evidence. For example, data sheets and other materials obtained from experts who are not designated to testify should be available freely without the need for separate motions, because such materials are important for the evaluation of the scientific evidence in the case of DNA typing. Such free exchange of information, including access to databanks and to samples of evidence DNA, should apply to defense and prosecution experts in both criminal and civil cases.

### (a) Recommendations for Prosecutors for Post conviction

Requests for post conviction DNA testing may come from a variety of parties, including inmates, their families, defense attorneys, or police. When a request for post conviction DNA testing is received, recommendations for prosecutors include the following:

- Get as much information as possible about the inmate and the case, including defenses proffered at trial and defenses currently claimed.
- Determine whether the case is suited to DNA testing, depending on the category of the case. Evaluate previous DNA testing.
- Provide information to the requestor, including the fact that DNA testing could have a negative effect if the inmate's DNA testing results are placed in a DNA criminal identification bank and he is identified as a perpetrator of other crimes.
- Throughout the process, consult and notify victim/witness specialists, forensic DNA experts, defense counsel, and prosecutors experienced in DNA technologies and postconviction relief issues.

## 8.11 The Defense

Defense counsel must have access to adequate expert assistance, even when the admissibility of the results of analytical techniques is not in question, because there is still a need to review the quality of the laboratory work and the interpretation of the results. When the prosecutor proposes to use DNA typing evidence or when it has been used in the investigation of the case, an expert should be routinely available to the defendant. If necessary, he or she should be able to apply for funds early in the

discovery stages to retain experts without a showing of relevance that might reveal trial strategy.

Whenever possible, a portion of the DNA sample should be preserved for independent analysis by the defense[334].

The prosecutor should promptly reveal to defense counsel that DNA was involved in the investigation and might be available for analysis at the trial. Normally, the criminal-justice system will not provide for the appointment of counsel for the defendant or for payment for experts until the defendant has been arrested or charged. Where a sample of the defendant's tissue is sought for DNA typing, application to the court for DNA experts should be possible even before an arrest has been made.

In our judicial system, jurors are relatively independent. Nevertheless, through limitations on the admissibility of evidence and on the form of its presentation and through the use of a variety of instructions, the court exercises considerable influence. DNA evidence, like other scientific and statistical evidence, can pose special problems of jury comprehension. Courts and attorneys should cooperate to facilitate jury understanding. Innovative techniques, such as allowing jurors to take notes or ask questions, might be considered. Jargon should be avoided, and information should be presented simply, clearly, and fairly. Unless limited by law or court rules, judges should be free to pose questions to witnesses when they feel that the answers might clarify the testimony. Reports and relevant materials should be admitted into evidence so that they can be studied by courts at their leisure. Finally, a judge would not be amiss in pointing out to attorneys the wisdom of including jurors who are found to have a background that enhances their ability to understand the expert testimony.

**(a) Recommendations for Defense Counsel-**

- Perform extensive screening to determine if the case is suited to DNA testing.
- If a case is determined to warrant DNA testing, conduct an extensive search for evidence, consulting with prosecutors throughout the search.

334.See,Paul C. Giannelli, Ake V. Oklahoma: The Right to Expert Assistance in a Post-Daubert, Post-DNA World, *89 Cornell L. Rev. 1305* Available at https://litigationessentials.lexisnexis.com/webcd/app (visited on 3rd November 2010)

- Do not contact the victim. It is up to the prosecutor's office, through its victim services agency, to determine if it is appropriate to inform the victim of testing.

Defense counsel should appreciate that convictions are rarely reopened and that a noncontentious attitude may expedite the location of needed biological samples and accelerate the testing process that is an innocent client's best hope for relief.

On the other hand, defense counsel must also recognize and inform their clients that truth may have a price and that inculpatory results will have to be disclosed to the prosecution. Convicted felons are not entitled to testing without risking the consequences of false claims of innocence.

## 8.12 Policymakers and Lawmakers

DNA technology is increasingly vital to ensuring accuracy and fairness in the criminal justice system. In order to realize the vast potential of DNA technology, policy and legislation must set a framework that allows for the most effective use of the technology while ensuring privacy and information integrity.

### Protective Orders

Protective orders should not be used to prevent experts on either side from obtaining all relevant information, which can include original materials, data sheets, software protocols, and information about unpublished databanks. A protective order might be appropriate to limit disclosures by attorneys and experts to third parties about proprietary information acquired in the course of a particular case; but as a general rule, any scientific information used in a case should be open to widespread scientific scrutiny. One exception might be when the expert is involved in a current or recently completed study on which he or she does *not* directly rely to develop an opinion. That will ensure that the expert does not lose his or her opportunity to publish as a consequence of testifying. Protective orders to prevent unnecessary intrusion into the privacy of such persons as those who have been cleared after investigation or who are juveniles are appropriate

## 8.13 Data Bank Related Conclusion-Suggestions

- In principle, a national DNA profile databank should be created that contains information on felons convicted of violent crimes with high rates of recidivism. The case is strongest for felons who have committed rape, because perpetrators typically leave biological evidence (semen) that could allow them to be identified. The case is somewhat weaker for violent offenders who are most likely to commit homicide as a recidivist offense, because killers leave biological evidence only in a minority of cases. The wisdom of including other offenders depends primarily on the rate at which they are likely to commit rape, because rape is the crime for which the databank will be of primary use.
- There are a number of scenarios that illustrate the point that the databank need not be limited to persons convicted of specified crimes.
- The databank should also contain DNA profiles of samples from unidentified persons collected at the scenes of violent crimes.
- Databanks containing DNA profiles of members of the general population (as exist for ordinary fingerprints for identification purposes) are not appropriate, for reasons of both privacy and economics.
- DNA profile databanks should be accessible only to legally authorized persons and should be stored in a secure information resource.
- Legal policy concerning access and use of both DNA samples and DNA databank information should be established before widespread proliferation of samples and information repositories. Interim protection and sanctions against misuse and abuse of information derived from DNA typing should be established immediately. Policies should explicitly define authorized uses and should provide for criminal penalties for abuses.
- Although the committee endorses the concept of a limited national DNA profile databank, we doubt that existing RFLP-based technology provides a wise long-term foundation for such a databank. We expect current methods to be replaced soon with techniques that are simpler, easier to automate, and less expensive—but incompatible with existing DNA profiles. Accordingly, we do not recommend establishing a comprehensive DNA profile databank yet.
- For the short term, we recommend the establishment of pilot projects that involve prototype databanks based on RFLP technology and consisting

primarily of profiles of violent sex offenders. Such pilot projects could be worthwhile for identifying problems and issues in the creation of databanks. However, in the intermediate term, more efficient methods will replace the current one, and the forensic community should not allow itself to become locked into an outdated method.

- State and federal laboratories, which have a long tradition and much experience with the management of other types of basic evidence, should be given primary responsibility, authority, and additional resources to handle forensic DNA testing and all the associated sample-handling and data-handling requirements.
- Private-sector firms should not be discouraged from continuing to prepare and analyze DNA samples for specific cases or for databank samples, but they must be held accountable for misuse and abuse to the same extent as government-funded laboratories and government authorities.
- Discovery of a match between an evidence sample and a databank entry should be used only as the basis for further testing using markers at additional loci. The initial match should be used as probable cause to obtain a blood sample from the suspect, but only the statistical frequency associated with the additional loci should be presented at trial.

### 8.14 Other Suggestions Recommendations

#### (a) Eliminating Backlogs

One of the biggest problems facing the criminal justice system today is the substantial backlog of unanalyzed DNA samples and biological evidence from crime scenes, especially in sexual assault and murder cases. Too often, crime scene samples wait unanalyzed in police or crime lab storage facilities. Timely analysis of these samples and placement into DNA databases can avert tragic results.

#### (b) Effect of Clearing the Backlog

The results of addressing backlogs are dramatic, as the two examples below illustrate:

Several law enforcement agencies, prosecutors' offices, and crime labs across the country have established innovative programs to review old cases. Often called "cold case units," these programs have enabled criminal justice officials to solve cases that have languished for years without suspects. Most frequently, DNA evidence has been the linchpin in solving these cases

**(c) Strengthening Crime Laboratory Capacity**

At present, many of our Nation's crime laboratories do not have the capacity necessary to analyze DNA samples in a timely fashion. Many have limited equipment resources, outdated information systems, and overwhelming case management demands. As a result, the criminal justice system as a whole is unable to reap the full benefits of DNA technology. The President's initiative will provide federal funding to further automate and improve the infrastructure of federal, state, and local crime labs so they can process DNA samples efficiently and cost-effectively. These infrastructure improvements are critical to preventing future DNA backlogs, and to helping the criminal justice system realize the full potential of DNA technology.

**(d) Increasing the Analysis Capacity of Public Crime Labs**

The labs can update their infrastructure, automate their DNA analysis procedures, and improve their retention and storage of forensic evidence[335].

- Providing Basic Infrastructure Support: Some public crime laboratories still need assistance to help them obtain equipment and material to conduct the basic processes of DNA analysis – extraction, quantitation, amplification and analysis – and to help them meet various accreditation requirements.
- Building Infrastructure through Laboratory Information Management Systems: Laboratory Information Management Systems, or "LIMS," are designed to automate evidence handling and casework management, to improve the integrity and speed of evidence handling procedures, and to ensure proper chain of custody. DOJ estimates that only 10 percent of the public DNA laboratories have LIMS systems.

[335] http://www.justice.gov/ag/dnapolicybook_solve_crimes.htm (visited on 4th December 2010)

- Providing Automation Tools to Public DNA Laboratories: To streamline aspects of the DNA analysis procedure that are labor and time-intensive, crime laboratories should have automated systems, such as robotic DNA extraction units. Automated DNA analysis systems increase analyst productivity, limit human error and reduce contamination.
- Providing Support for the Retention and Storage of Forensic Evidence: Forensic evidence must be stored in a manner that ensures its integrity and maintains its availability throughout criminal investigations and judicial proceedings. Appropriate evidence storage conditions require costly equipment such as security systems, environmental control systems, ambient temperature monitors, and de-humidifiers. The initiative will support the improvement of evidence storage capabilities.

**(e) Funding the Forensic Analysis Programs**

The Laboratory runs several different programs for the analysis of DNA information. The Nuclear DNA Program supports central, state, local, and international law enforcement agencies by providing advanced technical assistance within the forensic biology discipline and sub-disciplines through interrelated capabilities and expertise. Mitochondrial DNA is a powerful tool available for investigating cases of kidnapping, missing persons, and skeletal remains where nuclear DNA is not present.

**(f) Stimulating Research and Development**

In order to improve the use of DNA technology to advance the cause of justice, the Attorney General will stimulate research and development of new methods of analyzing DNA samples under the President's initiative. Also, the President has asked the Attorney General to establish demonstration projects under the initiative to further study the public safety and law enforcement benefits of fully integrating the use of DNA technology to solve crimes. Finally, the President has directed the Attorney General to create a National Forensic Science Commission to study rapidly evolving advances in all areas of the forensic sciences and to make recommendations to maximize the use of the forensic sciences in the criminal justice system. In all, the President's initiative will devote $24.8 million in FY 2004 to fund advances in the use of DNA technology.

### (g) Improving DNA Technology

Forensic DNA analysis is rapidly evolving. Research and development of tools that will permit crime laboratories to conduct DNA analysis quickly is vital to the goal of improving the timely analysis of DNA samples. Smaller, faster, and less costly analysis tools will reduce capital investments for crime laboratories while increasing their capacity to process more cases. Over the course of the next several years, DNA research efforts will focus on the following areas:

- The development of "DNA chip technology" that uses nanotechnology to improve both speed and resolution of DNA evidence analysis. This technology will reduce analysis time from several hours to several minutes and provide cost-effective miniaturized components.
- The development of more robust methods to enable more crime labs to have greater success in the analysis of degraded, old, or compromised items of biological evidence.
- Advanced applications of various DNA analysis methods, such as automated Short Tandem Repeats (STRs), Single Nucleotide Polymorphisms (SNPs), mitochondrial DNA analysis (mtDNA), and Y-chromosome DNA analysis.
- The use of animal, plant, and microbial DNA to provide leads that may link DNA found on or near human perpetrators or victims to the actual perpetrator of the crime.
- Technologies that will enable DNA identification of vast numbers of samples occasioned by a mass disaster or mass fatality incident.
- Technologies that permit better separation of minute traces of male sexual assailant DNA from female victims.

### (h) Establishing DNA Demonstration Projects

To further research the impact of increased DNA evidence collection on public safety and law enforcement operations, the Attorney General will conduct rigorous scientific research through demonstration projects on the use of DNA evidence under the initiative. This research will help determine the scope of public safety benefits that result when police are trained to more effectively collect DNA evidence and

prosecutors are provided with training to enhance their ability to present this evidence in court.

Several jurisdictions will be selected to incorporate core training and evidence collection requirements in their daily operations. At each site, one or more law enforcement agencies will be chosen to implement extensive training on the collection of DNA evidence and to increase the resources devoted to the investigation and prosecution of these cases. Prosecutors will also receive training on how to more effectively present DNA evidence and how forensic DNA technology may be used to solve current and "cold" cases. Jurisdictions that received increased training and resources will be compared with jurisdictions that did not receive these benefits.

The resulting comparison will measure the impact of increased DNA evidence collection on public safety and law enforcement operations. For example, projects will examine whether there are increased crime clearance rates, whether DNA aided investigations, the number of cases successfully prosecuted, the number of cases where guilty pleas were obtained due to the presence of DNA evidence, any financial savings resulting from the use of forensic evidence, and increased responsiveness to victims. The information obtained will allow state and local governments to make more informed decisions regarding investment in forensic DNA as a crime-fighting tool.

**(i) Creating a National Forensic Science Commission**

To facilitate the ability of policymakers to assess the needs of the forensic science community, and to stimulate public awareness of the uses of forensic technology to solve crimes, the President has directed the Attorney General to create a National Forensic Science Commission. The Commission will be charged with two primary responsibilities: (1) developing recommendations for long-term strategies to maximize the use of current forensic technologies to solve crimes and protect the public, and (2) identifying potential scientific breakthroughs that may be used to assist law enforcement.

The Attorney General will appoint Commission members from professional forensic science organizations and accreditation bodies and from the criminal justice

community. These individuals will have broad knowledge and in-depth expertise in the criminal justice system and in various areas of the forensic sciences such as analytical toxicology, trace evidence, forensic biology, firearms and toolmark examinations, latent fingerprints, crime scene analysis, digital evidence, and forensic pathology, in addition to DNA. Judges, prosecutors, attorneys, victim advocates, and other members of the criminal justice system will also be represented on the Commission.

The Commission will study advances in all areas of the forensic sciences and make recommendations on how new and existing technologies can be used to improve public safety. The Commission will also serve as an ongoing forum for discussing initiatives and policy, and may issue recommendations that will assist state and local law enforcement agencies in the cost-effective use of these technologies to solve crimes.

### 8.15 Training to various agencies

#### (a) Training the Criminal Justice Community

In order to maximize the use of DNA technology, under the President's initiative, the Attorney General will develop training and provide assistance regarding the collection and use of DNA evidence to the wide variety of professionals involved in the criminal justice system, including police officers, prosecutors, defense attorneys, judges, forensic scientists, medical personnel, victim service providers, corrections officers, and probation and parole officers.

Key players in the criminal justice system should receive additional training in the proper collection, preservation, and use of DNA evidence. Fundamental knowledge of the capabilities of DNA technology is essential for police officers to collect evidence properly, prosecutors and defense attorneys to introduce and use it successfully in court, and judges to rule correctly on its admissibility. Victim service providers and medical personnel likewise need to understand DNA technology in order to encourage more successful evidence collection and to be fully responsive to the needs of victims.

**(b) Law Enforcement Training**

As the first responders to crime scenes, law enforcement officers should be able to identify, collect and preserve probative biological evidence for submission to crime laboratories. Improper collection can mean that valuable evidence is missed or rendered unsuitable for testing. The initiative devotes $3.5 million in FY 2004 to assist law enforcement in meeting the following training needs:

- Basic "awareness training" on DNA evidence for patrol officers and other first-responders;
- Intensive training on identifying, collecting, and preserving potential DNA evidence for evidence technicians, investigators, and others processing crime scenes;
- Training and education for investigators and responding officers on DNA databases and their potential to provide leads in current and "cold" cases; and
- Training and information for law enforcement leadership and policymakers to facilitate more informed decisions about effective DNA evidence collection and testing.

**(c) Training Prosecutors, Defense Attorneys, and Judges**

In order to achieve just results in cases involving DNA evidence, prosecutors, defense attorneys, and judges should receive proper training on the use and presentation of DNA evidence. The initiative devotes $2.5 million in FY 2004 to support:

- Training and technical assistance for prosecutors to learn about solving "cold cases" with DNA evidence, responding to post-conviction DNA testing requests, and developing innovative legal strategies to optimize the power of forensic DNA technology. Grant funds will be available for state and local prosecutors' organizations for the development and delivery of training materials to assist prosecutors in presenting this evidence before courts and juries, and in understanding more about the value of DNA evidence in particular cases.
- Training for defence counsel handling cases involving biological evidence on the applications and limitations of DNA evidence. Grant funds will be made

available to continuing legal education programs or bar associations to provide training and resources on forensic DNA technology.

- Training for judges, who must be equipped with sufficient technical and scientific knowledge to make appropriate rulings in cases involving DNA evidence. Grant funds will be available to national judicial conferences and organizations.

**(d) Training for Probation and Parole Officers and Corrections Personnel**

Probation and parole officers play a critical role in ensuring that offenders are complying with their statutory obligations to provide DNA samples. Corrections personnel often are responsible for obtaining DNA samples from inmates required by law to submit such samples. Through training and education programs, these professionals will be better equipped to ensure that samples are taken from all individuals who are required by law to provide them. The initiative calls for $1 million in FY 2004 to support this training.

**(e) Training for Forensic Scientists**

The forensic science community has a critical need for trained forensic scientists in public crime laboratories. The initiative will assist the development of comprehensive training programs for a new generation of forensic scientists, enabling new forensic scientists to receive in-depth training to prepare them for analyzing actual casework in a crime laboratory. The initiative calls for $3 million in FY 2004 to support this training.

**(f) Training for Medical Personnel**

The initiative will also provide $5 million in FY 2004 to support the development of training and educational materials for doctors and nurses involved in treating victims of sexual assault. Trained medical personnel are needed to effectively collect usable DNA evidence, while safeguarding the privacy rights and addressing the needs of rape victims requiring sexual assault exams. These programs will specifically target underserved areas of the country. Funding may also be used to support the

development of SANE (Sexual Assault Nurse Examiner), SAFE (Sexual Assault Forensic Examiner), and SART (Sexual Assault Response Team) programs.

**(g) Training for Victim Service Providers**

Victims and those who advocate on their behalf must have access to information about the investigative and courtroom uses of forensic DNA evidence. Victims should be properly informed about how DNA evidence may impact their cases. In situations involving post-conviction DNA testing, victim service providers must be able to assist victims through the often-painful process of newly-ordered DNA tests and re-opened court proceedings. To address the concerns of victims, the initiative would develop additional DNA education and training programs for victim advocates and victim service providers so that they may better assist victims in all cases involving DNA evidence.

**8.16 Accountability and Public Scrutiny-**

Because the application of DNA typing in forensic science is to be used in the service of justice, it is especially important for society to establish mechanisms for accountability and to ensure appropriate public scrutiny.

Accountability must be an issue in proficiency testing and accreditation. There is reason to be skeptical of entrusting any important regulatory matters to a self-regulating organization. Accordingly, any organization conducting accreditation or regulation of DNA technology for forensic purposes should be free of influence of private companies, public laboratories, or other organizations actually engaged in laboratory work.

Private laboratories used for testing should not be permitted to withhold information from defendants on the grounds that "trade secrets" are involved. Alternatively, law-enforcement agencies could use only public laboratories for testing, so that the issue of "trade secrets" would not arise. Critics of DNA testing have suggested that the profit motive of private testing companies undermines their reliability. Although that criticism might be justified when companies are eager to market a product before it is ready, no general indictment of private companies on this basis is justified.

Testing methods and data need to be made available for public scrutiny. There has been a notable dearth of published research in forensic DNA testing by scientists unconnected to the companies that market the tests. In contrast with the research approach whereby new drugs and biomedical devices undergo controlled trials of safety and efficacy, forensic science has used more informal modes of evaluating new techniques. The process of peer review used to assess advances in biomedical science and technology should be used for forensic DNA technology.

Whether in publications or in court, companies might be reluctant to reveal their specific testing methods or the population data used to determine the probability of a match, because they consider this information to constitute a trade secret that could be exploited by competitors. However, the integrity of the scientific method and judicial due process demand that such information be revealed, particularly in criminal cases. The scientific community should require that the same standards used to assess new findings in other sectors of science be applied to DNA typing in the forensic setting.

## 8.17 Expectations

The introduction of a powerful new technology is likely to set up unwarranted or unrealistic expectations. Various expectations regarding DNA typing technology are likely to be raised in the minds of jurors and others in the forensic

For example, public perception of the accuracy and efficacy of DNA typing might well put pressure on prosecutors to obtain DNA evidence whenever appropriate samples are available. As the use of the technology becomes widely publicized, juries will come to expect it, just as they now expect fingerprint evidence, surveillance photographs, and audio and visual eavesdropping. Moreover, prosecutors will not want to give defense attorneys the opportunity to ask on summation, "If my client was the perpetrator, where is the DNA evidence?"

Once a prosecutor produces DNA evidence, the defense will be under great pressure to undermine it through the use of reports and experts, because of an assumption that the jury would interpret a failure to call a defense expert as an admission that the DNA evidence is persuasive. Mere cross examination by

Two aspects of DNA typing technology contribute to the likelihood of its raising inappropriate expectations in the minds of jurors. The first is the jury's perception of an extraordinarily high probability of enabling a definitive identification of a criminal suspect; the second is the scientific complexity of the technology, which results in laypersons' inadequate understanding of its capabilities and failings. Taken together, those two aspects can lead to the jury's ignoring other evidence that it should be considering.

Expectations regarding the power of DNA typing can lead to overlooking or ignoring sources of error or mistakes in applying the technology. For example, jurors' focusing on the probability of correctly identifying a per-

Perpetor might lead them to discount the possibility of laboratory error, whether it stems from incompetence or carelessness of personnel, malfunctioning equipment, or unavoidable mistakes.

The efficacy and accuracy of a new technology typically are initially demonstrated by the most highly competent and knowledgeable practitioners. As DNA typing becomes routine, the quality of laboratories and personnel using it might decrease while still meeting the standards required for accreditation or licensing. However, the expectations of judges and juries might remain high, because of the superior knowledge and competence of the initiators of the technology. Later gains in experience and improved typing could lead to an increase in quality.

As large felon databanks are created, the forensic community could well place more reliance on DNA evidence, and a possible consequence is the underplaying of other forensic evidence. Unwarranted expectations about the power of DNA technology might result in the exclusion of relevant evidence.

Both prosecutors and defense counsel are entitled to benefit from the power of DNA evidence, but they should not oversell it. DNA evidence is not infallible; all laboratory work is subject to error; and, given current population databanks and laboratory protocols, a witness or prosecutor will seldom (if ever) be justified in stating that the probability that a reported DNA match involves someone other than the suspect is so low as to make that possibility entirely implausible. Claims that treat

DNA identifications as though they are as reliable as fingerprint identifications in the typical rape or murder case are unjustified; until technology and databanks improve, they are likely to remain so.

Presentations suggesting to a judge that DNA typing is infallible can rarely be justified and should generally be avoided. However, there might be instances where a prosecutor could legitimately argue that the DNA evidence conclusively proves that the defendant committed the offense. Two examples are illustrative:

- The victim is confined to an institution where access is limited to relatively few male attendants. Semen taken from the vagina is subjected to analysis and compared to blood samples from all possible males with access to the victim. The defendant's known sample is the only profile that matches the evidentiary sample. In this circumstance, the prosecutor could well argue that only the defendant could have committed the crime.
- In a prosecution for sexual assault of a child, again a limited number of people might have access to the child, with only one possible donor matching the evidentiary sample. Again, the prosecutor might argue that the DNA evidence is conclusive.

### 8.18 International Exchange-

The need for international cooperation in law enforcement calls for appropriate scientific and technical exchange among nations. As in other areas of science and technology, dissemination of information about DNA

Typing and training programs for personnel likely to use the technology should be encouraged. It is desirable that all nations that will collaborate in law-enforcement activities have similar standards and practices, so efforts should be furthered to exchange scientific knowledge and expertise regarding DNA technology in forensic science[336].

[336] See, DNA Technology in Forensic Science, National Academic Press, Available at http://www.nap.edu/openbook.php?record (visited on 2nd January 2011)

## 8.19 Universal Declaration on the Human Genome and Human Rights, 1997.

(a) The Universal declaration on the Human Genome and Human Rights, adopted unanimously and by acclamation by the General Conference of UNESCO at its 29th session on 11 November 1997, is the first universal instrument in the field of biology. The uncontested merit of this text resides in the balance it strikes between safeguarding respect for human rights and fundamental freedoms and the need to ensure freedom of research. The moral commitment entered into by States in adopting the Universal Declaration on the Human Genome and Human Rights is a starting point, the beginning of international awareness of the need for ethical issues to be addressed in science and technology, and it is now upto States, through the measures they decide to adopt, to put the Declaration into practice and thus ensure its continued existence.

(b) The Declaration is without prejudice to the international instruments, which could have a bearing on the applications of genetics in the field of intellectual property. The Declaration recognizes that research on the human genome and the resulting applications open up vast prospects for progress in improving the health of individuals and of humankind as a whole, emphasizing that such research should fully respect human dignity, freedom and human rights, as well as the prohibition of all forms of discrimination based on genetic characteristics.

(c) Articles 1 to 4 emphasize the importance of human dignity and it is declared that human genome underlies the fundamental unity of all members of the human family, as well as the recognition of their inherent dignity and diversity, which in a symbolic sense is the heritage of humanity. Everyone has a right to respect for their dignity and for their rights regardless of their genetic characteristics. Human dignity makes it imperative not to reduce individuals to their genetic characteristics and to respect their uniqueness and diversity. It is declared that the human genome which by its nature evolves is subject to mutations and contains potentialities that are expressed differently according to each individual's natural and social environment including the individual's state of health, living conditions, nutrition and education. It is further declared that human genome in its natural state shall not give rise to financial gains.

(d) Part B of the Declaration, in Articles 5 to 9, deals with the rights of persons concerned. Article 5 provides that research treatment or diagnosis affecting an individual's genome shall be undertaken only after rigorous and prior assessment of the potential risks and benefits pertaining thereto and in accordance with any other requirement of national law, and further provides that, in all cases, the prior, free and informed consent of the person concerned shall be obtained. If such person is not in a position to consent, consent or authorization shall be obtained in the manner prescribed by law, guided by the person's best interest. Right of each individual to decide whether or not to be informed of the results of genetic examination and its consequences should be respected. If a person does not have the legal capacity to consent, research affecting such person's genome may only be carried out for direct health benefit of such person subject to the authorization and the protective conditions prescribed by law. Article 6 shuns discrimination based on genetic characteristics that has the effect of infringing human rights, human dignity and fundamental freedoms. Genetic data associated with identifiable person and stored or processed for the purposes of research or any other purpose is required to be held confidential in the conditions set by law. Every individual shall have the right, according to international and national law[337], to just reparation for any damage sustained as a direct and determining result of an intervention affecting his or her genome. In order to protect human rights and fundamental freedoms, limitations to the principles of consent and confidentiality may only be prescribed by law, for compelling reasons within the bounds of public international law and the international law of human rights.

(e) Articles 10, 11 and 12 deal with research on the human genome and provide that, no research or research application concerning the human genome, in particular, in the fields of biology, genetics and medicine, should prevail over respect for the human rights, fundamental freedoms and the human dignity of individuals or, where applicable, of groups of people. Practices which are contrary to human dignity, such as, re-productive cloning of human beings shall not be permitted, as declared by Article 11, which exhorts States and competent international organization to cooperate in identifying such practices and in taking, at national or international level,

[337]See, Universal Declaration on the Human Genome and Human Rights office of the United Nations High Commissioner for Human Rights, Available at http://www2.ohchr.org/english/law/genome.htm (visited on 25th January 2011)

the measures necessary to ensure that the principles set out in the Declaration are respected. Benefits from advances in biology, genetics and medicines concerning the human genome, are required to be made available to all, with due regard for the dignity and human rights of each individual. Freedom of research, which is necessary for the progress of knowledge, is considered to be a part of freedom of thought. The applications of research, including the applications in biology, genetics and medicines, concerning the human genome, shall seek to offer relief from suffering and improve the health of individuals and humankind as a whole, as declared in Article 12(b).

(f) Articles 13 to 16 are grouped under the head "Conditions for the exercise of scientific activity", highlighting responsibility inherent in the activities of researchers, including meticulousness, caution, intellectual honesty and integrity in carrying out their research on the human genome because of its ethical and social implications. The provisions require the States to take appropriate measures to foster the intellectual and material conditions favorable to freedom in the conduct of research on the human genome and to consider the ethical, legal, social and economic implications of such research, on the basis of the principles set out in this Declaration and expects the States to ensure that research results are not used for non-peaceful purposes. The establishment of ethics committees to assess ethical, legal and social issues raised by research on human genome and its application are to merit the attention of the States.

(g) Articles 17 to 19 lay emphasis on solidarity and international cooperation towards individuals, families and sections in the world's population vulnerable to disease or disability of a genetic character and fostering scientific and cultural cooperation between industrialized and developing countries.

h) For promotion of the principles set out in the Declaration, Article 20 makes it obligatory on the States to take appropriate measures to promote the principles through education and relevant means, inter alia, to the conduct of research and training in inter-disciplinary fields and through the promotion of education in bioethics, at all levels, in particular for those responsible for science policies. Article 21 provides that the States should take appropriate measures to encourage other forms of research, training, and information dissemination conducive to raising the awareness of society and all of its members of their responsibilities regarding the

fundamental issues relating to the defence of human dignity which may be raised by research in biology, in genetics and in medicine, and its applications. They should undertake to facilitate on this subject an open international discussion, ensuring the free expression of various socio-cultural, religious and philosophical opinions. The States are expected to take appropriate measures to promote through education, training and information dissemination, respect for the principles set out in the Declaration and the International Bioethics Committee of the UNESCO is also expected to contribute to the dissemination of these principles, under Articles 23 and 24.

**Conclusion**

- DNA technology is increasingly vital to ensuring accuracy and fairness in the criminal justice system. DNA can be used to identify criminals with incredible accuracy when biological evidence exists, and DNA can be used to clear suspects and exonerate persons mistakenly accused or convicted of crimes.
- The Initiative calls for increased funding, training, and assistance — to Federal, State, and local forensic labs; to police; to medical professionals; to victim service providers; and to prosecutors, defense lawyers, and judges—ensure that this technology reaches its full potential to solve crimes, protect the innocent, and identify missing persons. This Initiative has the following specific goals:
- Eliminate the current backlog of unanalyzed DNA samples and biological evidence for the most serious violent offenses — rapes, murders, and kidnappings—and for convicted offender samples needing testing.
- Improve crime laboratories' capacities to analyze DNA samples in a timely fashion.
- Stimulate research and develop new DNA technologies and advances in all forensic sciences areas.
- Develop training and provide assistance about the collection and use of DNA evidence to a wide variety of criminal justice professionals.
- Provide access to appropriate post conviction DNA testing of crime scene evidence not tested at the time of trial.

- Ensure that DNA forensic technology is used to its full potential to solve missing persons cases and identify human remains.
- In the forensic context as in the medical setting, DNA information is personal, and a person's privacy and need for confidentiality should be respected.
- The release of DNA information on a criminal population without the subjects' permission for purposes other than law enforcement should be considered.
- Misuse of the information, and legal sanctions should be established to deter the unauthorized dissemination or procurement of DNA information that was obtained for forensic purposes.
- Prosecutors and defense counsel should not oversell DNA evidence. Presentations that suggest to a judge or jury that DNA typing is infallible are rarely justified and should be avoided.
- Mechanisms should be established to ensure the accountability of laboratories and personnel involved in DNA typing and to make appropriate public scrutiny possible.
- Organizations that conduct accreditation or regulation of DNA technology for forensic purposes should not be subject to the influence of private companies, public laboratories, or other organizations actually engaged in laboratory work.
- Private laboratories used for testing should not be permitted to withhold information from defendants on the grounds that trade secrets are involved.
- The same standards and peer-review processes used to evaluate advances in biomedical science and technology should be used to evaluate forensic DNA methods and techniques.
- Efforts at international cooperation should be furthered to ensure uniform international standards and the fullest possible exchange of scientific knowledge and technical expertise.
- In the forensic context as in the medical setting, DNA information is personal, and a person's privacy and need for confidentiality should be respected.
- The release of DNA information on a criminal population without the subjects' permission for purposes other than law enforcement should be considered a misuse of the information, and legal sanctions should be established to deter

the unauthorized dissemination or procurement of DNA information that was obtained for forensic purposes.

- Prosecutors and defense counsel should not oversell DNA evidence. Presentations that suggest to a judge or jury that DNA typing is infallible are rarely justified and should be avoided.
- Mechanisms should be established to ensure accountability of laboratories and personnel involved in DNA typing and to make appropriate public scrutiny possible.
- Organizations that conduct accreditation or regulation of DNA technology for forensic purposes should not be subject to the influence of private companies, public laboratories, or other organizations actually engaged in laboratory work.
- Private laboratories used for testing should not be permitted to withhold information from defendants on the grounds that trade secrets are involved.
- The same standards and peer-review processes used to evaluate advances in biomedical science and technology should be used to evaluate forensic DNA methods and techniques.
- Efforts at international cooperation should be furthered, in order to ensure uniform international standards and the fullest possible exchange of scientific knowledge and technical expertise.
- Courts should take judicial notice of three scientific underpinnings of DNA typing
- The study of DNA polymorphisms can, in principle, provide a reliable method for comparing samples.
- Each person's DNA is unique (with the exception of identical twins), although the actual discriminatory power of any particular DNA test will depend on the sites of DNA variation examined.
- The current laboratory procedure for detecting DNA variation (specifically, single-locus probes analyzed on Southern blots without evidence of band shifting) is fundamentally sound, although the validity of any particular implementation of the basic procedure will depend on proper characterization of the reproducibility of the system (e.g., measurement variation) and the inclusion of all necessary scientific controls.

- The adequacy of the method used to acquire and analyze samples in a given case bears on the admissibility of the evidence and should, unless stipulated, be adjudicated case by case. In this adjudication, the accreditation and certification status of the laboratory performing the analysis should be taken into account.
- Because of the potential power of DNA evidence, authorities must make funds available to pay for expert witnesses, and the appropriate parties must be informed of the use of DNA evidence as soon as possible.
- DNA samples (and evidence likely to contain DNA) should be preserved whenever that is possible.
- All data and laboratory records generated by analysis of DNA samples should be made freely available to all parties. Such access is essential for evaluating the analysis.
- Protective orders should be used only to protect the privacy of the persons involved.
- DNA Technology has many dimensions and has scope of development in science, law society. The technology has impact on almost all aspects of life, society, science, law, religion and morality.
- There is a need to utilize this technology at its optimum level by eliminating all negative out come of the use of the technique by applying suitable legislations for the welfare of the state and public interest.

# BIBLIOGRAPHY


**Books Referred**

- Yashpal Singh and Mohammad Zaidi "*DNA Test in Criminal Investigation, Trial and Paternity Disputes*" , Alia Law Agency, Allahabad, 2006
- J.N. Pandey *: The Constitution Law of India*, 44th Edition, 2006
- Paras Diwan : Hindu Law, Allahabad Law Agency, 20th edition, 2009
- Paras Diwan : Muslim Law Modern India, Allahabad Law Agency,2009
- Jaising P Modi, "*Modi's Medical Jurisprudence and Toxicology*",23rd Edition, 2007, Allahabad Law Agency
- V.D. Mahajan, *"Jurisprudence and Legal Theory"* , 5th Edition,2011
- Sarkar and Manohar Sarkar, "*Sarkar Evidence"* (1999), Wadha & Co., Nagpur
- Ratan Lal, Dhiraj : "*Law of Evidence"* (2006), Wadhwa, Nagpur
- Allison Puri "*An International DNA Database: Balancing Hope, Privacy, and Scientific Error*," Allahabad Law Agency, 2003
- jit Parulekar, Sarita D'Souza: "*Indian Patent Law : Legal and Business Implications*", Macmillan Publishers India

**Bare Acts**

- Code of Criminal Procedure , 1973
- Code of Civil Procedure, 1908
- Indian Penal Code, 1860
- Indian Evidence Act, 1872
- Indian Patent Act, 1970 (Amd-2000)
- Identification of Prisoner's Act, 1920
- Indian Succession Act,1956
- Constitution of India
- Transplantation of the human Organs Act 1994
- Indian Succession Act, 1925
- Medical Termination of Pregnancy Act 1971 (Amd) 2004

**Articles from various Journals**


- Dr.Durga Parasad Das,"Maintenance Proceeding, Adultery and DNA-Fingerprinting", *Criminal Law Journal*, 2003, page 324 to 327
- Shree Pranam Kumar Rout,"DNA Test- A Forensic Boon'' *Orissa-Criminal Law Journal* 2003, page 349 to 352
- Add. District And Sessions Judge/Director In charge, Institute of Judicial Training And Research, Lucknow ,"Blood Is Thicker In Law", *Criminal Law Journal* 2004, page 1 to 5
- Dr. Bhavani Prasad Panda , "Neurogenetic Evidence In Criminal Trial-A Case Analyses For DNA Informatics Regular Tory Agency", *Criminal Law Journal* 2005, Page 104 To 114
- Pandit M. W. and Dr. Lalji Singh "DNA Testing, Evidence Act and Witness Testing" ,*The Indian Police Journal*, Dec.2000 Page100
- Justice A.S.Anandair ,"Intellectual Property Rights-The Indian Experience' 1997 (Jr) 1 *All India Reporter* 1997
- Surendra Lawrence and Gopal Krishna, "Intellectual Property, Seeds, The Future of Farmers And Farmi *AIR 1995 (Jr.)*
- Durga Pada Das, "DNA Fingerprinting And It's Impact On The Administration Of Criminal Justice'' ,2005(2) *Unreported Judgments* ,Page 97 To 99
- Dr. Ravi K. Chaubey ,"Intellectual Property Rights under Trips Agreement-Curse or Boon For India In The Era Of Globalisation , January, *Corporate Law Cases*, 2005(10) Journal Section Page 96, 98
- Mike Redmayne ,"DNA Evidence Probability and the Courts",*Criminal Law Review,1995*
- Swami Satyaswarupanand, Editorial, "Bio-Ethics and Cloning", *Prabudha Bharat/Awakened India*(of Ramkrishna order ,a monthly Journal started by Swami Vivekanand in 1986 )Vol-110 March 2005 Page 147 to 151
- Swami Jitadmanand, "Bio-Ethics for Science And Technology – A Hindu Perspective", *Prabudhabhara*t March 2005,–Page 164 To 168
- Amalendu Chokroborty ,"Bio Technology and Human Dignity" ,*Criminal :Law Journal* , March 2005,page 213 to 216

- Editorial,"Scientific Approach To Culture", *Vedant Kesari*, December 2001 Vol-88
- Dr.P.C.Shekharan, "Forensic Science in Criminal Investigation", *Encyclopedia of Police in India*, Page 1862


**Websites:**


- Http.//www.Biology-genetics-education-ppt-powerpoint
- Http.//www.Caselaw.findlaw.com/va-supreme-court
- Http ://www.met.police.uk/history/fingerprints.htm
- Http://books.google.com/books/about/Essentially_yours.html
- Http://educationportal.com/articles/Associate_of_Biotechnology_Degree_Overview.html
- Http://ejabat.google.com/ejabat/thread
- Http://electricaloutlet.org/type-
- Http://en.allexperts.com/q/Careers-Police-1531/2008/2/Quick-question-Forensics.htm
- Http://en.wikipedia.org/wiki/Protect_the_Innocent
- Http://erhverv.ku.dk/forskere/patenter_og_rettigheder/dias_patentering_opfindelse.ppt/
- Http://findarticles.com/p/articles
- Http://gujarathighcourt.nic.in/Articles/legalpers.htm
- Http://in.rediff.com/news/2003/oct/28tandoor.htm
- Http://indiankanoon.org/doc/1322009/
- Http://onlinelibrary.wiley.com
- Http://scocal.stanford.edu/opinion
- Http://web.utk.edu/
- Http://www.alrc.gov.au/publications/39-forensic-uses-genetic-information/use-genetic-information
- Http://www.answeringlaw.com/php/displaycontent.php
- Http://www.answers.com/topic/human-genome-project

- Http://www.asiaing.com/identifying-victims-using-dna-a-guide-for-families.html
- Http://www.authorstream.com/Presentation/raniashok-272852-dna-fingerprinting-forensics-molecular
- Http://www.bc.edu/bc_org/avp/law/lwsch/journals/bciclr/24_2/05_FMS.htm
- Http://www.caselaw4cops.net/searchandseizure/evidence.htm
- Http://www.cops.usdoj.gov/default.asp
- Http://www.counterbalance.org/genetics/discrim-frame.html
- Http://www.cps.gov.uk/news/fact_sheets/sexual_offences/
- Http://www.dna.gov/audiences/investigators/know/whatisdna
- Http://www.dna.gov/basics/biology/
- Http://www.dna.gov/solving-crimes/cold-cases/longandshort/typesofanalysis
- Http://www.docstoc.com/docs/22615485/patent
- Http://www.drtomoconnor.com/3220/3220lect02b.htm
- Http://www.eco-business.com/business/algaetechinternational/
- Http://www.forensic-evidence.com/site/EVID/dnaexonerations.html
- Http://www.imdb.com/title
- Http://www.justice.gov/ag/dnapolicybook_solve_crimes.htm
- Http://www.lawtechpublishing.com/samplechapters/forensicstudies.pdf
- Http://www.lawyersclubindia.com/articles/DNA-Tests-in-Paternity-Disputes-3388.asp
- Http://www.legalserviceindia.com/article/l254-Patenting-Recent-Biotechnological-Inventions.html
- Http://www.legislation.gov.uk
- Http://www.lycos.com/info/biotechnology--technology.html
- Http://www.mslawyer.com.
- Http://www.mta.info/nyct/service/gline.htm
- Http://www.myspace.com/sandiegoinnocent
- Http://www.nap.edu/openbook.php
- Http://www.nddb-bndg.org/main_e.htm
- Http://www.ndsu.edu/ndsu/academic/factsheets/ag/biotech.shtml

- Http://www.nij.gov/topics/forensics/events/dnasummit/trans-1.html
- Http://www.nytimes.com/1988/02/06/us/rapist-convicted-on-dna-match.html
- Http://www.ornl.gov/sci/techresources/Human_Genome/elsi/forensics.shtml
- Http://www.pbs.org. /wnet/redgold/innovators/bio_landsteiner.html
- Http://www.uspto.gov/web/offices/dcom/olia/confu/confurep.pdf
- Http://www.voidspace.org.uk/technology/genome
- Http://www.youtube.com/watch
- Http://www2.ohchr.org/english/law/genome.htm
- Http:pbs.org/wgbh/pages /frontline/shows/cases/revolution/wars.html
- Http;//store.cq.com./cq-store/dnateexbi.html.
- Https://www.findthemissing.org/homes/resources
- Https://www.rkb.us/contentdetail.cfm
- Https://www .Litigation-essentials.lexisnexis.com
- Http.//www.Usdoj.gor/nij/dna/welcome.html
- Http.//www.Pharmalicensing.com/public/articles
- Http.//www.Rcmp-grc.gc.ca/dnaac-adncc/annurp/2004-2005-annurp-eng.htm
- Http.//www.austlii.edu.au/au/other/alrc/publications
- Http.//www.courts.state.va.us/scndex.htm
- Http.//www.google.com./DNA technology and Legal system
- Http.//www.indianscience.org
- Http.//www.ncbi.nlm.nih.gov/pmc/articles/
- Http.//www.techdirt.com/articles


..

# Appendix-I

## Acronyms

- A Gene is "a stretch of DNA, ranging from a few thousand to tens of thousands of base pairs, that produces a specific product, usually a protein
- Albino: Having pale or colorless skin, eyes, and hair because the body does not produce enough pigment.
- Alpha-Fetoprotein Test (AFP): A prenatal test to measure the amount of a fetal protein in the mother's blood. Abnormal amounts of the protein may indicate genetic problems in the fetus.
- Americans With Disabilities ACT (ADA): A 1990 federal law that forbids discrimination against persons who are disabled.
- Amniocentesis: A prenatal test in which cells surrounding a fetus are removed in order to examine the chromosomes.
- Artificial Insemination: The injection of semen into a woman's uterus (not through sexual intercourse) in order to make her pregnant.
- Autosomes*:* Humans normally have 23 pairs of chromosomes, one member of each pair derived from the mother and one from the father. One of those pairs consists of the sex chromosomes – with two X chromosomes determining femaleness, and one X and one Y determining maleness. The other 22 chromosomes are known as Autosomes.
- Bases: Distinct chemical ingredients found in the genetic material of all life forms.
- Behavioral Genetics: The study of whether and how traits for behavior are inherited.
- Biotechnology: The use of living things to make products. CARRIER: A person who has one copy of the gene mutation for a recessive disorder. Carriers are not affected by the disorder. However, they can pass on the mutated gene to their children. Children who inherit two such genes may be affected by the disorder.
- Chorionic Villus Sampling (CVS): A prenatal test in which cells surrounding an embryo are removed in order to examine the chromosomes.

- Chromosomes: Separate strands of genes, contained in the nucleus of a cell. Normally, chromosomes appear in corresponding pairs. A genome is made up of a complete set of paired chromosomes.
- Clone: To make an exact copy of something.
- Crossing Over: Where a section of one chromosome switches places with the same section from the other chromosome of the pair. This sometimes occurs when a germ cell makes copies of its chromosomes before dividing.
- Cultivate: The DNA of each gene is characterized by a unique sequence of bases that form the `genetic code'. These bases are arranged in groups of three, known as cultivate To cause to grow and multiply, such as by growing cells in a laboratory dish that contains nutrients.
- Data Bank: A collection of information organized so that specific facts can be retrieved as needed. Today, many data banks are organized on computers.
- Disorders: Problems in how the body functions. Health problems caused by mutations in the genes are referred to as genetic disorders.
- DNA Fingerprinting: A term for DNA typing.
- DNA Marker: A gene or other fragment of DNA whose location in the genome is known.
- DNA Typing: The analysis of sections of DNA for purposes of identification.
- DNA: The material inside the nucleus of cells that carries genetic information. The scientific name for DNA is deoxyribonucleic acid.
- Dominant: Having power and influence. In genetics, a dominant gene is a gene that expresses its instructions.
- Embryo: An animal in the early stage of development before birth. In humans, the embryo stage is the first three months following conception.
- Enotransplantation: The transplantation of genetically engineered animal organs into a human body
- Environment: The nongenetic conditions and circumstances that affect a person's conduct and health.
- Enzymes: Proteins that trigger activity in the cells of the body. An enzyme is not affected by the activity that it sets off.

- Ethical Issues: Questions concerning what is moral or right.
- Ethicists: People who spend time thinking about ethics, that is, about values related to human conduct.
- Eugenics: The belief that information about heredity can be used to improve the human race.
- Evolution: The process by which all forms of plant and animal life change slowly over time because of slight variations in the genes that one generation passes down to the next.
- Ex Utero Genetic Testing: DNA analysis performed on cells of eggs that have been fertilized *in vitro*.
- Fetus: An animal in the later stage of development before birth. In humans, the fetal stage is the from the end of the third month until birth.
- Gene Therapy: The altering of genes in order to affect their function.
- Genes: Units of hereditary information. Genes contain the instructions for the production of proteins, which make up the structure of cells and direct their activities.
- Genetic Counseling: Education and guidance offered by professional advisors in order to help people make informed decisions based on genetic knowledge. Genetic counseling is intended to help a person understand the meaning of specific information about his or her genes. It also is intended to help a person decide whether to have a genetic test performed or what to do with information provided by such a test.
- Genetic Determinism: The false belief that solely his or her genes determine a person’s fate.
- Genetic Engineering: The artificial introduction of changes to the genes in a cell.
- Genetic Expression: The effects of a gene's instruction on the cells of the body.
- Genetic Linkage Study: Examination of the DNA of family members to determine who may be at risk for a genetic disorder occurring in the family tree. Doctors look for variations that consistently appear in the DNA of family members with the disorder. These DNA variations may or may not be related to the genetic

disorder. However, if they appear in the DNA of another family member, it can indicate the person's risk of inheriting the disorder

- Genetic Products – Item produced by the use of genetic materials, including proteins, nucleic acid probes, nucleic acid constructs such as vectors and plasmids, and anti-sense DNA.
- Genetic Profile: A collection of information about a person's genes.
- Genetics: the field of science that looks at how traits are passed down from one generation to another, through the genes.
- Genome: The complete package of genetic material for a living thing, organized in chromosomes. A copy of the genome is found in most cells.
- Genotype: refers generally to the genetic makeup of an organism; however, it also can be used to describe the genetic makeup at a number of loci, from one to the total number.
- Germ Cells: The cells of the body involved in reproduction. Sperm of the male and eggs of the female are formed from germ cells.
- Germ-Line Therapy: The altering of genes in reproductive cells (sperm or egg) in order to affect their function in any offspring that may be created.
- Heredity: The handing down of certain traits from parents to their offspring. The process of heredity occurs through the genes.
- Heterozygous. A person whose DNA falls into different bins is said to be heterozygous.
- Homologous almost all cells in the human body contain 23 pairs of chromosomes (for a total of 46 chromosomes). The two members of a chromosome pair are said to be
- Homozygous, A person who’s DNA falls into the same bin is said to be homozygous
- Hormones: Proteins produced by organs of the body that trigger activity in other locations.
- Human Genome Project: The scientific mission to "read" the order of bases as they appear in the DNA of human chromosomes. The Human Genome Project actually is not one project, but rather many hundreds of separate research projects

being conducted throughout the world. The objective is to create a directory of the genes that can be used to answer questions such as what specific genes do and how they work.

- Huntington's Disease (HD): A dominant genetic disorder in which a protein is produced abnormally, leading to the breakdown in the parts of the brain that control movement. A neurodegenerative disease which is inherited in an autosomal dominant pattern)
- Immune Disorders: Health problems caused by the fact that the body cannot properly fight infection.
- Karyotype: A picture of the chromosomes in a cell that is used to check for abnormalities. Staining the chromosomes with dye and photographing them through a microscope create a karyotype. The photograph is then cut up and rearranged so that the chromosomes are lined up into corresponding pairs.
- Legal Issues: Questions concerning the protections that laws or regulations should provide.
- Multifactorial Disorders: complex interaction between genes and the environment
- Mutation: Changes that occur to the order of bases appearing in the DNA inside a cell.
- Nuclear Transfer Technology: A procedure for making a clone, or exact genetic copy, of an existing animal. In this procedure the nucleus containing the chromosomes is removed from the cell of one animal for fusion with an egg cell from which the nucleus has been removed. The life that results is the genetic equal of the animal that donated the nucleus.
- Nuclei: The plural of nucleus.
- Nucleus: The central part of a cell where the chromosomes are contained. .
- Paternity: Identification of the father of a child.
- Pigment: The dyelike material in cells that provides color to skin, eye and hair.
- Prenatal: Before birth.
- Privacy: The condition of being left alone, out of public view and in control of information that is known about you.

- Proteins: The basic chemicals that make up the structure of cells and direct their activities.
- Recessive: Moving back and out of view. In genetics, a recessive gene is a gene that does not express its instructions when paired with a dominant gene.
- Reproductive Technology: The application of scientific knowledge to assist in making babies.
- Selective Breeding: The selection of certain seeds or animals for reproduction in order to influence the traits inherited by the next generation.
- Severe Combined Immunodeficiency (SCID): An immune disorder in which the body does not produce the special blood cells that resist infection.
- Sickle Cell Anemia: A recessive genetic disorder in which red blood cells take on an unusual shape, leading to other problems with the blood.
- Social Issues: Questions concerning how events may affect society as a whole and individuals in society.
- Species: A single, distinct class of living creature with features that distinguish it from others.
- Transcription. This process of reading the message in the DNA is called Transcription
- Transgenic: Containing genes from another species.
- Viruses: Extremely small and simple life forms made merely of a protein shell and a genome. A virus reproduces by inserting its genome into the cells of other life forms. As those cells duplicate, so does the virus.

## Appendix-II

## Abbreviation

| | |
|---|---|
| A | Adenine |
| ADA | Americans With Disabilities Act |
| AFP | Alpha-Fetoprotein Test |
| APFSL | Andhra Pradesh Forensic Science Laborator |
| APM | Amplitype Polymarker |
| BM | British medical association |
| C | Cytosine which are known as *Pyrimidines* |
| CCMB | Centre For Cellular And Molecular Biology |
| CDFD | Centre For DNA Fingerprinting And Diagnostic |
| CODIS | Combined DNA Index System |
| CVS | Chorionic Villus Sampling |
| CVS | Crionic Villus Sampling |
| DAB | DNA Advisory Board |
| DHGHR | Declaration On The Human Genome And Human Rights 1997 |
| DNA | Deoxyrebo Neucleic Acid |
| DNAIA | DNA Identification Act |
| DOE | Department of Energy |
| DVI | Disaster Victim Identification Database |
| EPO | European Patent Office |
| FBI | Fedraration Burro Of Investigation |
| G | Guanine Which Is Known As *Purines;* |
| GC | Group-Specific Component). |
| GMOS | Genetically Modified Organisms |
| *GYPA* | Glycophorin A, The Mn Blood-Groups |
| HBGG | Haemoglobin Gamma Globin |
| HD | Huntington's Disease |
| HGCA | Human Genetics Commission Of Australia |
| HGP | Human Genome Project |

| | |
|---|---|
| IBC | International Bioethics Committee |
| LDIS | The Local DNA Index System |
| LDLR | Low-Density Lipoprotein Receptor |
| MDNA | Mitochondrial DNA |
| MRNA | Messenger RNA |
| NCIDD | National Criminal Investigation DNA Database |
| NDIS | National DNA Indexes System |
| NHMR | National Health And Medical Research Council |
| NHRC | National Human Rights Commission |
| NIH | National Institute of Health |
| PCR | Polymerase chain reaction-based |
| RGCB | Rajiv Gandhi Centre For Biotechnology |
| SCID | Severe Combined Immunodeficiency |
| SDIS | State DNA Index System |
| SNPS | Single Nucleotide Polymorphisms |
| STR | Short Tandem Repeats |
| T | Thymine |
| UNESCO | United Nations Educational Scientific Cultural Organization |
| USPTO | United States Patent And The Trade Mark Officer |
| VNTR | Variable Number Tandem Repeats |

## Appendix- III

## Legal Maxims

- Nemo Tenetur Scipsum Accusare- *No Man Can Be Condemned To Criminate Himself*
- Cuilitbet In Arte Perito Est Credendem –*Credence Should Be Given To Once Who Is Skilled In His Peculiar Profgession*
- Affirmanti Non Neganti Incumbit Probatio – The Burden Of Proof Lies Up On Him Who Denies
- Boni Judicis Est Judiciam Sine Diletione Manclare Excecutioni-A good judge have judgement without delay
- Boni Judicis Est Lites Crilimare Ne Lix Ex Lite Oriture, Et Interest Reipublicae Ut Sini Fines Litium- *A Good Judgeshould Put On End To Litigation That Suit May Not Grow Out Of A Suit As It Concern The Welfare Of State*
- Confirm Actio Omnes Supplet Defectus Licet Id Quod Actum Est Ab Inition Non Velait – Though Something Has Done Not Valid Confirmation Cures All Defects
- Contemporenea Expositio Est Optima Et Fertissima In Lege –*Contemporaneous Exposition Is The Best And Strongest In Law*
- Cuilibet In Sua Artepertio Est Credendum –*Credence Should Be Given To An Expert*
- Deficiante Uno Non Potest Esse Haeres –*There Being No Utility Of Blood One Cannot Be A Heir*
- Deas Salus Haerendum Facere Potest Non Homo- *God Alone Can Make Heir Not Man*
- Fortior Et Potentior Est Dispositio Legis Quam Hominis-*Law Is Stronger And More Powerful Then Any Man*
- Habemas Optimum Testem Confitentem Reum- *The Best Witness Is The Acused Himself Who Confesses His Guilt*
- Haeres Legitimas Est Quem Nupitiae Demon Stratrant – The Lawful Heir Is One Who Born In Wedlock
- Heriditus Nunquam Ascendit –*Inheritance Never Ascends*
- Imperitia Culpae Adnumeratur –*In Expert Wont Of Skill Is Culpable*

- Interest Republicae Ne Matifia Remaneant Impanita –In The Interest Of The Republic Crime Should Not Go Unpunished
- Judicias Est Jus Decere Non Dare – *The Judge's Duty Is To Decide According To The Allegation And Proof*
- Misera Est Servitus Ubi Just Estvagum Out Incertum – *When Justice Is Vague, Uncertain The Condition Of People Is Miserable*
- Necessitas Publica Major Est Quam Privata- *Public Necessity Is Superior To Private*
- Nemo Punitur Pro Alieno Delicto -*No One Should Be Punished For The Wrongs Of Another*
- Nihil Inlege Intolarabillica Est Candem Rem Diverso Jure Censeri- *There Should Not Be A Discrimination In Law*
- Nihil Simul Inventum Est Et Perfactum – *A Thing Invented Takes Time To Be Perfacted*
- Nova Constitio Futuris Forman Imponere Debet, Non Proteritis –*New Laws Are Prospective Not Rtrospective*
- Nullum Simile Est Idem –*There Is Never A Complete Identity*
- Omni Praesumuntur Contra Spoliatorem- Everytrhing Is Presumed Against The Wrong Done
- Perpetua Lex Est Nulluum Legem Humanum Ac Positivam Perpetuam Esse Et Clausula Quae Abrogationem Excludit Ad Initio Non Valet- *No Law Can Be Permenant And A Law Which Takes Always A Power Of Repeal Is Abinitio Void*
- Persona Conjeneta Aequiparatur Interesse Proportio- Proximity Of Blood And One's Own Interst Are Equilant
- Qui Ex Damnato Caitu Mas Cuntur Inter Liberus Computenture-*Illegitimate Children Are Not Counted As Children*
- Res Judicata Pro Verilate Accipitur – *A Decision Of Court Is Accepted As Evidence Of Truth*
- Salus Populi Est Suprema Lex –*The Good Of The People Is The Supreme Law*
- Summa Ratio Est Equae Pro Religion Facit-The Best Reason Is That Which Is In Favour Of Religion