BIOPOLITICS OF DNA: Human DNA Profiling in India

Dissertation submitted to Jawaharlal Nehru University
in partial fulfillment of the requirements
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Master of Philosophy

by

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DECLARATION

I, Manpreet Singh Dhillon, declare that the dissertation entitled "Biopolitics of DNA: Human DNA Profiling in India" submitted by me in partial fulfillment of the award of the degree of Master of Philosophy (M. Phil) of Jawaharlal Nehru University is my original work. This dissertation has not been submitted for any other degree of this University or any other university.

Manpreet Singh Dhillon

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Certificate

It is hereby recommended that this dissertation be placed before the examiners for evaluation.

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For Padma

Contents

At the entrance to science, as at the entrance to hell, the demand must be made:

Qui si convien lasciare ogni sospetto
Ogni vilta convien che qui sia morta.

[From Dante, Divina Commedia:
Here must all distrust be left;
All cowardice must here be dead.]

Karl Marx
London, January 1859

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Genesis

> For millennia, man remained what he was for Aristotle: a living animal with an additional capacity for a political existence; modern man is an animal whose politics places his existence as a living being in question. (Foucault, 1984b,265)

"In the beginning was the word… and the word became flesh…" [1] This sentence from *The Bible* draws back to the origin, the Nietzschean beginning (Foucault 1984b). The originary story of DNA similarly also, tells us how that this molecule is the vessel of information that links us straight to our past and tells us exactly where we belong. Thus, we have research like *Complex genetic origin of Indian populations and its implications* attesting that, "the Indian populations are the descendants of the very first modern humans, who ventured the journey of out-of-Africa about 65,000 years ago" (Tamang, Singh, and Thangaraj 2012). We are told that DNA also marks us as bearers of unique information, which is different from anyone else on this earth. It individuates us from the collective while at the same time informing us that ultimately we are all One: just that a minuscule amount of material differentiates us. And this has become a 'code'; a hieroglyph in the sense in which those who can read it (and only a chosen few can) will become the priestly class able to gaze into the crystal ball to predict the future and trace back the footprints of the past who are able to change destiny and if humanity obeys them, they will be able to deliver the people into a heavenly kingdom free from mortal problems.

The myths and legends tell us that it is not a new story that we fight with the gods and search for the elixir of immortality, at the same time willing to rid ourselves from the base instincts that guide us towards killing each other and committing atrocities to other life forms we share this planet with; what we desire is to live forever and live peacefully in a perfect utopia. Here, the myth of Prometheus comes to mind. His desire was to be

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[1] *John 1: 1-14, The Bible [King James Version] See https://www.biblegateway.com/passage/?search=John+1%3A1-14&version=KJV [Accessed July 17, 2015]*

like the gods, to have the powers that only they possessed; to become immortal like them and to have control over his own destiny. He stole fire from the gods, and taught men to use it…thereby unleashing the trajectory of mankind into modern warfare and the most atrocious uses of fire. Fire can cook food, give warmth and protect from wild animals. It can also be used to burn people and forests, and cause immense misery. It is no wonder that after the creation of language to communicate, learning to use fire is considered the greatest technological leap forward after the acquisition of the ability to speak and to express ourselves to one another through communication.

We have a technology now that is not too different in essence (and perhaps even more potent) from fire that signifies newer myths of origin under the sign of DNA. It is also a code which is said to be the script to enable one to read the 'book of life' (Kay 1998). It is proclaimed as a universal book, in a sense that there is a common language to this DNA that is pre-programmed. Scientists proffer that all of humanity shares this; we have the original language of humankind before the collapse of the Tower of Babel. We only have to wait till we read it completely and we shall have the *Philosopher's Stone* -- the power to be lords of ourselves through the 'rhetoric of cells' (Sidler 2006).

Many commentators have noted how much the language of DNA borrows from Christian theology (Roof 2007). And in a way, it is true. It is a marvelous tool. But the problem is with the master who is mortal and sinful; 'human, all too human' (Nietzsche 1878). How and when s/he will use it, and for which end, is open to how much power s/he has, and DNA is a powerful material of scientific and social applications. It can be used to create bio-chemical products that will kill people and, it can also be used to permanently change the hereditary information of humans so that actual 'mutants' will be born (it is not a strange co-incidence that the founder of DNA profiling Alec Jeffreys is now working on understanding mutations from nuclear radiation in Chernobyl).[2] It can be used in such a way that it does not allow certain people to reproduce; by editing the capacity to procreate. Monsanto already has seeds that do not self propagate; you have to buy seeds

[2] *See the University of Leicester webpage "The history of genetic fingerprinting": http://www2.le.ac.uk/departments/genetics/jeffreys/history-gf [Accessed July 17, 2015]*

from the company for the next sowing. Is it then unimaginable that humans will also come with their shelf lives constricted to just one generation?

The history of DNA is a story enmeshed with the control of the power over life and death. For example, Craig Venter, the persona behind the private face of the Human Genome Project and Ray Kurzweil, a futurist working at Google, are pursuing the white rabbit of immortality.[3] Kurzeil predicts a coming 'singularity' where humans will 'transcend' biology and become machinic. (2005). However, what the DNA proclaims, it has rarely delivered. Its promise of being a code for information or a glimpse into your past is constructed at best by scientists who are enamored by the power to create a history of the world via technological growth. They claim to be able to make a Dinosaur one day from the DNA of fossils but do not yet explain how/why, if all the 'coding' and the 'language' is universal, does a specific number of genes create a snake as a snake and a man as a man? There are several species which greater number of gene than *homo sapiens* but are much 'simpler' organisms.[4] (Sarkar 1996a; Sarkar 1996b; Sarkar 2006; Levy 2011; Smith 2000)

The 'truth' of DNA is also used, as usual by politicians and the powerful to exert influence and power. Throughout history any new technology has always been used in a way that gives a strategic military and political advantage to its possessors. The history of civilization is replete with instances where technological superiority has killed countless millions of people who do not have such sophisticated technologies. Ultimately it is realized that technologies become the handmaiden of death and destruction by the priests of technology, who later on, realize their folly and want to control it but it is too late. For example, Linus Pauling was ostracized from the scientific community for his pacifist view later in his life and was hounded out of Caltech because of his stand against nuclear testing and was instrumental in creating the non-proliferation treaty (Paradowski, n.d.).

This political-technology of life is invested with the power to create a 'truth' and then to normalize that for mass consumption. In the case of DNA it is in the field of life.

[3] *See http://www.kurzweilai.net/global-futures-2045-ray-kurzweil-immortality-by-2045 and http://2045.com/news/32110.html [Accessed July 17, 2015]*

[4] *This question was asked by a quirky old man to Eric Lander at his lecture at AIIMS, to which he admitted he did not have all the answers yet.*

Foucault writes, “power produces; it produces reality; it produces domains of objects and rituals of truth” (1977,194). DNA, being the ‘stuff that life is made of’, it also has the ability to intervene and change the course of life and history. But since it is a political-technology that is manmade and hence fallible, it is not so easy to become godlike or indomitable.

DNA is a molecule that is shared by all the people in the population; hence it is both scientific and political. The political role of DNA is becoming more and more explicit as it is used worldwide to give citizens security, enforce law and order and to ensure justice for the subjects. On the one hand, it is a disciplinary tool that elicits the confession of the criminal body, it marks the techno-scientific inscription of proof of crime which is so much in demand by the penal regime of the liberal democratic states in their quest to create a balance between the discourses of human rights on the one hand, and the ownership of the lives of its citizens; it is a machinery of power. On the other hand, the DNA is not just a repressive apparatus; it is also the harbinger of health and vitality in the modern era. Its power is also exerted in the form of control of diseases and the 'identification’ of pathologies; the thanatopolitical and the biopolitical are looped together like the two strands of the double-helix (Bröckling, Krasmann, and Lemke 2010; Lemke 2010a; Mbembe and Meintjes 2003).

It is this friendship, this ‘Janus face’ of the genetic paradigm that needs examination. We need to interrogate how the metamorphosis of a molecule, into the triumph of techno-scientific modalities of life, which discipline the body to release its potentialities of the productive labour of its members takes place; how it gives life and produces its ‘truths’, how the right over life is juxtaposed with the power of death in one embrace. Referencing penal regimes, Foucault tried to manifest how, “in what way a specific modality of subjection was able to give birth to man as an object of knowledge for a discourse with a “scientific” status” (1984b,171).

The political-technology of the body in our era is defined by its ability to distinguish that we are all one, a homogenized and normalized entity; individually and politically. It demands that life is lived according to the logic of being our own governors. This is where the technical inscription of the body as a ‘genetic body’ finds its location (Thacker,

2006,91-130). Bio-medicine grants us a technique of ascertaining how and in what form diseases strike, what are the propensities we carry, how long we have in this world to live, and what are our chances to escape death if we tune our bodies and subject it to the anatamo-technologies of 'genetics'. Information defines this, statistics is the hand-maiden of genetics, and it gives the power of truth to the gene to calculate for us our very mortalities. But this mortality is never our own, it is always mirrored to the total population. Genomics is the entrenchment of data in the calculation of life. Schrödinger (1944) asked the question, 'What is life?' and he responded in a language the we should take note of, i.e., "Life is data and data is life". We are 'data-subjects' (Lyon 2001): our very lives depend on the hunt for some genetic outliers which will lead us to an understanding of when and how diseases will strike us. Thus it comes as no surprise really, when the whetstone of genetics is increasingly turning out to be the study of mental processes. In this dissertation I will not go into how, increasingly, 'consciousness studies' and 'neurobiology' are paralleling the search for genetic and biological understandings of the life of the mind (N. Rose 2013). If everything is data and information, then the mind must also obey a code of binaries. Brain science is the next frontier for computers and genetics to crack, it is the ultimate puzzle in a long line of puzzles. At the risk of sounding reductionist, I would define science as pretty much an attempt to solve puzzles.

Coming back to genetics, I would like to locate this strand, i.e., the strand in which life is geneticized. It is important to look at the way in which the gene is created and manifests itself in the social life of human beings. From being a molecule, it is turned into the code of life. But as will be shown, it is geneticized as information. Looking back at the last hundred years, we have evolved into a 'homo informaticus.'[5] We have forfeited our brains for the simulacrum of information. As Schrödinger noted in 1944, life has become an information science.

Humankind finally is aware of its own destiny, or so is the claim. The power over life is in his/her hands. What will s/he do? If you take the case of atomic science, we can be depressed and cynical. The question is not, whether we will destroy ourselves but when?

[5] *See http://summit.is4is.org/programme/tracks/homo-informaticus-the-image-of-man-in-the-information-society [Accessed July 17, 2015]*

Capitalism is an edifice that cannot be taken apart of the life sciences. What we are dealing with, is a technology that enables us to edit life; our emotions, our brains, our 'human-ness.' Post-humanism is knocking on our doors even as we speak (Nayar 2014). But the strain of fascism that Foucault (1983) warned us against in the preface of Gilles Deleuze and Felix Guattari's book 'Anti-Oedipus' needs greater evaluation day after day; the fascism that is embedded in our selves.

Is it then that genetics is a product and process of this fascism? Does it not have a long lineage associated with eugenics and the breeding of superior human beings, which reflects in the minds of the scientists and reformers? In Chapter 1, I will inquire into this pre-history of the gene. Also, I will illustrate how the 'techno-scientific' paradigm that we live in today has been created by the forces of social progress and modern warfare combined together. Further, I will also elucidate in what way the gene is embedded in the way of being of a capitalist society. The coming together of two forms of knowledge in the 'order of things' will be highlighted; one, the birthing of molecular biology and two, the cybernetic revolution leading to what is now called the information society. How these two ways of knowing have co-produced the gene, will be explored. The first chapter of my dissertation locates the gene as a historical object of the archaeology of knowledge. It is the point of entry and highlights how it did not *become* a political object par excellence later on, but, how it always was a *political* object. Foucault writes in his answer to "What is Enlightenment?" (1984c)

> We must try to proceed with the analysis of ourselves as beings who are historically determined, to a certain extent, by the Enlightenment. Such an analysis implies a series of historical inquiries that are as precise as possible; and these inquiries will not be oriented retrospectively toward the "essential kernel of rationality" that can be found in the Enlightenment and that would have to be preserved in any event; they will be oriented toward the "contemporary limits of the necessary," that is, toward what is not or is no longer indispensable for the constitution of ourselves as autonomous subjects.

In the second chapter, we will see how the gene left the laboratory and entered the domain of society. We will see how the gene is a political technology of the governance of modern societies. It is a part of the 'analytics of government' (Lemke 2010b; Lemke 2014); a specifically neo-liberal form of governance (Cotoi 2011; McAfee 2003; Ylönen and Pellizzoni 2012). To enable this, I am specifically looking at two facets - one being

criminality and the other being health. I take these two because of two events that occurred in the same time nearly; the completion of the Human Genome Project along with its predictions of healthy living coincided with the destruction of the twin tower which introduced life to its precariousness in the American and European body politic (see Barkan 2012). It is a sketch of how the gene came to occupy a central role in the governance regimes, the *raison d'etat* of both the United States of America and the countries of Europe (especially focusing on the United Kingdom).The gene occupies a central location in both, which does not mean that it *exists* as the same gene in both. However, as I will show that there are very similar strains of the gene that occupies the technique of the governance of life in both examples.

In the third and final chapter, I will show how the modality of the gene functions in India. This chapter looks at the way in which the 'genetic modality' is germinated in the Indian terrain. India has a history and culture that is non-Western, but then what does it say about 'our modernity'? (Chatterjee 1997). I argue in chapter 3 that India is a part of the global network of power in which the evolution of the gene and its instrumental knowledge in the governance of the population is a marker of the nation's prestige. The gene, as it cross-pollinates with already sedimented notions of social spaces in India will present a different reality but which cannot be too different from the one in the Western countries or elsewhere, because ultimately 'we all share the same gene' (read Capital). This universal language of the gene is the embodiment of that which enables us to locate the universal in the local and vice versa. This dissertation highlights certain 'pathologies' that the gene explicates in the social dimensions of life in India.

This dissertation is a process in presenting a slice of the history of the present. A present that is marked by globalization, techno-science and the contested hegemony of the United States. To do this I will interrogate the assemblages that have been created by using Michel Foucault's concept biopolitics and governmentality as has been understood in light of recent developments as an 'analytics of government' (Bröckling, Krasmann, and Lemke 2010).

(Gene)alogy

> If as a result of biotechnological developments the living body is now understood as a readable and rewritable text, then the question of biopolitics is posed in a new way: what is the meaning of life within such a political-technical constellation? (Lemke 2010, 166)

2.0 Introduction:

It has been twelve years since the human genome was sequenced and in these years the disclosures concealed within the genetic code have mutated the manner we live life. In every facet of our lives, the gene brings forth a truth that we have to come to terms with in our relationship with our own selves and the world. The function of the gene is central to our identities in this age. We look to the gene as a vessel that contains the past and thus gives us a grounding in our precarious present while simultaneously eliciting hope for a better future free from the shackles of death, disease and despair. This optimism that the gene generates allows us to manifest ourselves as owners of our individual destinies and the biographers of our being.

The gene (literally and metaphorically) is everywhere now. The genie has escaped the bottle in America and is now found in almost every country of the world in these globalized and interconnected times. It has also reached India through contagion and is on fertile ground because, quite simply put, India has the largest 'gene pool' in the world.

Taking the method etched by Nietzsche via Foucault's essay, "Nietzsche, genealogy, history", this chapter will elucidate the many contours and 'errors' by which the manifest 'truth' of the 'gene' erupts in the social spaces we inhabit.

> The body is the inscribed surface of events (traced by language and dissolved by ideas), the locus of a dissociated self (adopting the illusion of a substantial unity), and a volume in perpetual disintegration. Genealogy, as an analysis of descent, is thus situated within the articulation of the body and history. Its task is to expose a body totally imprinted by history and the process of history's destruction of the body. (Foucault 1984,83)

To do this we need a tracing of the dispositif that manufactures the apparatus of biotechnology and creates the 'genetic imprint' on the subject of the population. As Foucault notes, a dispositif is, "firstly, a thoroughly heterogeneous ensemble consisting

of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions–in short, the said as much as the unsaid" (1980,194). He calls this intermeshing an apparatus, "the apparatus itself is the system of relations that can be established between these elements." (1980,194) What we need to do now is to probe this genetic cross pollination into India and trace its dispositif.[6] In this chapter, I will trace the socio-technical construction of the gene as a network of assemblages.

2.1 The Genetic vision of life:

We need to know what exactly a 'gene' is and what exactly 'DNA' is. To help us understand this, the University of Leicester's genetic department webpage, a leading genetics research department in the world, informs us that,

> A **gene** is a length of DNA that codes for a specific protein. So, for example, one gene will code for the protein insulin, which is important role in helping your body to control the amount of sugar in your blood.
>
> Genes are the basic unit of genetics. Human beings have 20,000 to 25,000 genes. These genes account for only about 3 per cent of our DNA. The function of the remaining 97 per cent is still not clear, although scientists think it may have something to do with controlling the genes.
>
> Genes are made of a chemical called DNA, which is short for 'deoxyribonucleic acid'. The DNA molecule is a double helix: that is, two long, thin strands twisted around each other like a spiral staircase.
>
> The sides are sugar and phosphate molecules. The rungs are pairs of chemicals called 'nitrogenous bases', or 'bases' for short.
>
> There are four types of base: adenine (A), thymine (T), guanine (G) and cytosine (C). These bases link in a very specific way: A always pairs with T, and C always pairs with G.
>
> The DNA molecule has two important properties.
>
> - **It can make copies of itself**. If you pull the two strands apart, each can be used to make the other one (and a new DNA molecule).

[6] *See also, Gilles Deleuze (1992), "What is a dispositif?"*

- **It can carry information**. The order of the bases along a strand is a code - a code for making proteins.

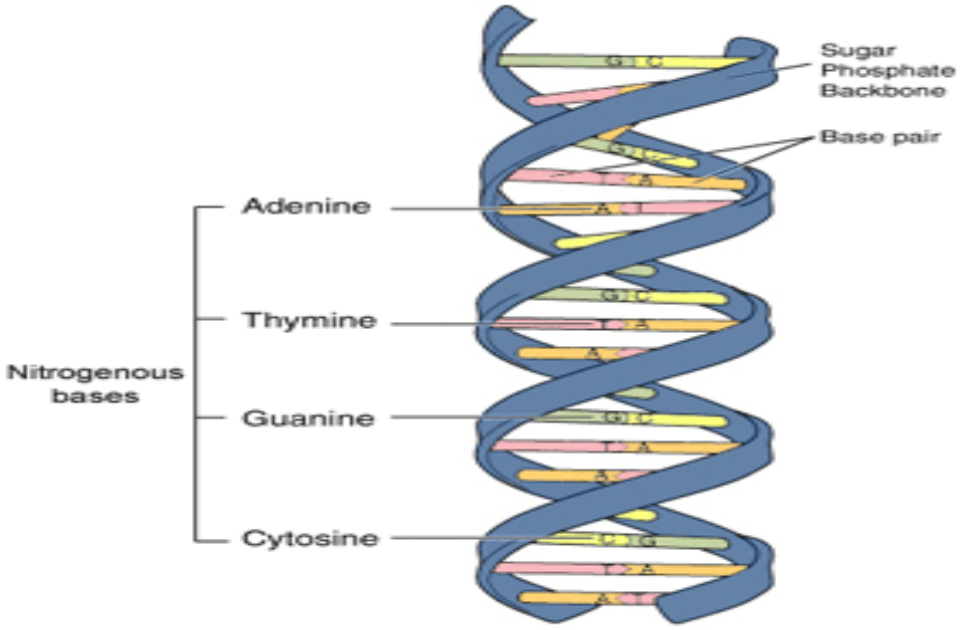

Image adapted from: National Human Genome Research Institute.

Eric Lander, the principal leader of the Human Genome Project, teaching the introductory class on biology to undergraduates at MIT for more than 20 years, said that all the basic tenets in genetics that he has taught since 1992, which is when he began teaching the ourse, has turned out to be incorrect year after year after year.[7] Francis Crick's insight proved to be true when he wrote in 1970,

> My broad conclusions, then, are that between now and the year 2000 biological research will take place on a massive scale….there will inevitably be a proportion of novel, unexpected and significant advances the nature of which we can hardly guess. In short, the whole field is likely to be even more fascinating in the year 2000 than it is today (Crick 1970; Portugal and Cohen 1977, 321).

What we know today as the field of 'genetics' has been present from the earliest times. The study of how life is created and the way traits are passed on from one generation to another generation has been of vital importance to our forebears. The term 'genetics' was coined by William Bateson in 1905. It is derived from the Greek word 'pangenesis'

[7] *The Cell Press-TNQ India Distinguished Lectureship Series 2015 on the topic, "The Human Genome and Beyond: A 35-year journey of genomic medicine." All India Institute of Medical Sciences (AIIMS), New Delhi. 23 February, 2015.*

which, "suggested that sperm was secreted from all parts of the body during intercourse and that, animated by some unknown force, the sperm from each body part subsequently reproduced the portion from which it had been derived" (Portugal and Cohen 1977, 90). W. Johannsen, between the years 1908-1910, came up with the concepts of 'gene' 'phenotype' and 'genotype'.

> The definition of gene was derived by isolating
>
> …the last syllable "gene," which alone is of interest to us, from Darwin's well known word (Pangenesis) and thereby replace the less desirable ambiguous word "determiner." Consequently, we will simply speak of "the gene" and "the genes" instead of "pangen" and "the pangens." The word "gene" is completely free from any hypothesis; it expresses only the evident fact that, in any case, many characteristics of the organism are specified in the germ cells by means of special conditions, foundations, and determiners which are present in unique, separate, and thereby independent ways – in short, precisely what we wish to call genes (Portugal and Cohen 1977, 118).

Later on, Charles Darwin developed his own version of the theory of pangenesis in *The Variation of Plants and Animals under Domestication* (1892),

> I assume that the units [tissues] throw off minute granules which are dispersed throughout the whole system; that these when supplied with proper nutriment, multiply by self –division, and are ultimately developed into units like those from which they are originally derived. These granules may be called gemmules. They are collected from all parts of the system to constitute the sexual elements, and their development in the next generation forms a new being; but they are likewise capable of transmission in a dormant state to future generations and may then be developed….These assumptions constitute the provisional hypothesis, which I have called Pangenesis.

Darwin continued,

> The reproductive organs do not actually create the sexual elements; they merely determine the aggregation and perhaps the multiplication of the gemmules in a special manner. These organs, however, with their accessory parts, have high functions to perform. They adapt one or both elements for independent temporary existence, and for mutual union. (quoted in Portugal and Cohen 1977, 92)

It was only when Mendellian genetics was rediscovered by Carl Correns, Erich von Tschermak and Hugo De Vries in 1900 that the germ plasm theory (developed by August Weismann in 1885)[8] was pushed further. Correns wrote, "I thought that I had found something new. But then I convinced myself that Abbot Gregor Mendel in Brunn, had

[8] *"Weismann, August Friedrich Leopold." Complete Dictionary of Scientific Biography. 2008. Encyclopedia.com. (March 3, 2015). http://www.encyclopedia.com/doc/1G2-2830904595.html*

during the sixties, not only obtained the same result with extensive experiments with peas, which lasted for many years, as did De Vries and I, but had also given exactly the same explanation, as far as that was possible in 1866." (Portugal and Cohen 1977, 115)

Similarly, De Vries also wrote in a letter, "After finishing most of these experiments I happened to read L.H. Bailey's "Plant Breeding" of 1895. In the list of literature of this book, I found the first mention of Mendel's now celebrated paper, and looked it up and studied it." (1977,115)

The intermixing of Darwin's theory of Pangenesis and Mendel's theory of heredity opened up a whole new vista for the life sciences which is still continuing. (Y. Liu and Li 2012) It is uncanny how the re-discovery of Mendellian hereditary genetics coincided with the birth of the Amercian eugenics movement. "After 1900 the movement became, in the eyes of its American advocates, a major breakthrough in the application of rational, scientific methods to the problems of a complex urban and industrial society." (Allen 1986, 225) We realize here that in a way, there is a parallel path that the human and the social sciences are taking.

Friedrich Miescher discovered, at the age of twenty-five, what is presently termed as DNA at the University of Tübingen. This was in 1869; because of the unique ratio of phosphorous to nitrogen his discovery received a lot of attention and he called the material *nuclein* (Portugal and Cohen 1977, 15). Thus, it took eighty-four years from the time that the DNA was discovered to the knowledge of the three dimensional double helical chemical structure of the DNA (Watson and Crick 1953). Watson and Crick (1953) were the first to create a three dimensional model of the double helical structure of the DNA and thus, introduced a paradigm shift in the way DNA was to be studied and conceptualized. This involved changing the cognitive and scientific understanding of the double helix. As Kuhn ([1970] 1996) has argued, science is a process of accumulation of knowledge though time and then there comes a moment of "incommensurability" when a "gestalt shift" occurs in the way we look and study phenomenon. This was the moment introduced by Watson and Crick in 1953 and it is continuing to accumulate knowledge presently. Their work was a moment where they stood literally on the shoulders of giants;

as P.B. Medawar, a Nobel laureate in Medicine in 1960, wrote in his review of James Watson's book *The Double Helix*,

> The discovery of the structure of DNA was logically necessary for the further advance of molecular genetics. If Watson and Crick had not made it someone else would certainly have done so – almost certainly Linus Pauling, and almost certainly very soon. It would have been the same discovery, too; nothing else could take its place. (Medawar 1968)

If it is true that science is a social enterprise that moves by the accumulation of collective knowledge then there is weight in Medawar's commentary on Watson and Crick. However, it is also useful to note here that science, as opposed to popular perceptions of it, is not a smooth journey from one discovery to the next. It is always a point of contestation where many alternate voices are voicing their opinions and giving proof of their superiority in explaining certain phenomenon.

2.2 The Eugenic lineage of Molecular Biology (Molecular Medicine)

This 'event' that occurred with the unraveling of the chemical structure of the DNA cannot be understood outside of the technico-political and epistemic juncture that it inhabited. To interrogate this point, let us look at the figure of Linus Pauling, who was, at the time the world's most influential and powerful expert working on the chemical ordering of the gene. He said, "I believe that this discovery of the double helix and the developments that resulted from the discovery constitute the greatest advance in biological science and our understanding of life that has taken place in the last hundred years" (Portugal and Cohen 1977, 271). Pauling was one of the chief architects of the molecular vision of life; building the infrastructural and institutional base from which the genetic vision could be realized. At that time, he was considered the foremost authority on genetics in the world. His contact with Warren Weaver and George Beadle in the Rockefeller Foundation was a key ingredient in the creation of the genetic story because of the material contributions provided to the research by the foundation.

> In December 1945 Linus Pauling (in collaboration with Beadle) submitted to the Rockefeller Foundation a plan for molecular biology that was remarkable in its scope, structure and language. Deploying metaphors of exploration of unknown terrains, the 25-page grant proposal charted, "the great problems of biology." It did so by placing heavy emphasis on group projects organized around scientific

> technologies, on instrumentation as a driving force of knowledge and a dominant framework for research, and on protein chemistry as the central paradigm of the new biology. With a price tag of $6 million, the new design called for two new buildings and an annual budget of $400,000 spread over a 15-year period, *the most comprehensive and costly plan in the life sciences ever proposed to the Foundation.* (Kay 1993, 225; *emphasis mine*)

Without the Rockefeller Foundation's support and Pauling's plan of action, Watson would never have met Crick, as, Watson was sent to work with Crick in the UK for post-doctoral studies. Once, in the UK, Watson remained in close contact with his teachers Max Delbrück and Salvador Luria in the US. Delbrück and Luria, in turn, communicated with Linus Pauling (who was also in the race to decipher the structure) regarding the progress made by Watson and Crick in determining the structure of the DNA (Kay 1993, 269-270). Further, Rosalind Franklin and Maurice Wilkins used instruments bought from funds provided by the Rockefeller Foundation to do their seminal studies on the x-ray structure of the DNA. Without their work, Watson and Crick could not have come up with their double helix. As Pnina G. Abir-Am writes: "In 1962, Randall's second-in-command, Maurice Wilkins, shared the Nobel Prize after repeating Franklin's work on DNA while using equipment that was ordered by her in 1950 and paid for by the RF" (2002,69). She further notes that the Rockefeller Foundation was intimately involved in setting up molecular biology in the UK by funding the Molteno Institute (1932-1952), the Cavendish Laboratory (1938-1963) and King's College, London (1946-1964). Not only this, the Foundation became a great refuge for scholars fleeing Europe between the two world wars, thus helping develop and concretize an interdisciplinary team consisting of experts from many different scientific fields; including, a network for the molecular understanding of biological phenomenon (Gemelli 2000). "Caltech geneticist and Nobel laureate George Wells Beadle observed that during the dozen years following 1953 (the elucidation of DNA structure) Nobel prizes were awarded to 18 scholars for research into the molecular biology of the gene, and all but one were either fully or partially sponsored by the Rockefeller Foundation under Weaver's guidance." (Kay 1993, 8)

Lily E. Kay, in her book *The Molecular Vision of Life: Caltech, The Rockefeller Foundation, and the Rise of the New Biology* writes how Linus Pauling spoke about his eugenic vision of creating a superior human race free from the diseases. His idea was that

of, "biology turning molecular, medicine maturing into an exact science, and social planning becoming rational" (1993,274). This vision was informed in his shaping of both the Rockefeller and the Ford Foundation on lines of the social engineering of human germ plasm based on 'molecular diseases' for which birth control and population control were recommended by him, as he saw, "the deterioration of the human race as the most compelling challenge for the new biology." (1993,275) Linus Pauling, the winner of two Nobel Prizes; one in Chemistry in 1954 and the Peace Prize for his activism on Nuclear Disarmament in 1962; wrote, what Kay refers to as a "yellow star" policy of eugenic prophylaxis," (276) by stating that,

> I have suggested that there should be tattooed on the forehead of every young person a symbol showing possession of the sickle-cell gene or whatever other similar gene, such as the gene for phenylketonuria, that has been found to possess in single dose. If this were done, two young people carrying the same seriously defective gene in single dose would recognize this situation at first sight, and would refrain from falling in love with one another. In my opinion that legislation along this line, compulsory testing for defective genes before marriage, and some form of public or semi-public display of possession, should be adopted. (Pauling 1967, 269)

In retrospect, we seem to have far "outdone" Pauling's plan as now the "genetic marker" does not need a Nazi "yellow star" or a "branding iron" of the prisoner or the slave, but is imprinted in individual's genetic profile accessible anytime, anywhere to the authorities for identification and to pursue goals relevant to the profilers. As Nadia Abu El-Haj puts it, "—a black disease on the one hand, a molecular disease on the other—the commitment to race as a molecular attribute took form." She further adds: "with the molecularization of the life sciences, so too has the molecularization of race continued apace" (2007,287). Babies in the United States are now regularly and mandatorily screened for genetic diseases such for Tay-Sachs disease amongst Jews mostly, sickle-cell disease amongst African-Americans and PKU (phenylketonuria) for whites. Testing for sickle-cell (both trait and disease) was linked to school attendance in Massachusetts in 1971 as a social policy (Duster 2004, 39).

> By 1973, newborn screening was compulsory in 43 states. Now it is universal…Only Maryland, Wyoming, and the District of Columbia currently seek parental consent for newborn screening…In Maryland, the consent is for the total screening package; parents are not asked to consent to specific tests. Thirty-three states provide an exemption from screening if contrary to parents' religious

> beliefs, but it is up to the parents to assert the objection without being asked. (Mehlman 2011, 231-232)

Not only Pauling, H.J. Muller (Nobel Prize in Medicine 1946), "…promoted a new eugenics free of class and race prejudices and based on biological and social merit" (Kay 1993, 275) by stating that, "it is more economical in the end to have developmental and physiological improvements of the organism placed on a genetic basis, where predictable, than to have to institute them in every generation anew by elaborate treatments of the soma." (Muller 1963,255) Another Nobel laureate in Medicine 1958, Joshua Lederberg, promoted the, "direct control of nucleotide sequences in human chromosomes, coupled with recognition, selection, and integration of the desired genes", so that we could "more confidently design genotypically programmed reactions, in place of evolutionary pressures, and search for further innovations" (Lederberg 1963; Lederberg 1966; Kay 1993, 275-276). Robert Sinsheimer, a leading Molecular Biologist at Caltech, said that, "the old eugenics was limited to a numerical enhancement of the best of our existing gene pool. The new eugenics would permit in principle the conversion of all the unfit to the highest genetic level." (Sinsheimer 1969; Kay 1993, 276)

Pauling's genetic eugenics lineage goes back a long way. Plato in his *Laws* and *The Republic* clearly advised eugenic methods for breeding better citizens, and so did Aristotle in *Politics.* What is also interesting is that both of them advised the use of legislation and social policy to achieve this end by use of various incentives and disincentives for procreating a better stock of humans in the city-state (see D. J. Galton 1998). Francis Galton (Charles Darwin's half-cousin) first coined the term "eugenics" in his *Inquiries into Human Faculty and Its Development* (1883) describing it as, "the science of improving stock, which is by no means confined to questions of judicious mating, but which, especially in the case of man, takes cognisance of all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had" (1883,25). Further on, he wrote Hereditary Genius in (1870) in which he argued for the heritability of intelligence and propagated early marriage among youth from reputed families in the hope of creating a better stock of human beings that can lead society. Then he described it again as, "the science which deals with all influences that improve the

inborn qualities of a race; also with those that develop them to the utmost advantage." in *The American Journal of Sociology*. (F. Galton 1904) Darwin wrote *The Descent of Man* (1872) where he likened the 'Negro' to somewhere between an ape and a human.[9]

The Rockefellers, Sr. and Jr., were both concerned with the deterioration of American society. They wanted a measure of social control that would negate the flux created by industrial capitalism in the United States, along with the upheavals created due to the World Wars. A technocratic society based on Protestant idealism was envisioned that would serve as a moral compass and lead the way for the American conception of how to live life. For this purpose, science was an ultimate tool in the 20th century. This was also the case in the UK around the same time with leading personalities like H.G. Wells, Eugene and Beatrice Webb and George Bernard Shaw propagating eugenicist ideas for the betterment of the race (Freeden 2009). As Kay notes, "their project aimed to restructure human relations and to develop social technologies commensurate with the material and ideological imperatives of industrial capitalism" (1993, 10). The scientific and managerial elites imbibed and shared a vision of the world that was commensurate with those of the Rockefeller Foundation. Their need to build a Comtean Science of Society was felt acutely in the post-war situation in which America found itself.

> The reality of industrial capitalism, however, fell short of the vision. Demographic dislocations fractured community and family structures, consumerism eroded spiritual values, social and economic conflicts pitted capital against labor; factory work bore little relation to the promise of salvation. The Protestant business establishment confronted a labor force swollen with foreign elements and was challenged by social ills even greater than those of industrialized Europe.
>
> …These huddled masses (more than 18 million arrived between 1890 and 1919) aggregated mainly in urban centers, infusing factories and sweatshops with abundant cheap labor…These social ills seem to support the Anglo-Saxon anxiety over racial inferiority, backward temperament and mental deficiency – and over the general deterioration of American society. (1993,25)

The question over security, territory, population and health gained a primary interest in the discourse of post-war national consciousness mediated by the belief in eugenics of the

[9] *Richard Weikert (2004) has traced an interesting link between Darwinism and the race politics of Nazism in his book From Darwin to Hitler: evolutionary ethics, eugenics, and racism in Germany.*

leaders in American public policy. The foundation funded the eugenics institutions in Nazi Germany that could not have evolved without their financial support and intellectual appeasement.

> By 1926, Rockefeller had donated some $410,000 — almost $4 million in today's money — to hundreds of German researchers. In May 1926, Rockefeller awarded $250,000 toward creation of the Kaiser Wilhelm Institute for Psychiatry. Among the leading psychiatrists at the German Psychiatric Institute was Ernst Rüdin, who became director and eventually an architect of Hitler's systematic medical repression.
>
> Another in the Kaiser Wilhelm Institute's complex of eugenics institutions was the Institute for Brain Research. Since 1915, it had operated out of a single room. Everything changed when Rockefeller money arrived in 1929. A grant of $317,000 allowed the institute to construct a major building and take center stage in German race biology. The institute received additional grants from the Rockefeller Foundation during the next several years. Leading the institute, once again, was Hitler's medical henchman Ernst Rüdin. Rüdin's organization became a prime director and recipient of the murderous experimentation and research conducted on Jews, Gypsies and others.
>
> A special recipient of Rockefeller funding was the Kaiser Wilhelm Institute for Anthropology, Human Heredity and Eugenics in Berlin. For decades, American eugenicists had craved twins to advance their research into heredity.
>
> At the time of Rockefeller's endowment, Otmar Freiherr von Verschuer, a hero in American eugenics circles, functioned as a head of the Institute for Anthropology, Human Heredity and Eugenics. Rockefeller funding of that institute continued both directly and through other research conduits during Verschuer's early tenure. In 1935, Verschuer left the institute to form a rival eugenics facility in Frankfurt that was much heralded in the American eugenics press. Research on twins in the Third Reich exploded, backed by government decrees. Verschuer wrote in Der Erbarzt, a eugenics doctor's journal he edited, that Germany's war would yield a "total solution to the Jewish problem." (Black 2003)

This was consolidated by the Protestant doctrine running through the policy decisions of the Rockefeller Foundation that was puritanical in its approach and looked at social deviance from a very critical and reformist perspective. Biology was meant to serve a social end that was reflective of the vision of the nation as a healthy organism. The Rockefeller Foundation along with its prominent partner Caltech was committed to this program. The Rockefeller Charity had given rise to the University of Chicago in 1892, the Rockefeller Institute of Medical Research in 1901, and the General Educational Board in 1903. Human engineering was proposed as a solution to the inability to adapt to

the technological changes brought about by industrial capitalism, which according to sociologists like William Ogburn was leading a range of social evils like "growing divorce rates, delinquency, crime, mental deficiency, personality difficulties, immigrant assimilation, prostitution, alcoholism and job instability" (Kay 1993,26) which he termed as a 'cultural lag'.

> The thesis acquired greater scientificity, higher resolution, and more specific technical formulations derived from engineering, eugenics, physiology, psychology, statistics, sociology, and the mass media. Social control attained a particularly strong expression in areas of human engineering, in the new field of behaviorism, and most significantly, in sociology, where the emphasis on behavior and the mission of scientism combined to stimulate highly technocratic formulations of social control. (1003,33-34)

Cold Spring Harbor, New York, the Mecca of the biotech revolution in the world traces its lineage directly back to the American eugenics movement initiated by Charles Benedict Davenport[10] and funded by the Carnegie Institution. Black (2003) writes, "in 1904, the Carnegie Institution established a laboratory complex at Cold Spring Harbor on Long Island that stockpiled millions of index cards on ordinary Americans, as researchers carefully plotted the removal of families, bloodlines and whole peoples. From Cold Spring Harbor, eugenics advocates agitated in the legislatures of America, as well as the nation's social service agencies and associations." Sara Vogt (2012) in her PhD dissertation *Bodies of Surveillance: Disability, Femininity, and the Keepers of the Gene Pool, 1910-1925* outlines the way in which field workers from the Eugenics Record Office (ERO) at Cold Spring Harbor shaped the prism through which "feebleminded" women were proclaimed pathological by the women field workers who thought that they were the normal; thereby, protectors of healthy germ plasm. Later on it became the Department of Genetics at Carnegie Institution of Washington headed by James D. Watson (Allen 1986, 232). The ERO became the 'nerve center' of the eugenics movement in the world and "became a meeting place for eugenicists, a repository for eugenics records, a clearinghouse for eugenics information and propaganda, a platform from which popular eugenic campaigns could be launched, and a for several eugenical

[10] *Charles Benedict Davenport was the founder and Director of the Station for the Experimental Study of Evolution (SEE) and the Eugenics Record Office (ERO) at Cold Spring Harbor, Long Island from 1910 until his retirement in 1934, along with being a member of the National Academy of Sciences and the National Research Council. See Allen (1986, 227-228)*

publications" under the guidanceship of Davenport and Harry Laughlin (1986,226). The eugenics movement may no longer exist in its previous structure but the form and content has been encapsulated by the scientists at Cold Spring, this can be substantiated by the 74th Annual Symposium on Quantitative Biology held in 2009 to celebrate the 150th anniversary of the publication of Charles Darwin's *On the Origin of Species.* The symposium was titled *Evolution: The Molecular Landscape* and could be said to be the grounding for the evolution of molecular biology research in the world; it contained an essay by K.R. Foster (2009) titled, "A defense of sociobiology". Another symposium *Man and His Future* was held in 1963 (ten years after the discovery of the double helical structure of DNA in 1953) that was attended by the who's who of molecular biology in the planet. Sir Julian Huxley (first Director of UNESCO, founding member of WWF and first President of the British Humanist Assn.)[11], in the inaugural address, made the statement,

> Man lives in three kinds of habitat, the planetary, the social and the psychological. The planetary habitat, the concern of ecology in the ordinary sense, I have just been discussing. To deal with the problems of the social habitat, which man has created himself, we need a science of social ecology. It has even been found possible to make one half of the body feel happy, while the other half remains in its normal state. To some people this seems somehow too materialistic; but after all, electric happiness is still happiness, and happiness is very much more important than the physical happenings with which it is correlated. (Huxley 1963, 11-12)

Man and his Future was more like an exercise by biologists looking at the question of regulating society via molecular genetics (note that women were not a part of the imagined future). Here are some of the titles presented in the conference: *Control of reproduction in mammals, The sex-ratio in human populations, Growth and development of social groups, Genetic progress by voluntarily conducted germinal choice, Eugenics and genetics, Potentialities in the control of behavior* (Wolstenholme 1963). In his address on *Eugenics and genetics*, Francis Crick noted,

> Is it the general feeling that people do have the right to have children? This is taken for granted because it is part of Christian ethics, but in terms of humanist

[11] *Bibby, Cyril. n.d. "Sir Julian Huxley." Encyclopedia Britannica. http://www.britannica.com/EBchecked/topic/277743/Sir-Julian-Huxley.*

> ethics I do not see why people should have the right to have children. I think that if we can get across to people the idea that their children are not entirely their own business and that it is not a private matter, it would be an enormous step forward. If one did have a licensing scheme, the first child might be admitted on rather easy terms. If the parents were genetically unfavourable, they might be allowed to have only one child, or possibly two under certain special circumstances. That seems to me the sort of practical problem that is raised by our new knowledge of biology. (1963,275)

This piece of discussion between Joshua Lederberg, winner of Nobel Prize in Medicine 1958 and Alex Comfort, a British physician and the author of *The Joy of Sex* (1972), might be poignant

> Lederberg: …most of us here believe that the present population of the world is not intelligent enough to keep itself from being blown up…it is not the negative put the positive aspects of genetic control that we are dealing with here.
>
> Comfort: Dr. Lederberg, what makes you think that we could make ourselves less likely to blow ourselves up by a genetic increase in intelligence?
>
> Lederberg: I didn't say I thought we would succeed; I said I think it is our underlying motivation for attempting genetic control.
>
> Comfort: I should think it is not so much low I.Q.'s, but personality problems and emotional disturbances which were the cause of our liability to blow ourselves up.
>
> Lederberg: These are just as likely to be under genetic control. (1963,288-89)

2.3 Eugenics: The modality of Control

The "race question" has always been a central part of American and European society and eugenics has played a seminal part in developing the notion of a racialized national consciousness. The relationship between the American Eugenics movement and its linkages with the Nazi pogrom is illuminating of the idea of how racial categories can be scientifically validated and explained to be used for genocidal purposes. Hitler was well aware of American eugenic ideology and used it for writing *Mein Kampf.* "There is today one state," wrote Hitler, "in which at least weak beginnings toward a better conception (of immigration) are noticeable. Of course, it is not our model German Republic, but the United States" (cited in Black 2003). Hitler wrote a fan mail to American eugenicist Madison Grant, author of *The Passing of the Great Race* (1916) calling it his *Bible* and is claimed to have boasted to a fellow Nazi, "I have studied with

great interest the laws of several American states concerning prevention of reproduction by people whose progeny would, in all probability, be of no value or be injurious to the racial stock" (cited in Black 2003). At the beginning of the twentieth century the whole of the American intellectual class cutting across all professional and disciplinary contexts were harbingers of the eugenics discourse.

> Early eugenics proponents, drawn from the ranks of scientists, politicians, doctors, sexologists, policy makers, reactionaries, and reformers, held that through selective breeding humans could and should direct their own evolution. Most believed in the supremacy of Nordic and Anglo- Saxon peoples, and to this end agitated for immigration restriction and supported antimiscegenation laws. Eugenicists advocated compulsory sterilization of the poor and the disabled and the "immoral." The legislation they drafted, the interventions they backed, the medical regimens they prescribed stemmed from a belief that everything from intellect to sexuality to poverty to crime was attributable to heredity. (Ordover 2003, xii)

The emergence of eugenics in America cannot be understood outside of the social, economic and political context of the age. *The U.S. Immigration Restriction Act of 1924* used forced sterilization and marriage controls as the modality to prohibit immigrants from procreating by excluding those with hereditary illnesses and people of other ethnic groups, including, "emancipated Negroes, immigrant Asian laborers, Indians, Hispanics, East Europeans, Jews, dark-haired hill folk, poor people, the infirm and anyone classified outside the gentrified genetic lines drawn up by American raceologists" (Black 2003). *The Page Law of 1875* (meant to ban Asian prostitutes) and the *Chinese Exclusion Act in 1882* were the precursor to the *Immigration Acts of 1917* and 1924 which barred immigrant communities from attaining citizenship rights and entry into the U.S. (Ordover 2003, xvi). "White mobs repeatedly attacked Chinese communities, burning down homes and business, and rallying to drive the "Yellow Peril" out of town. Additionally, like other Western states, California passed an antimiscegenation statute in 1850 that forbade unions between whites and "negroes and mulattoes," adding "Mongolians" to the list in 1880" (Stern 2005, 87). Almost all states passed Sterilization Laws in the United States targeting the "feebleminded" and "degenerate" so that they could not reproduce as they were deemed to be unfit and carriers of bad hereditary traits (Black 2012). California enacted its forced state sterilization law on April 26, 1909, a few weeks after Washington and two years after Indiana in 1907 on the back of heightened xenophobia regarding

immigrants, especially Mexicans. Mexicans were deemed to be too impure to enter the American body politic by a university professor in zoology Samuel Jackson Holmes at the University of California, accusing them to be "undemocratic, mentally retarded, and wildly procreative carriers of plague, typhus, and hookworm", he further created a 'family pedigree inventory' of Berkeley undergraduates espousing white female students and faculty wives to be monetarily incentivized for producing more babies (Stern 2005, 90).

The current citizenship tests (Etzioni 2007) conducted by the American government and the various debates that surround the question regarding whom to give citizenship and the criteria involved in granting these rights links itself up firmly with the notion of racial prejudice and the use of disciplinary power by the elites to manipulate who gets in and under what conditions which has been the hallmark of American race based immigration procedure (Löwenheim and Gazit 2009). As an example, Proposition 187 was voted into law in California in 1994, although challenged in court and "later superseded by federal enactments", the proposition "sought to bar undocumented immigrants and their children from a host of services, including health care and public education. Service providers would have become mandated reporters, demanding verification of legal residency from potential clients, patients, and students, and turning over the names of any "suspect" individuals to the Immigration and Naturalization Service." (Ordover 2003, 3)

The U.S. Supreme Court legitimized and validated the program of eugenics when in 1927 Oliver Wendell Holmes, Jr. gave the infamous judgment on *Buck v. Bell* (1927) by stating, "it is better for all the world, if instead of waiting to execute degenerate offspring for crime, or to let them starve for their imbecility, society can prevent those who are manifestly unfit from continuing their kind . . . Three generations of imbeciles are enough." (quoted in Leonard 2003,687) As a mark of ultimate respect, the Nazi exterminators quoted Judge Holmes in their Nuremburg trials. (Black 2012) The first eugenic law passed was the Indiana Sterilization Law 1907 based on the work of Reverend Oscar C. McCullough who created a degenerate "Tribe of Ishmael" out of the group of families he worked with; linking them directly with social problems and criminal activity. David Cullen, in a bibliographic essay on the eugenics movement

mentions *Preaching Eugenics: Religious Leaders and the American Eugenics Movement* (2004) where the author Christine Rosen, "…discovered that a surprising number of the nation's liberal Jewish, Protestant and Catholic leaders supported eugenics. A number of Social Gospel advocates reconciled scientific conclusions about human nature with the Bible by explaining such well-known stories as Noah's flood, for example, as a spiritual eugenic device to rid the earth of those who had turned away from the teachings of Jesus Christ." (Cullen 2007)

> Bolstered by statistics garnered from IQ tests, they sounded panicked alarms over the entry of Slavs, Italians, Jews, Poles, and others with a "dysgenic" bent toward "feeble-mindedness." After the 1917 enactment, they deftly exploited fears over a post–World War I "overflow"of refugees and an atmosphere of anticommunist, antianarchist, and antilabor persecution. Like eugenicists involved in campaigns to regulate sexuality and procreation among other marginalized groups, they began with social categories and then sought to legitimize them through statistical and biological "evidence."
>
> Exclusionist bids eventually culminated in the 1924 National Origins Act. Accepting neither the 1917 legislation nor the 1921 Three Percent Restrictive Act as fully satisfactory, eugenicists redoubled their efforts. No fringe element, they exerted direct influence on immigration debates: culling new test results, drafting legislation, testifying before Congress, and offering "evidence" of the disproportionate number of "insane" among Bulgarians, Chinese, Jews, Irish, Italians, Mexicans, Poles, Russians, and Turks. Eugenicists and eugenics sympathizers could be found in the House of Representatives, the Senate, and the White House. (Ordover 2003, 5)

The Protestant churches and their influential preachers played their class role by moralizing about the need to keep the American morals intact from the corrupting influences of the immigrants with their different religious persuasions. The prime location in America where eugenics flourished was in Southern California and scholarly work has focused on what were the social conditions that exploded the eugenic program into race consciousness amongst the elites of America in the early part of the 20th century. This took on the form of a class war where power was appropriated by the Anglo-Saxon elite against the incoming masses of immigrants, mainly Mexicans and Chinese whom they used as cheap labor for industrialization.

> …Reverend Robert Freeman uplifted his affluent flock, preaching in his Scottish brogue on the virtue and rewards of the work ethic, the Christian mission in California, and the threats to Americanism. He raged against foreign-born college teachers, who "without our wholesome traditions…make Bolsheviki out of those American-born children," impressing on his listeners that "We are here to keep up the average morality of the world." He warned Caltech's community of "the threat to our civilization from Mexican

> immigration now that the Johnson Act restricted European labor" and from the growing presence of Orientals and their Buddhist temples. (Kay 1993, 62)

Not only the Conservatives but also the most virulent Progressives were harbingers of race talk.[12] Further, social policy based on racial caricatures by leading economists and sociologists in America confesses to the way in which the idea of purity in race and the control of society's health for industrial production can be made manifest. Mostly it had to do with the question of minimum wage and welfare for the poor immigrants and the other discriminated categories in the U.S. The technocrats felt it was their moral imperative to control the spread of the population in a healthy way. Most of the intellectuals owed their affiliations to the American Economic Association (AEA) or the American Association for Labor Legislation (AALL). It included personalities like Francis Amasa Walker, Frank Fetter, Edward A. Ross, Irving Fisher, Sidney and Beatrice Webb, John R. Commons, Scott Nearing, Charlotte Perkins Gilman, Lester Ward and Gunnar Myrdal (Leonard 2003).

> What drew Progressives to eugenics was the same set of intellectual commitments that drew them to the AALL. The Progressive intellectual commitments were (1) a belief in the power of scientific social inquiry; (2) a belief in the legitimacy of social control, which derives from a conception of society as an organism prior to and more important than its constituent individuals; and (3) a belief in the efficacy of social control via state scientific management, in particular faith in the ability of academic experts to suspend their own interests and to circumvent (or better, transcend) the messy business of everyday interest-group politics. (2003,706)

As evident in all other elites, the Progressives were also concerned about how the immigrants were breeding too much and too fast, the hereditary inferiority of the blacks and other immigrants, the degeneracy of criminality, pauperism, alcoholism and prostitution and to this end they shared a very close affinity with the conservative eugenicists; an "ideological affinity" (Freeden 2009) which translated usually in similar designs over the life of the population.

2.4 The Genetic "CODE"

Erwin Schrödinger wrote a book called *What is Life?* (1944) based on a series of lectures that he gave in 1943 at Dublin (Olby 1971, 122). This book became a vision statement for

[12] *Diane Paul (1984), "Eugenics and the Left."*

future geneticists combining biology with physics, chemistry and cybernetics based on information science. This gave birth to biotechnology. Although it might look very causal and evolutionary to state that his book impregnated biology thus giving rise to a new discipline[13], the impact of Schrödinger's thought on biologists is gigantic as has been well documented by many researchers of the history of ideas. Portugal and Cohen (1977) mention that, "following the war, Crick became more directly interested in applying physical principles to biological problems. He was influenced by a Pauling lecture in 1946 and by reading the book *What is Life?* by the quantum physicist Erwin Schrödinger" (1977,226). Similarly, the other part of the helix, i.e. Maurice Wilkins and Rosalind Franklin, without whose seminal contributions on X-ray diffraction studies the structure of the DNA would never have been explained, also bore the mark of Schrödinger's influence: "during the war he [Wilkins] took part in the Manhattan project for the development of the atomic bomb. Partly in reaction to this work, and influenced by Schrödinger's book *What is Life?*, after the war he rejoined Randall at the physics department of St. Andrew's University, Scotland, to study the effects of ultrasonic waves on genetic material" (1997,236). Further; "As with Crick and Wilkins, his [James Watson] reading of Schrödinger's book *What is Life?* evoked in him a fascination with genetics" (1977,247). Francis Crick also wrote a thank you letter to Schrödinger, writing, "Watson and I were once discussing how we came to enter the field of molecular biology, and we discovered that we had both been influenced by your little book, "What is Life?".[14] Schrödinger was also Linus Pauling's teacher. Pauling was sent to Europe as on a National Research and a Guggenheim Fellowship by his teachers to study at top European universities. "He studied in Munich (1925-1926) with the leading theoretical physicist Arnold Summerfield, continuing his training in atomic physics and quantum mechanics the following year with Erwin Schrödinger in Zurich and with Niels Bohr in Copenhagen." (Kay 1993,147; Gray 1949) Max Delbrück (Nobel Prize in Medicine 1969), known for his legendary phage work of which Francis Crick was also a student, influenced Schrödinger with his ideas; which Schrödinger in turn, used to popularize

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[13] For critical readings of Schrödinger's influence, see Robert Olby (1971), Edward Yoxen (1979) and (Kay 2000, 59-66)

[14] Letter from F.H.C. Crick to E. Schrödinger dated 12th August 1953, Cavendish Laboratory, Cambridge. https://twitter.com/RIAdawson/status/499156924521525248/photo/1

biology amongst students of the physical sciences. Kay notes how the interaction of the physical sciences with biology in the haze of the atomic age stirred up intellectual curiosity amongst the physicists who were in a 'moral dilemma' regarding the power of physics and its use. Schrödinger's book "extolling Delbrück's physicomathematical approach to genetics" helped to popularize and legitimize the pursuit of biology amongst the physical scientists (a "scientific playground" for serious children) and became a seminal glue in connecting the two sciences and creating biotechnology as we know it today (Kay 1993, 246-47).

The relationship between the nuclei acids in the DNA and its validation as codes is traced to Schrödinger's lecture on the question of *What is Life?* which helped in the explanation of how in even a simple organism like a bacterium only the four based (A,T,G,C) "could specify the assembly of 20 amino acids into the myriad proteins present"

> *Erwin Schrodinger's suggestion of a code script for the gene had intrigued scientists since the mid-1940s, and the idea crystallized during the summer of 1953 that there had to exist some type of code relating the base sequences in polynucleotides to amino acid sequences in polypeptides.* It was proposed (and experiments designed to test this hypothesis confirmed it over the next few years) that the heterocatalytic function could be represented as a two-stage process: (1) the DNA template's transcription into messenger RNA; and (2) the translation stage: After carrying the coded information to the cytoplasm, the nucleotide sequences were translated into polypeptide chains of predetermined primary structure. (272-73; *emphasis mine*)

Judith Roof in her book *Poetics of DNA* (2007) writes that,

> As the current "starring" half of this DNA-gene composite, DNA is not simply a chemical active in biochemical processes. It stands at the tip of an iceberg of beliefs, ideas, and concepts about how life and science work, what we can do with what we know, and the forms knowledge can take. From the discernment of its structure, DNA has always been more than itself. The concepts DNA has come to represent have appeared at different points in history, mounting and accruing toward mechanisms for heredity, identity, development, cell regulation, and kinship. The three acronymic letters, then, like the chemical itself, have come to signify a vast number of processes, undifferentiated to the nonscientist and rendered intelligible by a series of metaphors or comparisons. These include such analogies as the "secret of life," the code, the book, the alphabet, sentences, words, chapters, histories, the Rosetta stone, the Holy Grail, the recipe, the blueprint, the text, the map, the homunculus, software, and others. None of these analogies is accurate in terms of how DNA works or even what it accomplishes. All of them import values, meanings, mechanisms, and possibilities that are not at all a part of DNA. The effect is that DNA has always stood for much more than what it is. (2007,7)

James Watson in *The Double Helix* (1968) exclaimed that "…a structure this pretty just had to exist" (Portugal and Cohen 1977, 260) when they were able to unravel the three dimensional double helical structure of the DNA; in retrospect this also seems to be the case in point when evaluating the script of the DNA as the "code for life" when scientists are just convinced of the beauty in this complexity or to quote Eric Lander's[15] notion of beauty via Aristotle as an "economy of form", which he mentions in *Poetics* as, "to be beautiful, a living creature, and every whole made up of parts, must … present a certain order in its arrangement of parts" and in *Metaphysics* as, "The chief forms of beauty are order and symmetry and definiteness, which the mathematical sciences demonstrate in a special degree" (See Sartwell 2012). This psychosis amongst scientists is quite striking as it seems to be the premise of the scientific exercise and worldview to look at nature or existence to be inherently "economical" and thus, "beautiful" (See French 1994). Early on, it became clear that the pristineness marked for the DNA was not such when, what Crick termed as the 'coding problem' emerged[16] i.e. it was not clear how information present in DNA formed the proteins, "The problem of how a sequence of four things (nucleotides) can determine a sequence of twenty things (amino acids)…" (F. H. C. Crick, Griffith, and Orgel 1957). In 1961, Crick, Barnett, Brenner, and Watts-Tobin wrote a paper to determine the triplet nature of the genetic code before Nirenberg and Matthaei elucidated the algorithm(Yanofsky 2007). Kay (2000) notes this aspect in the race for the genomic code in which, between 1963-67, there was a great race to find the sequence of the 'genetic code.' In this effort, Har Gobind Khorana's contributions were seminal where he found "new precision techniques for synthesizing trinucleotides of known sequences". Also, Philip Leder and Marshall Nirenberg would develop "an ingenious technique for binding trinucleotide messengers to ribosomes" which "would establish biochemically the triplet nature of the code and fix the "dictionary" of codons and amino acids." Also, the development of bacteriophage and genetic analysis by Sydney Brenner, Alan Garen and co-workers identified the part played by 'nonsense codons' for 'chain termination'(277). Come to think of it, it is not too different from the effort currently underway to find the usefulness and property of what was called 'junk

[15] *Mentioned during Q&A of his Cell Press Lecture at AIIMS, New Delhi on 23rd Feb 2015.*

[16] *See Portugal and Cohen (1977, 272) and Sarkar (1996), 'Decoding "coding": Information and DNA'*

DNA'. There is a tendency here to explain axiomatically and term as 'not important' anything that does not help in explaining the phenomenon under study. In the 60's it was 'non sense codons' in the 2000's it became 'junk DNA.'

Another great race took place in the annals of molecular biology to crack the "black box" of the genetic code. This effort required massive manpower and funding via various organizations. After the decline of the Rockefeller Foundation, the U.S. Defense Establishment was the primary sponsor of the project during the interwar years but later on it was superseded by the National Institute of Health (NIH) which emerged as the primary funder of research into molecular biology (please note that most of the Nobel laureates received their prize in Medicine interestingly). Kay writes: "As a major patron of biomedical research, NIH was increasingly displacing the dominance of military support…Each year from 1957 to 1963 the NIH budget increased by an average of 40 percent annually; *appropriations grew from $98 million in 1956 to $930 million in 1963*, with a twelvefold expansion in grants for extramural research. From a handful of buildings in the 1940s, by the early 1960s NIH sprawled to fifty buildings housing 13000 people." (2000,235-36; *emphasis mine*) This increase in funding was also informed by the Cold War and the socio-political situation of the era, noting this point Kay writes that, "NIH had entered a period of unprecedented growth, driven by the general boost to science and technology generated by the space program, which had itself expanded preeminently by the traumatized response to the Soviet's launching of *Sputnik I* on October 4, 1957." (236) Further, John F. Kennedy's assassination in 1963 along with Lyndon Johnson's move towards "The Great Society" led to legislations geared toward the *"War on Poverty," Medicare and Medicaid, Model Cities, the Voting Rights Act, as well as an avalanche of health-related legislation."* which brought down funding for the National Institutes of Health. However, this change in funding pattern did not affect the course of biomedical research and molecular biology research in the US much because of the network of offices the NIH had in Paris, Tokyo and Rio de Janeiro and also grants and funding from the Air Force, Army and Navy along with the Rockefeller Foundation (277-78; *emphasis mine*).

The superstars that emerged from this de-coding effort were Marshall Nirenberg and Heinrich Matthaei, Har Gobind Khorana, Severo Ochoa and Arthur Kornberg along with others[17]. This phase also birthed the future generation of molecular biologists who would be instrumental in the creation of the Human Genome Project viz. Robert Sinsheimer and C Thomas Caskey. There was fierce competition between the labs of Nirenberg and Ochoa to establish the "dictionary" by cracking all the "code words". Nirenberg, Khorana and Robert Holley were awarded the Nobel Prize in 1968 for their contribution in completing the code. "Some of the same prophesies delivered by the champions of the Human Genome Project in the 1980's could be heard already in the mid-1960s, all based on the biopower derived from decoding the book of life." (330) Nirenberg wrote

> The presence of bacteria 3 billion years ago may indicate the presence of a functional genetic code at that time. Almost surely the code has functioned for more than 500 million years. The remarkable similarity in codon base sequences recognized by bacterial, amphibian and mammalian AA-sRNA [aminoacyl-tRNA] suggest that most if not all, forms of life on this planet use almost the same genetic language, and that the language has been used, possible with few minor changes, for atleast 500 million years. (Nirenberg et al. 1966, 19)

This case for the universality of the "code" or what is also termed as the "language" of life was a key link that propelled genetics into the pathway of the technology of life; as Kay writes,

> Universality was of course a highly prized feature. If true, then on the phenomenological level it would elevate the genetic code to the pedestal of universal laws of nature, a privilege generally reserved for the Olympian reaches of physics. On the technological and social level universality would open the door for genetic and biomedical engineering. Joshua Lederberg predicted that in "no more than a decade" the molecular knowledge of microbes will be applied to the human genome. (Kay 2000, 276-77; Lederberg 1963)

Marshall Nirenberg and Heinrich Matthaei co-wrote two path breaking papers in 1961, 'the first, "Characteristics and Stabilization of DNAase-Sensitive Protein Synthesis in E. Coli Extracts," by Heinrich Matthaei and Marshall W. Nirenberg; the second,"The Dependence of Cell-Free Protein Synthesis in E.Coli upon Naturally Occuring or Synthetic Polynucleotides," by Marshall W. Nirenberg and Heinrich Matthaei. The understated title gave no clue that they had broken the code' (Kay 2000, 253-54). These

[17] *For a detailed account of this race for cracking the code, see Chapter 6 "Matter of Information: Writing Genetic Codes in the 1960s" (Kay 2000, 235-93) and Chapter 12 "The Genetic Code" (Portugal and Cohen 1977, 272-303)*

papers elaborated upon the composition of the genetic code by introducing informational tropes in the understanding of how the genes work at a molecular level. There was now a code for the working of the genetic language and the task that remained was its decipherment. Life became a code that needed the scientific revelators. Nirenberg writes

> Comparing the genetic code of *E.coli* to that of *Xenopus* and hamster, we found that the code is essentially universal. These results had a profound philosophical impact on me because they indicate that all forms of life on this planet use essentially the same language. Some dialects have been reported subsequently in some organisms, but all are modifications of the same genetic code. (2004, 52-53)

Below is a reproduction of the table of the genetic code as deciphered by Nirenberg et al (2004)

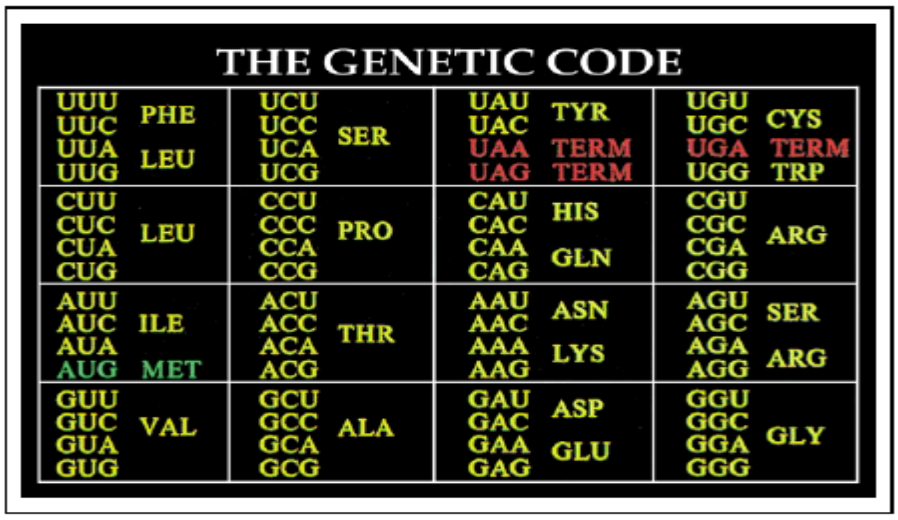

Figure 14. It took us about a year to synthesize the 64 trinucleotides and test each against 20 radioactive aminoacyl-tRNA preparations to determine the nucleotide sequences of RNA codons [30,33,35–40]. Gobind Khorana and his colleagues synthesized the 64 trinucleotides chemically and also determined nucleotide sequences of some RNA codons [44]. The green AUG corresponds to methionine and *N*-formyl-methionine tRNA, an initiator of protein synthesis [45]. The red codons specify the termination of protein synthesis [46–48].

http://tibs.trends.com

What we need to do now is to trace what Kay notes as "…a rupture in representation of life shifted from purely material and energetic to the informational…*a molecular vision of life supplemented by an informational gaze*" (Kay 2000, xvi; *emphasis mine*). She further explicates: "The genetic code is a "period piece," a manifestation of the emergence of the information age" (2000,2). Foucault writes in *The Birth of the Clinic*

(1973) : "…the medical gaze circulated within an enclosed space in which it is controlled only by itself, in sovereign fashion, it distributes to daily experience the knowledge that it has borrowed from afar and of which it has made itself both the point of concentration and the centre of diffusion" (1973,30-31).

Kay notes in her chapter titled *Production of Discourse: Cybernetics, Information, Life* (2000) the genesis of the informational understanding of life via the birth of information science and cybernetics in the scientific knowledge factories of the military complex. Its main progenitors were Norbert Wiener, Claude E. Shannon and John von Neumann and Henry Quastler, amongst others. The creation of this way of looking at things is embedded in the *military-industrial-academic* complex of the U.S. government and the techno-politics of the Cold War. In 1948, Wiener gave birth to cybernetics, exclaiming, in his path breaking book *Cybernetics: or Control and Communication in the Animal and the Machine,* "to call the entire field of control and communication theory, whether in the machine or in the animal, by the name of cybernetics which we form from the Greek (κυβερνήτης) meaning 'steerman.'" At around the same time, Shannon wrote *The Mathematical Theory of Communication* (1949) along with Warren Weaver; Kay (2000) notes Shannon's views on information when she writes

> His often cited paper, "Transmission of Information," stressed that the capacity of a system to transmit any sequence of symbols depended solely on distinguishing at the receiving end between the results of various selections made at the sending end – not on the meanings of these sentences. He viewed information as "logical instructions to select," since any such scientifically usable definition of information had to be grounded in what he called "physical," rather than "psychological," considerations. "Information" and even its precursor, "intelligence," were used metaphorically. *Information – defined as the number of possible messages – was thus demarcated from meaning.* He used this definition to derive a logarithmic law for information transmission… (95; *emphasis mine*)

Kay has critiqued this view as, "…a scheme designed for communications between machines, where information was conceptualized in a manner divorced from content, subject matter or nature of the channel" (2000,97).

Sahotra Sarkar notes that, "…the sterility of the informational picture of molecular biology is a much-needed reminder that DNA is, ultimately, a molecule and not a language" (1996,863). Sarkar and many others have caught the lie that is embedded in the

story of the genes, one that speaks truth to power; power here being the use of linguistic metaphors to create a simulacra of life. Molecular biologists have absorbed the informational trope into their understanding of the function of the gene. As Kay argues, this absorption was anything but co-incidental and the interlinkages of its metaphoric power with its explanatory potential proclaims a "manifest truth".

> Yet despite the acknowledged technical importance of information theory in molecular biology, *its discursive potency intensified by compromising its technical structures.* In the theory's proper form, and indeed in Quastler's mathematical analyses, all organized entities – carbohydrates, proteins, nucleic acids – contained information. *Molecular geneticists (and biochemists in the late 1950s) singled out nucleic acids as the unique carriers of informational attributes.* Information – as meaning and commodity – came to signify the privileged status of DNA as "master molecule." ***Emptied of its technical content, it actually became a metaphor of a metaphor, a signification without a referent.*** This, however, did not diminish its scientific and cultural potency. The discourse of information linked biology to other postwar discourses of automated communication systems as a way of conceptualizing and managing nature and society. ***And it provided discursive, epistemic, and, occasionally, technical frameworks for the scriptural representations of genetic codes in the 1950s.*** (2000, 127; *emphasis mine*)

2.5 From the CODE to the BOOK of Life

The sequencing of the human genome in 2003 in America was referred to as, "…the most important, most wondrous map ever produced by human kind" by President Bill Clinton along with Bruce Alberts, president of the National Academy of Sciences saying that it is a, "tremendous foundation on which to build the science and medicine of the 21st century."[18] This book cost $3 billion and took 13 years to complete. Here again, the towering figure of James Watson from Cold Spring Harbor was instrumental in getting the U.S. government to grant the funds for the project based on the reasoning of how the mapping of the complete human genome will be the answer to incurable diseases like cancer and the way it will enable people to live long and healthy lives. The project initially started as a project of the Department of Energy (DOE) in 1985; "This idea was met with the approval of the scientific community and as a result, in 1988, the National Centre for Human Genome Research (NCHGR) was founded." (Brajušković, Pavićević, and Romac 2013, 1168) The National Institute of Health later added it to its program.

[18] *quoted in: Gannett, Lisa, "The Human Genome Project", The Stanford Encyclopedia of Philosophy (Fall 2010 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/fall2010/entries/human-genome/>.*

> …Congress appropriated funds to both NIH and DOE for human genome research for the fiscal year 1988; NIH received $17.2 million, almost 50% more than that of DOE. Wyngaarden created an NIH office in 1988 for Human Genome Research with James Watson as its head. In 1989, this office became the National Center for Human Genome Research (NCHGR).
>
> In 1997, NCHGR was promoted to National Human Genome Research Institute (NHGRI), and DOE created a Joint Genome Institute (JGI), which was composed of Lawrence Berkley, Lawrence Livermore, and Los Alamos National laboratories." (Choudhuri 2003, 364-365)

Ultimately, it became an international effort called "The International Human Genome Consortium" with participation from 18 countries in total including the European Union, the United States, Japan, China and Australia. The creation of the Information Society was instrumental in enabling the cross-national project of the sequencing of the human genome. The use of supercomputers was also of prime importance as massive facilities were created to sequence the genomes. In a way it can be argued that the early completion of the human genome sequence was a direct correlate to the exponential technical increase in the power of computing (Chow-White and García-Sancho 2012). Hallam (2011) writes that, "Since molecular biologists in the 1950s and 1960s understood DNA as a Book of Life, it followed that its writing must contain an origin story, an account of where we came from. Such an origin story could be reconstructed by examining differences between protein-coding sequences. Computers became a tool through which molecular evolutionists could highlight and demonstrate the objectivity and statistical precision of molecular methods in their battle against traditional morphological approaches to evolution." (265-66) The five part PBS documentary *DNA*, especially *Episode 3: The Human Race*[19] provides a great insight into the modality of how the project became the "Manhattan Project" (Lander 2011) of biology and pushed genomics into the league of big science. As mentioned earlier, the eugenics propagandist Robert Sinsheimer was the brainchild behind the idea of sequencing the human genome along with the Director of the Office of Health and Environmental Research (OHER) at the DOE in Washington, Charles De Lisi. GenBank, the DNA Sequence database was established by the DOE in 1983 in Los Alamos and it moved to the National Center for

[19] *PBS documentary on DNA. https://www.youtube.com/watch?v=MJu9dL7a3ZI*

Biotechnology Information in 1993. Sinsheimer held a meeting in 1985 with Walter Gilbert, George Church, Leroy Hood, Charles Cantor and David Botstein in Sana Cruz to check the feasibility of a human genome sequencing project. There was another meeting at Alta again. De Lisi convened a meeting again in 1986 at Santa Fe to look into the genome sequencing project (Choudhuri 2003, 363).

The rise of the human genome project also coincided with the growth of corporate science, especially in the field of biotechnology. (Thackray 1998; Hughes 2001; Rasmussen 2014; Springham, Moses, and Cape 1999) The promises of the eradication of diseases and the assurances of longevity proved to be a big business opportunity and consequently many of the pioneers in molecular biology went on to institute their own private companies either with the involvement of their home universities or with venture capitalists in what has been termed the "University-Industrial Complex" (Kenney 1988) wherein,

> Hundreds of embryonic biotechnology firms, created from venture capital, formed symbiotic relationships with major universities. These firms sought the newly trained graduate students and postdoctoral researchers to work on company projects. They also needed eminent scientists to serve on their advisory boards, providing the intellectual "capital" that was essential for attracting the venture capital, high-risk investments. (Krimsky 2004, 109)

Sheldon Krimsky further notes that, "in 2001, the journal Nature reported in an editorial that "one third of all the world's biotechnology companies were founded by faculty members at the University of California" (2004,111). This academic capitalism (Slaughter and Leslie 1997) gave birth to Genentech[20], one of the first biotech companies in the world founded by a professor from the University of California, Herbert Boyer and venture capitalist Robert Swanson[21] in 1976 (Russo 2003). "Genentech served as the model for start-up companies that could turn a profit either by selling their technologies to larger pharmaceutical companies or by trading their stock publicly." (Curnutte, n.d., 41) In October 1980 Genentech's initial stock offering jumped from $35 to $89 in a few minutes of trading without having sold any product (Facts On File 2008, 24). "To the

[20] *For a history see, "Genentech: The Beginnings of Biotech" (Hughes 2011)*

[21] *MIT News, "Robert Swanson, 52, alumnus who launched biotechnology industry." http://newsoffice.mit.edu/1999/swanson-1208*

investment and business communities, agog at what they were witnessing, the company confirmed that genetic engineering could build a business, attract major money, and promise lifesaving pharmaceuticals as well. *Genentech's spectacular success launched a period of speculative frenzy over biotechnology as a revolutionary approach for creating novel products, generating incalculable profits, and fashioning a new industrial sector*" (Hughes 2011, Prologue; *emphasis mine*). The most famous of the bio-capitalist turned out to be Craig Venter, who posited a direct challenge to the public funded project by competing against them directly in what came to be known as the "Genome War" (Shreeve 2007) to sequence the human genome first and use the patents generated from it to make profits and thereafter turn his sequencing company into a pharmacogenomics company for gene therapy; thereby generating even more revenues.

The privatization and corporatization of science and especially biotechnology had a big influence on how genomics came to be constructed (Rabinow 1996). The change in the nature of the welfare state and the coming together of the two forces of Reaganism and Thatcherism (Wright 1994; Montpetit, Rothmayr, and Varone 2006) defined the age of biotechnological research where universities were re-constructed as sites for the "production of knowledge" which could be "harnessed" for the "industry". In the case of the U.K., Wright (1994) writes, "An exception was a 1981 government White Paper on biotechnology, reflecting the "philosophy" of the Thatcher government, which argued that industry, not government, should be responsible for transforming genetic engineering into a commercially viable technology." (410) Therefore, the linkage between industry and universities became more pronounced during the reign of Reagan in the US as well (Kenney 1988). Reagan's science advisor George Keyworth II gave a big push to the intermixing of the universities and industry because he thought that universities were only working in silo and not contributing to the economic might of the nation as much as it could.

> During the 1980s, a series of federal and state policies established incentives for private companies to invest more heavily in university research, a move that provided opportunities for universities to benefit directly from the discoveries of their faculty. The two basic approaches-namely university-industry partnerships and patenting-are encapsulated by the phrase "technology transfer'' and "intellectual property rights of basic research." (Krimsky 2004, 30)

The market became a player in deciding what kind of knowledge would be created and toward which ends. The science of life became a great source of business because of its centrality to an individualized consumer (Venkatesan and Peters 2010; Tutton 2014). The union of private companies with scientific knowledge making also produced the question of ownership of such knowledge. Research was conducted with a view to make profits and profits required the notion of ownership of property rights for the company. Thus Intellectual Property Rights came into the domain of the race for finding and patenting biological knowledge. The first cases of patenting 'life' was brought by General Electric, whose researcher Ananda Chakrabarty filed a case for patenting an oil eating genetically modified bacterium in 1980. The US Supreme Court ruled 5-4 on giving a patent to GE, which became the first patent on a living organism. This opened the floodgates of patent for modified 'life' in all forms,

> Plants, seeds, and plant tissue cultures became patentable in October 1985, when Molecular Genetics, Inc., obtained a patent on a type of genetically engineered corn. A year and a half later, in April 1987, the PTO ruled that genetically engineered animals (except humans), as well as human genes, cells, and organs, could also be patented. The first genetically engineered animal to be patented was the Harvard Oncomouse, a type of mouse designed to be a test animal in cancer research, which was patented in April 1988 by Harvard University. The PTO received 1,502 patent applications for transgenic animals in the decade that followed and approved more than 90. Most were genetically altered mice intended for medical research, but the list ranged from worms to sheep. Since 1998, the PTO has approved about 7,000 biotechnology-related patents each year, and more than 400 genetically altered animals have been patented. (Facts On File 2008, 24-25)

The patent rights held over the genes linked with causing breast cancer i.e. BRCA1 and BRCA2 by Myraid Genetics has also caused considerable debate and litigation (Kevles 2011). This was a contestation over the rights to patent individual genes and other related information that might be useful for the companies. (McAfee 2003) This became manifest in the fight for the completion of the human genome sequencing between the Public Consortium on the one hand and Celera Genomics led by the upstart Craig Venter on the other. Venter has left National Human Genome Research Institute (NHGRI) and founded The Institute for Genomic Research (TIGR) and succeeded in sequencing the whole genome of a bacterium "*Haemophilus influenza…* consisting of 1,749 genes" in less than six months (Brajušković, Pavićević, and Romac 2013, 1168). Venter had rebelled against the public consortia and created a company called Celera Genomics in

1988 with venture capitalist funding to sequence the human genome and patent it. This act went directly against the public science and open access framework of the international collaboration. There were a series of media reports that focused on the fight between them. Craig's company used the open information uploaded on the world wide web by his competitors to complete his own draft of the genome. The competition was very high profile and severely contested wherein the other party had to constantly legitimate the public spending of so many resources for the sequencing of the genome. Craig's effort also used a different technology for sequencing called the "shot-gun"[22] method. In the end the manufacturer of the sequencing machine was selling the machine to both Celera Genomics and the International Consortium. The pace of the sequencing was a directly correlate to the sequencing machines that were available to the scientists.[23] Using the computational powers of the sequencing machines both the Human Genome Project Consortium (HUGO) and Celera Genomics announced along with President Bill Clinton on June 26, 2000 that the human genome was 90% complete,

> …yet, only 28 per cent of that 90 per cent sequence had reached a finished form, and it contained about 150,000 gaps… they were both missing some 10 per cent of the so-called euchromatin – the portion of the genome representing the major genes – and some 30 per cent of the genome as a whole (which includes the gene-poor regions of heterochromatin)."
>
> The final sequence, containing 99 per cent of the gene-containing sequence and fewer than 400 defined gaps, was published in April 2003, marking the fiftieth anniversary of Watson and Crick's publication of the double-helical structure of DNA. (Rouvroy 2007)

It is interesting to note that as two parties were involved in the sequencing of the genome, ultimately, their results were not similar. Further, according to Eric Lander there are still

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[22] *Shotgun sequencing breaks the genome into many fragments and scientists sequence each fragment from both ends. For this method, scientists use fluorescent chemical labels that attach to the DNA to determine the sequence, which is called the chain termination method. Scientists sequence the several random fragmentations of the genome, producing some overlap between the ends of fragments. Then, a computer assembles the sequenced pieces into one genome by matching up overlapping fragment sequences. Shortly after the initial development of this sequencing method, the whole-genome shotgun sequencing method became applicable to larger genomes, even those as large as the human genome. In 1996, Venter and his colleagues published a paper arguing that the advances made in shotgun sequencing made it feasible to apply the method to the human genome. They predicted they could complete the project before 2005 under a cost of three billion dollars. (Carvalho and Zhu, n.d.)*

[23] *See PBD documentary on DNA, "Episode 3: The Human Race." https://www.youtube.com/watch?v=MJu9dL7a3ZI*

around 300 genes that have not been sequenced yet.[24] This puts into question the actual creation of the "book" of life (Pertea and Salzberg 2010). In a significant footnote, Kathleen McAfee (2003) notes that,

> The publicly funded Human Genome Project and the private company, Celera, jointly announced the sequencing, albeit incomplete, of the human genome. The two enterprises concurred that the number of human ''genes'' is only 30,000 or so, comprising just over 1% of our DNA. However, of the approximately 30,000 ''genes'' identified by each of the two projects, only about 15,000 were the same on each list. (2003,207)

Further, in another footnote Rouvroy (2007) writes,

> The exact number of human genes is still controversial however: the publicly funded HGP and the private United States firm, Celera Genomics, who produced the two first draft sequences of human genome, put the number of human genes at around 35,000. Studies since the completion of the Human Genome Project have generated widely different estimates. A third team, based at Ohio State University, Columbus, has reanalysed the raw data, using a supercomputer, and came up with a higher estimate for the number of human genes (66,000 to 75,000). The reason for so much uncertainty is that predictions of the number of human genes are derived from different computational methods and gene-finding programs, some tending to overestimate gene numbers by counting as a gene any DNA segment that looks like a gene, other methods underestimate the number of genes by identifying as genes only those portions of DNA that are similar to what scientists have previously identified as genes. (2007,32)

This leads us to the notion of the 'constructivist' (Knorr-Cetina 1981; Cetina 2009) view of the human genome which is explained by Lily E. Kay, who writes,

> The constructivist view, on the other hand, would assign the agency of this molecular writing to scientists themselves. This position would not necessarily deny that objects exist external to thought; it would not negate the existence of genes or the correlation between codons and amino acids. But it would deny the objectivist claim that these entities and phenomenon present themselves to practitioners as transparent reading, unmediated by scientists' own modes of representation: theoretical, material, discursive and social. According to the constructivist view, rather than simply deciphering the DNA language, or reading a preexisting genomic text, researchers were actively producing the representation of genomic phenomena as *writing*: they were *constructing* imageries of the text, its messages, letters and words. According to the constructivist view, then, it is molecular biologists who wrote the Book of Life. (2000, xvii; *emphasis in original*)

Kay's point is exemplified, for example, when we look at the way Craig Venter's research bent has been aligned with his worldview and his priorities in life, his likes and dislikes and the way he wants to create the world for himself; which has been described

[24] *Cell Press Lecture at AIIMS, New Delhi on 23rd Feb 2015.*

in his book *A life decoded: My genome: My life* (2008). Zwart notes that, "In separate boxes dedicated to his sequenced genome, he especially focuses on genes that are associated with behavioral characteristics such as thrill-seeking behavior, ADHD and the ability to cope with almost superhuman amounts of stress. Thus, in Venter's case, autobiography and the human genome are interconnected in more than one way." (2008,366). Thomas Lemke also acknowledges this constructivist notion of the human genome and terms this notion as the *consensus genome* (2004, 553-54), in which a 'uniform genetic standard' is manufactured by compiling genetic information from various persons and then creating a standard which is not identical with those of any single person.

> The human being' in the human genome project is, in other words, a canonical sequence compiled from many individuals. This certainly does not mean that in the case of this artificial human we are dealing with was a 'democratic' representation of individuals or a general statistical median of the population. *Instead, the human in the 'human genome' is a very special person 'who will possess both an x and a y chromosome. It will therefore be a man. This 'he' will be an average collection in terms of his chromosomes, of sequences (ie the chemical structures found in his genomes) which occur in men and women of different nations, the United States, Europe, and Japan. In other words, he will be an average male from the industrialized nations, who together are internationally researching the genome.* (Feyerabend 1997,32;*emphasis added*)

In her book *Human genes and neoliberal governance: A Foucauldian critique,* Antoinette Rouvroy (2007) further adds that,

> The human genome as it is described in the published reference sequences does not exist as a unique genome common to all human beings. No one actually possesses a genome identical to that described by the Human Genome Project. At best, the genome sequences published by the HGP and Celera are conventional templates. The human genome reference sequences are composite maps based on chromosomal segments originating from a few different individuals. In fact it seems that the majority of the DNA used to compile the HGP and Celera reference sequences originated from just two men: 74.3 per cent of the HGP sequence is derived from one male individual, presumably from the Buffalo area, while 71 per cent of the Celera sequence has been compiled from the genome of one single individual, selected among five donors, two males and three females – one African-American, one Asian-Chinese, one Hispanic-Mexican, and two Caucasians, DNA from the four other donors being used to fill in the gaps. (2007,96)

Kay highlights the way in which, "Many physical, biological and social phenomena were reinscribed within the system of metaphors, models, analogies, and semiotics, derived from information theory and cybernetics." (2000, 19) She writes that, "The observation

that language and metaphors shape our temporal relations to the natural and social world is, by now, a truism. Some scholars go so far as to assert that because metaphor so pervades everyday life – not just in language but in thought and action – "our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature." (2000,21-22) Nerlich and Hellsten (2004) also point to the way in which metaphors have constantly changed and their usage became what can only be defined as a trope of genetics. They studied the changes in the metaphorical framing of the human genome project between 2000 and 2003. Here is an email conversation they mention in the article,

> *Iina: October, 24, 2003*
>
> In Nature there were some pretty nice, 'new' metaphors as well: genome salad, for instance.
>
> *Brigitte: What's a genome salad?*
>
> *Iina:*
>
> That's used in the context of Lander criticizing Celera's work of having 119,000 scaffolds instead of the predicted 5,000: "The majority of Celera's scaffolds are very small, claims Lander, and represent a "tossed genome salad" " (Nature, 409, pp. 747–8, 2001). Nice metaphor, he´?
>
> *Brigitte:*
>
> now, what's a scaffold!?
>
> *Iina:*
>
> To my knowledge that refers to the gaps in the genome, that come about when using the 'shotgun' method. BTW, I did not take 'shot- gun' as a metaphor…perhaps I should.;-D
>
> *Brigitte:*
>
> I suppose it depends on who reads about it in what context…
>
> *Iina:*
>
> …now a shotgun seems to be used for making a genome salad …;-D (2004,255-56)

Francis Crick has used the metaphoric effort brilliantly to sell the idea of the gene to the scientific community, the political machinery and the public at large. His central dogma of biology has by now become defunct. He is also the person who came up with nonsense

in the DNA jargon. The usage of noise as a tool to understand the way genes function can also be attributed to him. Codes without commas is also an invention by him. Geneticists have been trying to find the structure in the double helix, the code in the As, Ts, Cs and Gs, the alphabet in the way DNA codes to specific amino acids and now the book in the way that all these codes are sequenced for the complete human genome (Sarkar 1996a; Sarkar 1996b; Smith 2000; Griffiths 2001). As Paul Berg (2015) points out 96% percent of the DNA was considered junk DNA but it seems to have a big influence on the way the genes function. Also, as Richard Lewontin (2001) argues, the triple helix of the DNA is 'gene, organism and environment' and not only a simplistic bonding of two strands of chemical molecules. Roof also asserts the way in which the metaphoric trope has been used, she writes, "…this hyperbolized notion of DNA, as it has become inevitably confused or conflated with our notion of the "gene," has become the vector through which older ways of thinking can merge with the new, through which newer, more threatening ideas can emerge masked by the old, and through which older, more conservative ideas can survive. DNA transmits more than genetic information or life codes. It is more than an evolutionary record of the development of life on earth. In the twenty-first century it has become the symbolic repository of epistemological, ideological, and conceptual change." Nelkin and Lindee (1995) also point to the DNA myth in their book *The DNA Mystique: The gene as a cultural icon.*

Computers and information technology were central to sequencing the human genome and the way algorithms were created, the objectivity and precision of molecular methods came about due to the automation of sequence comparison and tree-building algorithms that provided exact "quantitative measure of difference" (Stevens 2011, 270).

> Code-talk was productive for two reasons. First, on a linguistic level, when DNA became information, it became susceptible to information processing machines; the coding of life could be imagined to be like "coding" software or programming a computer. Second — on a more practical level—for biologists who wished to emphasize the centrality and importance of strings of letters to biology, computers offered ready-made tools for rapid symbol manipulation. (2011,267)

Text processing had been introduced by the French researchers Jean Pierre Dumas and Jacques Ninio Dumas in a paper written in 1982.[25] In 1982 again, Roger Staden created an algorithm for sequence assembly, "Staden's algorithm employed the same strategy as 'hash-coding', a technique lifted directly from word-processing software, which allowed the user to locate a sequence of common letters in a mass of text. So, for example, a search for *pupp** would turn up both *puppy* and *puppet.* Clearly then, Staden saw the DNA sequence as a text…Managing texts was a key problem for those involved in the emergent computer industry. By borrowing a tool from word processing software, Staden began to break down the barriers between information society and biotechnology." (García-Sancho 2007, 20; Roger Staden 1982; Rodger Staden 1996) There was also a time in the 1960s before Matthaei and Nirenberg cracked the code along with others when a lot of informational theoretical work was done to crack the code by practically thinking through it (Sarkar 1996, 858-59). With the introduction of computers in molecular biology it became possible to use software to sequence genes as codes. Bioinformatics became a core discipline in biology as biology became increasingly informational (Trifonov 2000; Fujimura 1999).

> Itwasknownthattheywerealittleacquaintedbutnotasyllableofrealinformationcouldemmapro cureastowhathetrulywas…" Reduce it to just a sequence of letters, and even a delicate phrase from Jane Austen's Emma becomes virtually impenetrable gobbledygook. So it was something of a triumph for Simon Shepherd when, in 2001, an algorithm he had written reconstructed all of Emma, word for separated word, from just such an uninterrupted string, despite being unacquainted with English vocabulary or syntax. The software worked out which groupings of letters were most likely to appear together, and thus have distinct meanings." (Pearson 2006)

In the end it was computer scientists, Gene Myers from Celera along James Kent and David Haussler from the public consortium who compiled the 'book' of the human genome project (Kent and Haussler 2001). The path of James Kent exemplifies the intermixing of biology with information technology, Kristen Philipkoski mentions: "Before entering the PhD program at Santa Cruz, Kent worked for more than a decade as a programmer. But when the Microsoft Windows 95 developer CD came on no fewer

[25] *Dumas, Jean-Pierre, and Jacques Ninio. "Efficient algorithms for folding and comparing nucleic acid sequences." Nucleic Acids Research 10, no. 1 (1982): 197-206.*

than 12 CD-ROMS, he decided to go back to school to get a degree in biology."[26] In an article, staff reporter Nicholas Wade writes in the *New York Times*[27],

> In four hectic weeks last spring, Mr. Kent wrote a computer program that the consortium's leaders hadn't realized how much they needed, one that assembles the 400,000 fragments of DNA they had decoded into a coherent sequence. Using 100 computers that his senior colleague, Dr. David Haussler, had persuaded the university to buy for the purpose, Mr. Kent performed his first assembly on the human genome on June 22, just four days before Dr. Francis S. Collins, the consortium's informal leader, and Dr. J. Craig Venter of Celera, announced at the White House on June 26 that each had assembled the human genome…"Without Jim Kent, the assembly of the genome into the golden path wouldn't have happened," said Dr. Collins, referring to the nickname for the GigAssembler, as the program is known.

The fight between Collins' and Venter's camp continued regarding the validity of sequencing technologies used for sequencing the draft of the human genome (Waterston, Lander, and Sulston 2002; Myers et al. 2002).

Manuel Castells outlines the coming into being of the information society with the rise of the network society where information takes on paramount importance and seeps into the cultural, political, economic imagination; this includes genetic technologies as well. In this age power operates through the "space of flows" i.e., "material organization of time-sharing social practices that work through flows, purposeful, repetitive, programmable sequences of exchange and interaction between physically disjointed positions held by actors." (García-Sancho 2007, 18; *quoted text*) Thus, biology has become an information science supported by the vast network of computers located in different research institutes and the world wide web; in which, "information generation, processing and transmission" has become "the fundamental sources of productivity and power" (Castells 1996). Genomics is firmly embedded in this knowledge economy wherein private enterprises are in a new race to create a form of biological citizenship that is linked to how and in what area research is conducted to gain maximum return on investments (N. Rose and Novas 2004; Hughes 2001).

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[26] *Wired.com, "Kent: The Genome Superman." http://archive.wired.com/medtech/health/news/2001/08/46154*

[27] *The New York Times, "READING THE BOOK OF LIFE; Grad Student Becomes Gene Effort's Unlikely Hero." http://www.nytimes.com/2001/02/13/science/reading-the-book-of-life-grad-student-becomes-gene-effort-s-unlikely-hero.html?pagewanted=1*

Besides the code-workers that created the coding and software required to generate the human genome, the DNA sequencing machines were instrumental in the success of the whole exercise and ultimately were a major portion of the cost of the project. The progress of the project was directly related to the growth in the sequencing power of the machines (Chial 2008). Applied Biosystems commercialized the first automated DNA sequencer Model 370A in 1986, they were also the same company that launched ABI PRISM 3700 DNA Analyzer in 1998 that enabled the completion of the human genome project two years earlier than scheduled.[28] The race is on now amongst companies for sequencing technologies that can deliver whole human genome sequencing for less than $1000 and thereby make it accessible to the personal consumer market (Pettersson, Lundeberg, and Ahmadian 2009; Bentley 2006).

Fred Sanger developed DNA sequencing in 1977 for which he received the Nobel Prize in Chemistry in 1980; he had received a previous Nobel in Chemistry in 1958. "Francis Crick, Sydney Brenner and other Cavendish scientists saw Sanger's techniques as especially suitable for their investigations on protein synthesis or, as they also called it, the problem of the genetic code: how DNA specifies the structure of proteins. They approached Sanger in the late 1950s and persuaded him to move to a new center, the Laboratory of Molecular Biology (LMB), which was being specifically built to combine the Cavendish biological group with other researchers investigating related problems. After the move, Sanger began applying his techniques to RNA (1960s) and then to DNA (1970s) (García-Sancho 2010, 288). The Sanger Method[29] refined with the PCR technique helped to create the framework in which the book of the human genome code could be elucidated (de Chadarevian 1999; De Chadarevian 2002; García-Sancho 2012). This was prepared by Leroy Hood at Caltech who found a way to computerize and automate the procedure for reading DNA sequences. This also shows the "bi-directionality" in which genetics and information science co-evolved to give rise to

[28] *Lifetechnologies.com. "A history of innovation in genetic analysis." http://tools.lifetechnologies.com/content/sfs/posters/ABI6247_SOLiD_Timeline_v4_ONLINE.pdf*

[29] *DNA Learning Center, "Early DNA sequencing." http://www.dnalc.org/resources/animations/sangerseq.html Also see, yourgenome.org, "Where did DNA sequencing begin?" http://www.yourgenome.org/facts/where-did-dna-sequencing-begin*

genomics based on databasing of genetic information as shown by Chow-White and García-Sancho (2012).

Polymerase Chain Reaction (PCR)[30] was a key technology created by Cetus Corporation in 1983 that enabled the sequencing revolution to proceed, for which Kary B. Mullis received the Nobel Prize in Chemistry in 1993. Without the development of the PCR technique, the genomics revolution would not have been possible. It also highlights the beginning of the privatization of biotechnology and the scientific-entrepreneurs that emerged from this interaction (Rabinow and Dan-Cohen 2013). The technology enabled the amplification of DNA thereby producing multiple copies of small amounts of DNA (Pray 2008). It allows scientists to produce millions of copies of the same DNA segment precisely and accurately thereby making plentiful what once was a very scarce material.

> Not only is this material abundant, it is no longer embedded in a living system. Cloning had made scarce genetic material abundant, but its obligatory use of living organisms as the medium of reproduction was also its limitation; PCR took a major step away from that dependency. The step constituted a capital advance in the efficiency and, more important, flexibility of genetic intervention. PCR's versatility has been astounding; scientists have produced new contexts and new uses with stunning regularity. These uses have opened new avenues of research, which have in turn proved amenable to new uses of PCR. (Rabinow 1996, 1)

Besides, as Rabinow mentions, the development of PCR once again elucidates the intense competition and rivalry amongst scientists for fame and fortune with the next frontier of the 'life' sciences being the manipulation and editing of the human genome along with the production of bio-materials. Biotechnology has given way to bioengineering and biodesign. However, the concept of the 'gene' has been problematized by scientists themselves when they realized that the gene is not an code of life nor can it write a book, the idea of genetic determinism is not grounded on cutting edge scientific research as it has moved to complex theories of the interaction of genes with environmental and other factors towards an approach of 'systems biology'(García-Sancho 2006). Having said that, the contour of the 'gene' as a techno-political tool has taken a different shape based on the power of the gene to 'predict' an 'origin'. It is still taken to be a vessel of information and an imprint of the past in a singular living object.

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[30] *DNA Learning Center, "Polymerase Chain Reaction." http://www.dnalc.org/resources/animations/pcr.html*

> Genes are perceived at the same time as DNA sequences and determinants of phenotypic traits because scientists believed—and to a large extent still believe—that the old objective of genetics—deducing how genes work— could be directly achieved by the new sequencing techniques, connected to the power of computers. The excessively slow fulfillment of this expectation after the conclusion of the HGP has led biomedical researchers to establish more sophisticated ways of linking genotype and phenotype. Nonetheless, the hope still exists that finding a connection between sequences and gene function is just a matter of time, effort, and money. (García-Sancho 2015)

It looks like there is a deep commitment to the expenditure of 'time, effort and money' in genetic technologies linked to the ever greater data crunching capabilities of modern computers to generate big data that will provide a clue to the link between certain diseases. Also, the encapsulation of information networks with genomics has led to DNA sequencing of populations and loading them in databases. To interrogate this modality, let us now turn to the position that the gene has come to occupy in our socio-political reality.

Gene(o)politics

> The disciplines of the body and the regulations of the population constituted the two poles around which the organization of power over life was deployed. (Foucault 1984, 262)

3.0. Introduction

In this chapter, I would like to sketch and link the entry of the gene into the politics of life itself using a "sociological imagination" (C. W. Mills 1959) which encompasses the entwining of the "*anatomo-politics of the human body*" with those of the "*regulatory controls: a bio-politics of the population"*(Foucault 1984, 262; *original emphasis).*

> Life is not only the object of politics and external to political decision-making, it affects the core of politics – the political subject. Bio-politics is not the expression of a sovereign will, but aims at the administration and regulation of life processes on the level of populations. It focuses on living beings rather than on legal subjects – or, to be more precise, it deals with legal subjects that are at the same time living beings. (Lemke 2010,429)

When Sir Alec Jeffreys, a professor of biochemistry and genetics, discovered genetic fingerprinting in 1984 at the University of Leichester in the United Kingdom, the potential uses of this technology were immediately visible. These included the domains of, "crime, paternity and identical twins, as well as work on conservation and diversity among non-human species." Later, Jeffreys' wife added another to the list – immigration. This highlighted more directly the "political dimension" of this technology. He realized that, "it could change the face of immigration disputes, especially where no documentary evidence existed."[31] Hence, it came to be that the first case in which DNA was used for identification was in a paternity dispute in 1985 involving the question of whether a young boy was indeed the biological progeny of a British-Ghanian woman. The result of the test conclusively matched the DNA of the son to that of the woman and it was a

[31] *"The history of genetic fingerprinting" is outlined at the University of Leicester's Department of Genetics webpage. Jeffreys has worked here since 1977. See http://www2.le.ac.uk/departments/genetics/jeffreys/history-gf [Accessed June 18, 2015]*

happy resolution.[32] In this chapter I will elaborate on how the unique ability of deoxyribonucleic acid to conclusively pinpoint and identify a particular human being as the ***owner*** of a certain biological sample, makes it tremendously powerful.

In addition to the issue of ownership, I will spotlight the scene that emerges when DNA is viewed as a unique ***repository of information***. This information, when deciphered using cutting edge scientific tools, can reveal the underlying causes of many of our most basic characteristics (although there are lots of contestations over these 'truth claims'). What cannot be disputed however, is that this DNA reveals many of our hereditary characteristics and, although we do not yet comprehend all its myriad functionalities, still, the ability of the molecule to explain why there are certain rare and heritable diseases is beyond doubt. Not only this, the new genetic imaginary foresees itself as a tool in which genetic information can be manipulated to effectively change the trajectory of life. Herbet Gottweis notes that,

> On the most fundamental level, genomics and post-genomics seem to offer an image of humankind and with it a new techno-scientific imagery, which represents humans as determined by their genes and, at the same time, portrays human genes as objects of technological manipulation and transformation. Even if only a few maverick scientists speculate about the point when genomics scientists will be able to build 'organisms from the scratch', it is precisely such speculations which are gladly taken up by the mass media and disseminated to a broad public. (2005,182)

This "technological manipulation and transformation" by a "few maverick scientists" that Gottweis wrote about in 2005 has in 2015 become a force now in which genetically modified humans have been experimented with, especially in China (although it is highly probable that covertly, many countries have done it already). The news of Chinese scientists having modified the DNA of human embryos to has led to a hailstorm of debate in the Western media. Eric Lander (2015), the force behind the HGP, has cautioned against meddling with human embryos in a recent op-ed. He writes,

> For my own part, I see much wisdom in such a position, at least for the foreseeable future. A ban could always be reversed if we become technically proficient, scientifically knowledgeable, and morally wise enough and if we can make a compelling case. But

[32] *"Sarbah vs. Home Office, Ghana Immigration Case, 1985". See http://dnafingerprinting19.tripod.com/id14.html [Accessed June 18, 2015].*

> authorizing scientists to make permanent changes to the DNA of our species is a decision that should require broad societal understanding and consent.
>
> It has been only about a decade since we first read the human genome. We should exercise great caution before we begin to rewrite it. (2015,4)

Clearly, this opinion comes informed with a knowledge of the destructiveness that can be unleashed if bio-engineering of life is not regulated effectively. What this could mean for the future is a question I will not explore here.

What further complicates the matter and adds to a sense of foreboding is politics at the global level and the race for supremacy. The Chinese would be unwilling to heed the advice from the United States regarding a program that is so enmeshed in global hegemony, where the lead in scientific technologies is considered to be a tremendous military and strategic advantage amongst these two global players. Thus the understanding of the social impact of genetic technology and its implications for law and governance cannot be divorced from an understanding of the global political *resistance* to such an understanding.

Thus, as exciting as the current developments in genetic technologies may present themselves to be, the focus of this chapter in particular, and my dissertation overall, will be to look at two nodes through which we can dissect and examine the bio-political angle of the 'truth regime' of genetics. I have chosen a) crime and b) health as the two areas of in-depth investigation. The idea of specifically choosing these two fields is derived from an understanding informed by a study of Nazi Germany. The Nazi Genocide occurred at a time when the greatest possible attention was being given to ensuring the health of the German people. For the sake of health, the social body was being 'cleansed' of the disease of the unwanted population i.e. the Jews, gypsies, mentally ill and people with sexually 'deviant' behaviors (See Kühl 2002; Ordover 2003). "We should not forget that 1939 – the year that Hitler wrote his secret memo permitting certain doctors to grant 'mercy death' to patients whose lives were deemed not worth living – was also the year that his government designated as the year of 'duty to be healthy" (Rose 2001,17; Proctor 1988). Here, Rabinow and Rose note while referring to a book by Robert Proctor called *The Nazi War on Cancer* (1999),

> Biopower, in the form it took under National Socialism, was a complex mix of the politics of life and the politics of death—as Robert Proctor (1999) points out, Nazi doctors and health activists waged war on tobacco, sought to curb exposure to asbestos, worried about the over-use of medication and X-rays, stressed the importance of a diet free of petrochemical dyes and preservatives, campaigned for whole-grain bread and foods high in vitamins and fibre, and many were vegetarians. But, within this complex, the path to the death camps was dependent upon a host of other historical, moral, political and technical conditions. Holocaust is neither exemplary of thanatopolitics, nor the hidden dark truth of biopower. (2006,201)

This historical instance exemplifies the fact that health and crime are not mutually exclusive categories but are enmeshed in a political technology of governance/government. What Foucault (1984) terms the, "Right of Death and Power over Life." Nikolas Rose in his article *The politics of life itself* writes,

> Bio-politics was inextricably bound up with the rise of the life sciences, the human sciences, clinical medicine. It has given birth to techniques, technologies, experts and apparatuses for the care and administration of the life of each and all, from town planning to health services. And it has given a kind of 'vitalist' character to the existence of individuals as political subjects.(2001,1)

The "technê" (Heidegger, 1954) of the gene enables us to trace the cartography of how, on the one hand, the health of the population and the individual is a biopolitical act, and on the other hand, how keeping society safe from criminals is a necessity for the social body. Both the two nodes of health and crime are related to the notion of hygiene. Here, the notion of risk presents itself wherein the management of risk becomes the prime purpose of the art of government of the population and the security of the state; it's *raison d'etat*. For this reason, I am focusing on crime and health as the loci to interrogate the bio-political angle of the gene. Both present themselves as possible points of intervention and contestation in the body politic. The art of government is based on the notion of the management of the household, and any good patriarch will invest his attention in calculating the risks that are there in order to intervene appropriately for his own benefit. As noted by Ulrich Beck, we have entered the age of late modernity, where, in the words of Marx: 'all that was solid has melted into thin air'. This 'liquid modernity'(Bauman 2000), according to Beck is a period where life is lived based on the calculation of risk, what he calls living in a 'risk society'(Beck 1992). Noting this point, Rose writes that,

> …it consists in a variety of strategies that try to identify, treat, manage or administer those individuals, groups or localities where risk is seen to be high. The binary distinctions of normal and pathological, which were central to earlier bio-political analyses, are now organized within these strategies for the government of risk. Such strategies are organized at a number of levels. There are actuarial and epidemiological strategies that seek to reduce aggregate levels of risk across a population. There are strategies for the management of high-risk groups. And, increasingly, there are strategies based on identification of, and preventive intervention for, risky individuals. (2001, 7)

Using the theoretical grounding of the 'analytics of government'(Lemke 2010b) let us now trace how the gene has entered our social spaces carried by the 'genetic imaginary' (Gerlach 2004); on the one hand crime, and on the other hand, health; both of which are linked to *Security, Territory, Population* (Foucault 2009).

Biological Citizenship, Risk and the Politics of Health in neo-liberal times

National populace as genomic capital

The commodification of genetic information was the driving force behind the entry of the pharmaceutical and drug companies into the biotech boom. The emergence of companies associated with the creation of personalized medicine via genetics was premised on the economization of life. It was based on the calculation that the technological solutions to diseases via the genomics revolution will directly have a profitability component attached to it. This was also the conceptual rubric of what Rose and Novacs (2004) termed as 'biological citizenship' wherein civil society in the form of lobbies for particular genetic diseases interacted directly with government and the corporate drug companies to push for the production of solutions to their disease problems, most of which are rare and hereditary. This phenomenon has also been termed as 'genetic citizenship' (Heath, Rapp, and Taussig 2008). The commodification of genetic information to produce profit by creating novel treatment plans for the consumers required the consolidation of population wide data as only individual propensities could not provide a good estimate of the risks involved. This is in line with the argument made by the sociologist Ulrich Beck (1992) that we live in a 'risk society' where our lives are based on probabilities. The risk for, let us say, Alzheimer's or breast cancer was weighed against the cumulative risk associated with the population *and* the risk that one was the carrier of. Thus, it became important to compile data of disease patterns from the population and then match it with those of the

individuals. This is called population genetics, which the Stanford Encyclopedia of Philosophy defines as, "a field of biology that studies the genetic composition of biological populations, and the changes in genetic composition that result from the operation of various factors, including natural selection. Population geneticists pursue their goals by developing abstract mathematical models of gene frequency dynamics, trying to extract conclusions from those models about the likely patterns of genetic variation in actual populations, and testing the conclusions against empirical data" (Okasha 2012). Here, the partnership of biology and computers took place again in the form of bioinformatics wherein large chunks of genomic data are studied for insight into disease patterns. The key hope of the human genome project was the cure for cancers which did not materialize. However, with the promise of personalized medicine a big effort was conceived where genome wide association studies (GWAS) will be conducted to find evidence of the epigenetic causes of certain diseases and their possible cures. There are certain populations which are a goldmine for these kinds of studies; amongst them are the Askenazi Jews with their propensity to inherit Tay-Sachs disease (Carmeli 2004; Ostrer and Skorecki 2013). The Mormons in America have also been a community that is studied in detail because of the data available as they keep all data related to the health of their members in a repository which is digitized. Myraid Genomics, founded by a University of Utah scientist patented the rights to BRCA1/BRCA2 genes associated with breast cancer (Gillham 2011, 9-10). The population of the Canadian province of Quebec is also a prime target due to the unique hereditary profiles they possess because of relative isolation since the colonization of the province by French settlers (2011,72-73). The next phase of the genetics revolution has involved the gathering of massive patient data both by public and private firms for research purposes. One prime example of this push is the country of Iceland. In 1998 it went into an agreement with the company deCode (which had a tie-up with the pharmaceutical company Hoffman-La Roche) to provide data of its citizens for research purposes. Iceland is a prime country for population wide genetic analytics because i) it is a fairly small country with a uniquely homogenous population where ancestry tracing is maintained very conscientiously and ii) because of the detailed medical history records available of its citizens.

> Genealogy is a passion in Iceland and local newspaper obituaries give detailed family trees that can extend back a hundred years or more. Furthermore, comprehensive clinical records of Iceland's public health service go back as far as 1915. Stefansson recognized that a computerized database of this information for the entire Icelandic population would be an invaluable tool for tracking down genetic diseases. Even more important, Stefansson knew that an exclusive agreement between his company and the government of Iceland would be an integral part of any business plan. This would give deCODE a major advantage over potential competitors. (Gillham 2011, 13-14)

The schema of this contract was that deCode might be able to garner unique information from this project with Iceland thereby leading to the mutually beneficial consequence of both parties gaining; the one health and the other profit. However, it went into rough waters as questions of ethics and the commercialization of genetic information was questioned by several parties. Ultimately, deCODE filed for bankruptcy in the United States and was bought over by another company (See Fortun 2008). However, the question of who owns the genetic information of the people of Iceland and for what purposes it can/cannot be used in the future has never been qualified and answered satisfactorily. The logic of the market will dictate how the information will be used by the corporate to generate profit for its shareholders as the *information* is bought over by one merger or takeover or bankruptcy after another (Gillham 2011, 13-19). Another similar project that is being conducted is in Estonia (see Swede, Stone, and Norwood 2007). It also has a fairly unique and closed-in population with detailed medical records. Similar problems related to the ownership of genetic information and its uses have cropped up in Estonia too with the added baggage of being a former country in the Soviet Union. The sight is now on India and China to be the site for these kinds of population wide genetic studies (See Gottweis 2009; Sleeboom-Faulkner 2011; Liu and Hu 2014). China is already conducting many studies of these sorts on their own population (Xu et al. 2009; Sun et al. 2010). Similar is the case with India, which will be discussed in a later chapter. As Mitchell and Waldby note, "population biobanks are thus technologies that mediate between genetic information, biological samples, and patient experience on one hand, and between nation-states, populations, and "big science" on the other." (2015,333)

Generating profit from participatory genomics

Besides the role of national governments, many multinational projects have been initiated that collects the genetic profiles of individuals in a database for research purposes with

the vision of collating important pieces of information that might be relevant for medical treatments, especially in cases of various cancers and mental diseases like schizophrenia. *The Global Alliance for Genomics and Health* is an NGO made up of over 300 institutions across "healthcare, research, disease advocacy, life science, and information technology"[33] that seeks to create a global network for enabling partnerships between various actors in genomics. The genetic explanation of life is manifested in the creation of the Hap Map project that collects data from varied people in order to help researchers. The website of the project mentions that,

> The HapMap is a catalog of common genetic variants that occur in human beings. It describes what these variants are, where they occur in our DNA, and how they are distributed among people within populations and among populations in different parts of the world. The International HapMap Project is not using the information in the HapMap to establish connections between particular genetic variants and diseases. Rather, the Project is designed to provide information that other researchers can use to link genetic variants to the risk for specific illnesses, which will lead to new methods of preventing, diagnosing, and treating disease.
>
> Once the information on tag SNPs from the HapMap is available, researchers will be able to use them to locate genes involved in medically important traits. Consider the researcher trying to find genetic variants associated with high blood pressure. Instead of determining the identity of all SNPs in a person's DNA, the researcher would genotype a much smaller number of tag SNPs to determine the collection of haplotypes present in each subject. The researcher could focus on specific candidate genes that may be associated with a disease, or even look across the entire genome to find chromosomal regions that may be associated with a disease. If people with high blood pressure tend to share a particular haplotype, variants contributing to the disease might be somewhere within or near that haplotype. (International HapMap Project, n.d.)

Google has also entered the market in 2014 with its Google Genomics project that is based on crowd networking and the availability of genetic information for research purposes to researchers.[34] The 1000 Genomes Project attempts to sequence the profiles of that many individuals across the world along different ethnic lines to be able to provide glimpses into diseases inherited by particular populations.[35] There is a pan-African genomic project called *The African Genome Variation Project* under way with similar intentions (Gurdasani et al. 2015). Recently, the trend has been the creation of online companies that look for volunteers to give away their genetic information so that they can

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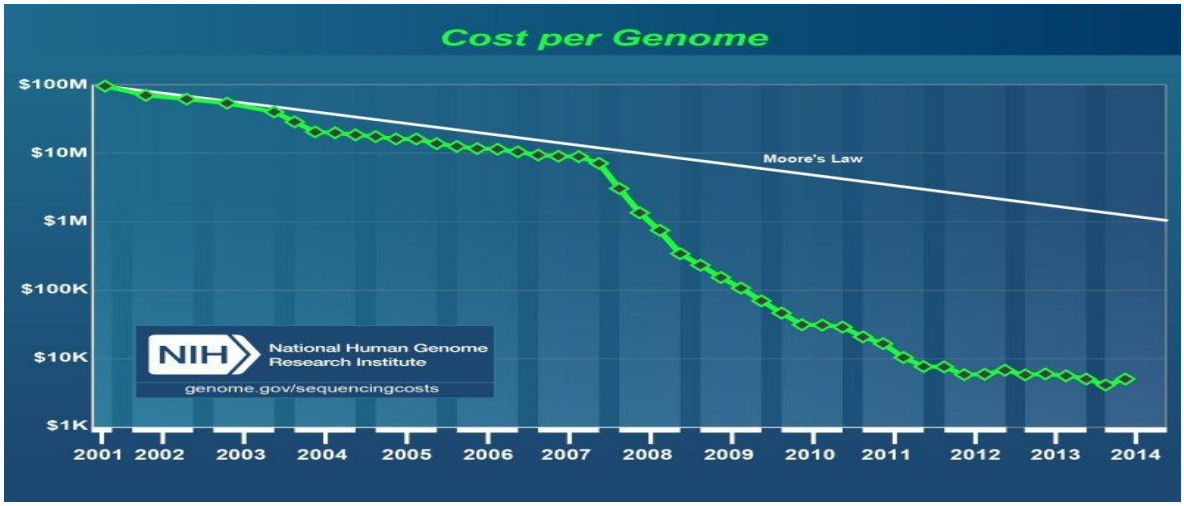
[33] *See http://genomicsandhealth.org/about-global-alliance [Accessed July 7, 2015]*

[34] *"Google Launches Genomics Effort, Joins Global Alliance" http://www.genengnews.com/gen-news-highlights/google-launches-genomics-effort-joins-global-alliance/81249571/*

[35] *http://www.1000genomes.org/about*

be part of the betterment of the human race. The ability to profile millions of genetic *profiles* via big data networking which is propelled by the decreasing cost of sequencing adds to the process of digitizing DNA profiles and working with it via bioinformatics for clues and patterns to diseases. The figure below illustrates the exponential lowering of costs of genome sequencing; it has beaten the Moore's law[36] that is applied to computers and information technologies, with the hunt now for $1000 whole human genome sequencing to be available commercially,



The International Cancer Genome Consortium (https://icgc.org/) is one such area where genetic analysis of cancer patients' biological samples is hoped to be used for cutting edge treatments. Similar projects related to mental diseases and other hereditable conditions are being conducted all over the world. The process has now come in the hands of individual citizens armed with sequencers who are recruited by pharma companies as citizen-researchers. Harvard Medical School launched its own *Personal Genomes Project* (http://www.personalgenomes.org/) in 2005.

[36] *"Of course, Moore's law is not really a law like those describing gravity or the conservation of energy. It is a prediction that the number of transistors (a computer's electrical switches used to represent 0s and 1s) that can fit on a silicon chip will double every two years as technology advances. This leads to incredibly fast growth in computing power without a concomitant expense and has led to laptops and pocket-size gadgets with enormous processing ability at fairly low prices. Advances under Moore's law have also enabled smartphone verbal search technologies such as Siri—it takes enormous computing power to analyze spoken words, turn them into digital representations of sound and then interpret them to give a spoken answer in a matter of seconds." (Sneed 2015)*

Genetic diagnostics industry and risk governance

There are private companies like 23andMe which initially set out offering diagnostic and ancestry testing tools for the consumer but now are increasingly looking towards using their client's genetic information to produce information relevant to the pharmacogenomics industry as part of their upscaling process. They have received funding from Google and Genentech. *The Telegraph UK* reports regarding services provided by 23andMe,

> The email alerts you to your results, securely detailed online: 11 'genetic risk factors' are analysed (how at risk you are to Parkinson's or Alzheimer's disease, for example); 'drug response' reports provide information on how your genetics may affect responses to certain medications; you will find out how likely you are to pass on 43 'inherited conditions' (from cystic fibrosis to sickle-cell anaemia); and you will discover your genetic inclinations towards 38 'traits' (from male pattern baldness to lactose intolerance). For the 'genetic risk factor' results, 23andMe provides the percentage chance the customer has of contracting the conditions or diseases based on the tests. These are shown next to the national average so as not to cause undue alarm. Customers can also elect not to discover some of the more potentially distressing results. 'There are still a lot of questions over whether consumers can handle the information,' Wojcicki says.[37]

Anne Wojcicki is Google co-founder Sergey Brin's ex-wife and Google invested $ 3.9 million in the company as it emerged in May 2007. Matthew Herper, writing for Forbes reports that, "People who have bought 23andMe kits and agreed to donate their data to research (that's about 600,000 of the company's 800,000 customers) automatically consent for 23andMe to sequence their genomes. 23andMe says that it is also able to share anonymous and pooled data about their self-reported health traits without asking. But Genentech wants even more: it wants to look at health and genetic data on an anonymous but individual basis. For that reason, the company will have to ask customers if they want to enter the study."[38] There are also companies which are now asking people to voluntarily give their genetic samples to them for the good of society, 23andMe being one among them. Apple has also recently entered the market with a product to enable

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[37] *"Are you at risk of cancer? Anne Wojcicki's controversial home DNA testing kit will tell you." The Telegraph. See http://www.telegraph.co.uk/news/health/11695832/Are-you-at-risk-of-cancer-Anne-Wojcickis-controversial-home-DNA-testing-kit-will-tell-you.html [Accessed June 27, 2015]*

[38] *"Surprise! With $60 Million Genentech Deal, 23andMe Has A Business Plan" http://www.forbes.com/sites/matthewherper/2015/01/06/surprise-with-60-million-genentech-deal-23andme-has-a-business-plan/ [Accessed July 8, 2015]*

customers to upload their medical data on the iPhone. It has delivered technology solutions to one of the biggest genome sequencing companies in the world, Illumina. The Apple website terms this as 'iPhone meets genome.' The webpage informs us that,

> Illumina is developing an iPhone application that will allow consumers to carry around their genomic information," Flatley explains. "Part of it may be on the phone itself, part of it may be in the cloud that the phone would have access to. It would allow the customer to bring up the application and interact with it live in conjunction with their doctor."
>
> …"The understanding of the human genome, which is very inaccessible to most people, can start to become accessible through iPhone," Flatley says. "It will be a mechanism for communications, for sharing, and for data management. iPhone can translate something very complicated into something very user-friendly." At Illumina, the convergence of science with iPhone is helping transform the future of individual health care.[39]

The National Health Service in the UK has launched a *100000 Genomes Project* in line with the 1000 Genomes Project that was undertaken in the USA. The focus of this project is to collect genomic data from 100000 patients in the national health network with a mandate to look into factors that can be discerned for rare diseases and cancers. The project is supposed to be completed in 2017, and it was launched in 2012. The Department of Health has created a fully funded and wholly owned company called Genomics England that will oversee this whole exercise.[40] This exercise will involve the project management of all parts of the health system in the UK with the project being connected with patients clinical records, information and communication networks being set up to enable the project and the upgradation in skill of health professionals to be able to effectively work in the new genetic environment. As usual, concerns related to privacy and confidentiality, commercialization and profitability and ethics are part of the debate. Thus, we find that the state, far from not being a player in the genomics revolution towards healthcare is intrinsically involved via the mode of neoliberal governmentality which places the state itself in the role of a player to enable the creation of the genomics industry. The UK effort is also a factor of this as the country tries to create a viable and profitable industry out of the technology for which it has traditionally been a world leader. As Foucault would argue, the health of the population is defined by the creation of

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[39] *See "iPhone in business": http://www.apple.com/iphone/business/profiles/illumina/ [Accessed July 8, 2015]*

[40] *http://www.genomicsengland.co.uk/the-100000-genomes-project/ [Accessed July 8, 2015]*

various modalities by which the body of the subject becomes a part of the calculability of life (See Rouvroy 2007). This is proved to be true when we see that the connection between genomic healthcare and insurance becomes more and more pronounced.[41] Thus, the connectivity of our health versus its insurability is now not based on unknown factors but on probabilistic risks defined by the normality of our genes. As Rouvroy highlights,

> If individuals with 'good genes certificates', or, more modestly, those who can prove they have been tested negative for a genetic predisposition, susceptibility or pre-symptomatic status, are allowed to dis-close those 'good' genetic risks to insurers or employers in order to be charged lower insurance premiums or to be hired preferentially, all those who choose not to disclose their genetic test results will be suspected of being at higher than average genetic risk and will be sanctioned accordingly. (2007,194)

To do this exactly, Google is in the effort of creating the 'normal man' the genetic equivalent of a (norm)alised human: an 'average' of the population, if you like it; but, "the *average* in the *average human genome*, rather suggests a kind of *perfection* which is essential virtual, the *perfection* of the mythical and abstract *human genome*" (Rouvroy 2007,196; *emphasis in original*). This is in an area wherein the connection of genes with environment and all other factors has not been proven nor realized but the grounds of being able to retain health is privatized and individualized by means of genetic information. Worldwide, there is an effort by national governments and transnational corporations to gather the DNA of individuals from the population and analyze it via computers to reveal some "truth" about the diseases that attack people; it is usually categorized into specific sub-populations based on so called "ethnic" markers. Dorothy Roberts (2013) has argued that such racialization of genomic technology once again brings back questions related to race segregation and the use of the black body as an object of repressive power and 'scientific' discrimination in America.

[41] *As an example, see the 'Genetics FAQ' of the Association of British Insurers: https://www.abi.org.uk/Insurance-and-savings/Topics-and-issues/Genetics/Genetics-FAQs [Accessed July 8, 2015]*

NA as big data and the worth of life

The coming together of big data and genomics has influenced the way genetic healthcare is being modulated. The ability of big data to crunch large amounts of genetic information and make cross connections between various factors enable the mixing of these two technologies into a healthcare framework. This solutions based approach to health is conducive to generating revenues for the industry based on diagnostic and probability based personalized medicare. There is currently another 'genome war 2.0' happening but this time it is between Google, Amazon and Apple, each trying to get into the big-data cloud driven bioinformatics business. Google has recently tied up with the Broad Institute which is headed by Eric Lander to use its proprietary software. MIT's *Technology Review* reports,

> Also speeding the move of DNA data to the cloud has been a yearlong price war between Google and Amazon. Google says it now charges about $25 a year to store a genome, and more to do computations on it. Scientific raw data representing a single person's genome is about 100 gigabytes in size, although a polished version of a person's genetic code is far smaller, less than a gigabyte. That would cost only $0.25 cents a year.[42]

The creation of bioinformatics has been mediated by the market wherein the information present in the human body is considered either a national resource by the state or an economic commodity by the corporates or a combination of both. The technology that enabled understanding of the gene was associated with fears regarding its possible ab(uses). It was considered to enable the editing of human characteristics to produce genetically modified babies, which were termed as 'designer babies' in the media. Another fear, and a more immediate one, was the fear that the knowledge of genetics about an individual will result in discrimination in employment and in insurance. This is the reason that the US government passed a *Genetic Information Nondiscrimination Act* (GINA) in 2008 which foresaw the problems that knowledge of genetic propensities of the person might affect her negatively. However, Davis mentions, "Over 1000 violations have been reported through GINA, typically involving an employer for asking genetic information or family medical history. As the science advances, though, and information

[42] *"Google wants to store your genome." MIT Technology Review. http://www.technologyreview.com/news/532266/google-wants-to-store-your-genome/ {Accessed July 26, 2015]*

becomes available, there will be more opportunities for genetic discrimination that falls within or outside of GINA's protection" (2010,11). And further, with the interest of employers and insurance companies coming in, there is no guarantee how long this embankment will hold (see Rouvroy 2007). The connection between insurance and risk is made by Ewald in looking at ways in which biopolitics floats in the paradigm of managing the *risky* individual. He describes insurance as an *political technology* (1991,207) to mediate life and writes: "Insurance individualizes, it defines each person as a risk, but the individuality it confers no longer correlates with an abstract, invariant norm such as that of the responsible juridical subject; it is an individuality relative to that of the other members of the insured population, an average sociological individuality" (1991,203). Thus, because insurance itself is a social risk the people inhabiting the domain of such calculation need to be pruned of all their defects, in this case, it is biological in nature, however, they will have to pay a price for it. Lemke notes that,

> Under contemporary social conditions and a political climate that favors further reductions in collective security systems the possibility that in the future individuals will fall in with an incurable sickness or give birth to a handicapped child spawns news fears and biological uncertainty. *The knowledge of genetic risks itself engenders risk*: it generates ethical, social, and psychological risks which would not exist without such knowledge. (2004,557;*emphasis mine*)

The biopolitical paradigm has also shifted because biobanks are used as a tool for producing profit in the biomedical domain. For this purpose, the population set becomes an important informational resource because it is the marker of diseases. Only by studying a cohort of population based on various defined parameters (such as twins, for example) will the research institute be able to create treatment programs or diagnostic tools for selling in the market. Thus, the new eugenics is not a *state sponsored eugenics* but a *market defined genetics* wherein the population will be governed based on their genetic markers which lead to a *flexible eugenics* underlined by the *technologies of the self*, "that illustrate the complexities of living in a market-driven society that places a premium on individual choice and, at the same time, largely embraces the emergent standards posed by genetic normalization" (Taussig, Rapp, and Heath 2005,206). The reproductive and social choices available will be mediated by the logic of the market wherein the market will dictate that they should have a certain lifestyle because of their

genetic make-up. So in a way this is a shift away from positive eugenics to negative eugenics, where the power over life will increasingly be given as 'choice' in the hands of people, especially women making reproductive choices. This is already happening in the case of people with certain incurable and fatal genetic diseases, wherein they are advised not to have children, or not to marry people with whom the chances of having such diseases might be magnified.

The anatomo-politics of personalized medicine

There is a new buzzword these days and it is called 'Personalized Medicine' which brings together all the 'regimes of truth' that I have highlighted by telling the consumer that he/she is in charge of the outcomes of their own life choices. This is based on the patients genealogical history coupled with diagnostic tools leading to 'precision' medication for the diseases that they will suffer from. They are told that unlike the medicines of old, the new genomic medicines will work at the patient's individual 'molecular' level. This molecularization of medicine is an epistemic shift in the way healthcare has been practiced and is changing the whole paradigm completely. As Foucault shows in *The Birth of the Clinic* (1973), medicine was increasingly institutionalized and normalized in the 18th century in France due to various factors. This lead also to what he conceived of as the 'medical gaze'. Similarly, my contention is that medicine as we know it is also changing completely to another form increasingly posed as 'specific', 'targeted' and 'non-intrusive', via the 'molecular gaze' (Rabinow and Rose 2006) that is enabled by today's sequencing and computational technologies. As Foucault notes in *Discipline and Punish,* "The perfect disciplinary apparatus would make it possible for a single gaze to see everything constantly" (1977,173). It is a 'brave new world' which has not yet exorcised the ghosts of its eugenic past. Merryn Ekberg in her article *The old eugenics and the new genetic compared,* stresses that, "while the end of the Second World War saw the collapse of the old eugenics, the discovery of the helical structure of DNA in 1953 gave birth to the new genetics" and underlines that, "*the old eugenics was genetics and the new genetics is eugenics*" (2007,581;*emphasis mine*). For naysayers, she quips,

> It would be naive to assume that the old eugenics differs from the new genetics because the old eugenics was faulty and the new genetics is faultless, or that the old eugenics was

> based on science fiction and the new genetics is based on science fact. Indeed, unanticipated risk and irreducible uncertainty is endemic to all science and to argue that the new genetics is not eugenics because the new genetics is error free is arrogance, ignorance and against the spirit of the scientific method. (2007,591)

Dorothy Roberts notes that, "both population control programs and genetic selection technologies reinforce biological explanations for social problems and place reproductive responsibility on women, thus privatizing remedies for illness and social inequity" (2014,785). She further notes that it is the black women's body that is the constant loci of intervention. She appraises Rose's reading of 'biological citizenship' as being overly optimistic and also contests his assertion that eugenics is not a tool of state intervention anymore by highlighting that eugenics was not only an assertion for racial purity amongst nation-states, but was more micro-level, she notes that, "it functioned to maintain the racial, gender, and class order within the nation" (2014,796). This has been referred to by Rayna Rapp as 'stratified reproduction' and by Roberts as 'reproductive caste system' (2014,784) wherein historically, blacks and other minority ethnicities in American have been termed as less intelligent than whites, more prone to 'deviant' behaviours like sexual promiscuity and violence. These old explanations of the racial inferiority of the black and other minority populations in America now has an increasingly genetic explanation, with the hunt for genes associated with intelligence (Herrnstein and Murray 2010), violent behaviours (Raine 2013) and range of other genes said to impact on behaviours, including homosexuality (Hamer 2011). It has led to plans based on welfare politics to disallow black women from giving birth in the past, and state subsidies and resources have been used as an excuse for disciplining the back body. Garland E. Allen notes that,

> a "bottom up" mentality is quickly becoming our guidepost. It is unlikely that we will see a return to blatant demands for sterilization, but the requirement for antifertilization medication for continued welfare benefits in the U.S., and bitter anti-immigration sentiment in southwestern U.S. and Europe are haunting reminders that we are not immune to the prejudices of our ancestors." (2001,61)

The explanation that it was the blacks who were constantly reproducing and not bothered about the welfare of their children, in which case the state has had to come in and spend precious resources has been an argument for blaming the blacks in America for their poverty without looking at the history of slavery (D. E. Roberts 2009). Taking the notion

of ‘stratified reproduction’ in which Rayna Rapp outlines how assisted-reproductive technologies are biased towards black women when compared to white, Roberts talks about ‘reprogenetics’, in which, “clinicians can biopsy a single cell from early embryos, diagnose it for the chance of having hundreds of genetic conditions, and select for implantation only those embryos at low risk of having these conditions” (Roberts 2009,784). It is interesting to note here that the burden of carrying a ‘defective’ population for the tax payer has been a polished argument for the eugenicists in trying to pursue negative eugenics. “We seem to be increasingly unwilling to accept what we view as imperfection in ourselves and others. As healthcare costs skyrocket, we are coming to accept a bottom-line, cost-benefit analysis of human life” (Allen 2001,61). This is especially true for disabled persons who now have to fight for a right to exist under the rationalization of the coming together of the twin forces of the state and the market. Historically, disabled people have borne the brunt of eugenic policies of the state, for example the Nazi policy of extermination of ‘defective’ populations for a healthy race. What will happen now is that there will be a new category of ‘genetically disabled’ which will be marked by their propensity as ‘carriers’ of defective genes. The implications of this ‘genetic sorting’ for society is huge (see Skene and Thompson 2008). Also, as technology expands, an attempt will be made to get rid of these ‘defects’ in the genomic level. It will have positive effects, for example, for people with eye disorder genetic and rare diseases. However, the question to raise also is, what is the limit to the ‘pruning’ of the genome of humans? Will we also edit our genomes for changing the eye color of our babies, making them six foot tall, or try to edit their genes to control their sexuality? These questions raise difficult ethical conundrums. But it does not mean that the future is not knocking on our doors right now. For example, questions of whether, if you find out that you have a gene for Alzheimer’s you should share the news with your loved ones, and, what life decisions you may have to come to terms with by sharing or not sharing the information is quite contingent on individuals. Besides being contingent on the individual, processes like ‘genetic counseling’ are geared in a paradigm of healthcare that seeks to enable the person to choose the best option for their lives. However, the terms of these choices are never questioned, and if they are then it is considered deviant. Gino’s story is an illumination of this when Callon and Rabeharisoa read into his disability and

the knowledge that he is slowly losing control of his body. His agency lies in the fact that he does not conform to the ideal of what a 'disabled person' should be as normativized by the society around him, but the negation of this commitment according to the researchers is a 'voice'. They note that, "a society in which everyone has the duty to have a standpoint and to defend it on their own behalf is a society which at every moment makes a liar of etymology, for the individuals inhabiting it are more divided within themselves than anywhere else" (Callon and Rabeharisoa 2004,21). This 'division within oneself' and the fact that people in all forms of life will have to negotiate tough decisions for themselves *vis a vis* others reflect also in the movies *Mar Adentro (The Sea Inside)* by Alejandro Amenábar (2004) and *The Sessions* by Ben Lewin (2012). As Gottweis notes,

> On the most fundamental level, genomics and post-genomics seem to offer an image of humankind and with it a new techno-scientific imagery, which represents humans as determined by their genes and, at the same time, portrays human genes as objects of technological manipulation and transformation. Even if only a few maverick scientists speculate about the point when genomics scientists will be able to build 'organisms from the scratch', it is precisely such speculations which are gladly taken up by the mass media and disseminated to a broad public. (Gottweis 2005a)

For example, Karen-Sue Taussig, Rayna Rapp and Deborah Heath (2005) in their ethnographic work amongst people with heritable dwarfism in the US show how they are co-opted in shaping their biological futures by the intervention of genetic technologies and the way in which they constantly have to negotiate their location, the researchers note that: "There is a convergence, or a constitutive tension, between genetic normalization and an individualism that increasingly engages biotechnology – *biotechnical individualism*. From this tension, what we call *flexible eugenics* arises: long-standing biases against atypical bodies meet both the perils and the possibilities that spring from genetic technologies" (2005,196). What these researchers talk about is 'atypical bodies' but what if the question is turned to 'atypical minds'? With the amount of energy that has been spent on finding the genetic basis of schizophrenia and bipolar 'disorder' (See Visscher et al. 2012) it is no wonder that the eugenic program of locating mental illness is on its way . As Robert Whitaker profiles in his book *Mad in America* (2002), the whole institutional network that gave rise to molecular genetics also gave rise to the study of psychiatry, with the treatment (lobotomy) of people considered mentally ill taking on gruesome inhuman proportions. Sylvia Onusic writes in a review of Whitaker's book,

> Yet, despite the inhumanity of these early procedures, the "darkest era in the treatment of the mentally ill" was the period between 1900 and 1950. The eugenics movement arising in the late 1800s set the stage for the development of further inhumane psychiatric treatments. Eugenics proponents judged the mentally ill as "societal wastage" and the product of a "defective germ plasm." The advocates of eugenics determined that mental illness is inherited and the end stage of a progressive decline in a family line. A "neuropathy gene," dubbed the "insanity gene," was a recessive gene that caused mental illness. A "normal" person could also be a carrier of such a gene. The theory of "tainted genes," popularized by Aaron Rosanoff, MD, who conducted a medical study on the topic, became a medical paradigm published in *The Science of Eugenics*.
>
> Thus, the only solution to stop the spread of mental illness, according to the eugenicists, was sterilization. This country's lawmakers agreed and as a consequence gave the U.S. the first laws for the compulsory sterilization of the mentally ill. (Onusic 2015)

Geneconomy

In this scenario it is pertinent to note that forms of life that do not contribute to the productive economy will be valued less than forms of life that have the potential of contributing to the capitalist economy. Further, the social body will be designed and manipulated in such a way that only such forms of life exist that can have a positive impact on the creation of value. When the state looks at its population as a resource then it is practical for it to invest life in it through and through. This is the 'vital politics' that is also biopolitics, however, it should be kept in mind that this politics is embedded in a bioeconomy. To elucidate this point let us look at the report created by the *Organization for Economic Co-operation and Development* in 2009 called 'Defining the Bioeconomy'. The bioeconomy is involved in all means by which biotechnology can be used to 'solve' the coming problems of the world; whether related to diseases or to the coming perceived food crisis. By manipulating nature, the bioeconomy forms a link with capital by contributing a significant share in economic growth. Thus, the uses of genetics for medicare in humans cannot be looked outside of the use of this technology in agriculture (Oecd 2009). Thereby, the plan is to use biotech in all forms of life and in all forms of how social spaces are inhabited. Hence, the trend towards Genetically Modified food is coterminous with the use of gene therapy. Biotechnology is the magic wand that will solve the problem of how an unsustainable population will inhabit a finite planet with ever shrinking resources and ever increasing burdens of diseases. This is where the creation of bioeconomy becomes of paramount importance (see Oecd 2009). However,

this bioeconomy is embedded in the domain of 'finance capital' which is premised on 'speculation' over different technologies, markets, resources and all types of maneuvers in the financial capitals of the world (Rajan 2006). Bioeconomy is also a speculation in the sense that it will manifest its power only when the speculative claims finds a way to connect with the lifestyles of the governed masses. As Birch and Tyfield note, "life science firms are asset-based enterprises rather than commodity-based ones, in that their value is derived from trade in intellectual property and financial investments, not from the production of biological commodities and materials" (2013,312). This is a speculation over life itself or the living of a speculative life for the individual; or as Melinda Cooper (2008) notes, 'life as surplus'. Mitchell and Waldby note that, "The production of biovalue is central to the development of bioeconomies. The citizenship status of donor populations is important in understanding this role…" (2015,336). Thus, in response to Schrödinger's question, 'What is Life?' we can also point towards life as capitalization and surplus production by encoding it in the frame of codes and linking it with the anatomo-politics of human worth. In a way, if the industrial revolution was about the exploitation of nature and making it 'productive', the 'biotechnical' revolution point to a modality in which bodies are harvested for to *produce productivity*. The body itself has become a resource that needs to be exploited to form what is termed the bioeconomy. This is done by creation a condition of 'clinical labor' which is the process in which, "subjects give clinics and commercial biomedical institutions access to their in vivo and in vitro biology, the biological productivity of living tissues within and outside their bodies" (Mitchell and Waldby 2015,339). Thus, the biocitizen is enmeshed in the bioeconomy which works by creating biovalue, the value of the citizen's life will also depend on where she is in the value chain of the 'economization of life' which *weighs* each person as an *individual*. This is not done via the classical modality of coercion as shown in the eugenics programmes of the United States or Germany where people were forced to morph or to annihilate their own body for the perceived social hygiene. It is not the disciplinary mechanism in which the supervisor wakes you up at 5 AM by the loud ring of the bell, and you are forced to wake up knowing that if you do not then you will be penalized. It is the method where in 'the care of the self' inscribes one's body with the morality of waking up on time by putting the alarm on by oneself because one is

convinced that it is the most 'productive' way to life one's life. Whether, the waking up is to work a monotonous 16 hour shift or share with loved ones is the question that bio*politics* will ask. How is one to care for oneself?

3.1. GENETICS AND CRIME

The importance of the DNA in catching criminals and persecuting them is by now well known. This capacity of the DNA to elicit 'truth' (what Foucault terms 'truth effects' (Foucault 1980b)) is due to a technology known as DNA fingerprinting or profiling. Alec Jeffrey's DNA profiling used RFLP (Restriction Fragment Length Polymorphism) which was quickly replaced by PCR (Polymerase Chain Reaction), invented at the Cetus Corporation by Kary Mullis. The development of NGS (Next Generation Sequencing) machines has greatly improved the accuracy and time taken to do DNA testing, while at the same time bringing down costs (See Roewer 2013). For example, QIAGEN recently launched its new genetic fingerprinting kits for US Forensics labs. The product profile news update mentioned a forensic scientist and special agent saying, "We can gain more information from a much smaller amount of DNA, while at the same time demanding more and more information from each examination. Working with trace amounts of DNA, every forensic analyst faces a challenge with these conflicting demands. The inclusion of internal aids such as the Quality Sensor will play a key role in allowing analysts to have confidence in their results. The Quality Sensor is a powerful troubleshooting tool to save precious time and lab resources in developing a DNA profile."[43] It is expected that with the rapid pace of development in sequencing technologies, soon there will be a PC like NGS machine that can be bought by anyone which is compact and light. There is already a 'brick size, battery-powered DNA sequencer for field use, invented by researchers in New Zealand.[44]

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[43] *"QIAGEN Launches New Genetic Fingerprinting Kits for U.S. Forensic Labs." prnewswire.com.*
See http://www.prnewswire.com/news-releases/qiagen-launches-new-genetic-fingerprinting-kits-for-us-forensic-labs-507961021.html [Accessed June 27, 2015]

[44] *"Portable, handheld DNA sequencer no bigger than a brick." See http://www.cnet.com/news/portable-handheld-dna-sequencer-no-bigger-than-a-brick/ [Accessed June 27, 2015]*

Every individual (except for identical twins, although recently technology, though very nascent and expensive still, for differentiating identical twins has also been invented) has a unique DNA. Despite the fact that 99.9% of the genetic makeup of humans across the world is the same, there is still the 0.1% that is unique to each human being. This difference is captured through the technology of DNA fingerprinting to enable a unique match between the sample that is gathered from the crime scene and the suspect. DNA is supposed to be an updated and fool-proof method from the previously used fingerprinting (Cole 2009). Michael Lynch notes that it is termed as "God's signature" thereby taking it away from mortal fallibility towards a concrete arena of truth that is infallible (2003). Forensic scientists and the police all over the globe are using DNA to capture and persecute criminals. The use of DNA as evidence in courtrooms across nations is now widely accepted although it has not been without its share of controversies (See Thompson 2008). Let us now briefly look at how DNA became the "truth machine" (Lynch et al. 2010) and the way it interacted with the legal system for a perspective on its evolution, and also to understand the specific modality in which 'norms' are created. As Hellmich writes, "There is no such thing as an isolated or independent norm; all norms are interdependent" (cited in Ewald 1990,161). Thus, let us now investigate the specific modalities by which the gene enters the domain of law.

3.1.1. The Confession of the Gene:

The first case in the world which used DNA fingerprinting for criminal conviction was the high profile rape and murder case called the "Colin Pitchfork" case that was solved in the UK. This was also, interestingly, and co-incidentally, the first case in which a convicted person who was already serving a prison sentence was exonerated by use of DNA fingerprints by the Innocence Project. In this case, Richard Buckland was found to be innocent although he had confessed to having committed the crime in the court. The case concerned the rape and murder of a fifteen year old teenager named Linda Mann in Narborough, England in 1983 and another fifteen year old named Dawn Ashworth who was also raped and murdered in 1986. A local man named Richard Buckland confessed to the murder of Dawn Ashworth. Due to similarities in the way that the crime had been committed the police accused him of murdering Linda Mann in 1983 as well, but Richard

Buckland refused to take ownership for her rape and murder, saying that he was the murderer of Dawn but not of Linda. In 1987, the DNA samples found on the body of the victims and that of Richard Buckland were sent to Sir Alec Jeffreys. Alec Jeffreys' DNA analysis result concluded that the samples from both the victims did not match with those of Richard Buckland, thus, he had committed neither of the crimes. But, what the test also confirmed was that the same man had committed both the murders because the DNA fingerprints matched for both victims. It was also established was that the killer had a blood type A. The police profiled the DNA of more than one thousand local men with blood type A but there was still no match with anyone among them. A breakthrough in the case occurred when a local man named Ian Kelly confessed to colleagues that he had sat in for his friend Colin Pitchfork by giving his own blood sample in Colin's name. One of the colleagues reported this information to the police who promptly acquired the blood sample from Colin Pitchfork and the DNA test matched in both cases (Cole 2009, 292). Colin Pitchfork confessed to the double rape and murder and was sentenced to life imprisonment with a minimum term of thirty years in prison (Bates 2014).

In the United States, the first case in which DNA fingerprinting was used in a criminal conviction was in Andrews v. State.[45] It used the same technology developed by Alec Jeffreys in the UK called RFLP (Restriction Fragment Length Polymorphism) (Rudin and Inman 2001, 187); although significantly, the analysis was not performed by a government laboratory but by a private firm called *Lifecodes*. DNA fingerprinting was required because although the blood type found at the crime scene matched the accused it was not conclusive evidence. This case involved the search for a habitual rapist involved in more than twenty-three cases who would rape women while covering their eyes to conceal identification.[46] The police got the lead from a woman who called him in as a prowler. In a previous incident, the police had found two fingerprints on a window screen and they matched it with those of Tommie Lee Andrews. When the police took vaginal swabs following the forensic information of the raped woman and gave it in for DNA analysis, the semen matched Andrews.

[45]*Andrews v. State, 533 So. 2d 841, 842 (Fla. Dist. Ct. App. 1988).https://casetext.com/case/andrews-v-state-498*

[46]*http://nitro.biosci.arizona.edu/courses/EEB208/Lecture20/Lecture20.html*

As Margaret Gibson succinctly puts it, "The scientist/doctor is the modern figure of knowledge/truth and, in dystopian, tech-noir and detective genres of film and literature, he is usually instrumental in capturing the criminal, deceiver and liar" (2010,62). The above case highlights the importance of 'scientific experts' in giving testimony to the court about the 'reliability' of new forensic technologies. Scientific experts told the court that DNA fingerprinting is a reliable tool to use to identify a person, although the defense pointed out that the experts have a vested interest in approving the method because their careers are dependent on it. This is an important point because the staff from *Lifecodes* was arguing for the reliability of their own tests. Further, another point worthy of note is that the *Frye* standard was deemed too strict a criteria to accept scientific evidence in the courtroom (Andrews v. State 1988). Hence, later, the *Daubert* standard became the norm. However, this too has been problematized by Susan Haack. Commenting on the *Daubert* standard extensively, she concludes, "…how can the legal system make the best use of expert testimony? – we are still fumbling towards an answer" (2014,121). This standard marks a very important point, which made the way for the acceptability of DNA as evidence in the court in the United States. The court witnessed a long argument over the admissibility of DNA as scientific evidence in criminal investigations and then finally convicted the accused (Clayborn 1989).

DNA evidence has also been used extensively to open old cases for exonerating convicted criminals who may have been wrongly sentenced to prison because the technology was not available at that time. This has particularly been spearheaded by the Innocence Project (http://www.innocenceproject.org/). The first case where DNA evidence was used to exonerate a convict, was one in which a man was found guilty by the court and sentenced to prison for an indeterminate 25-50 years. This was on the basis of false charges of rape and assault, filed by a woman named Cathleen Crowell. She had inflicted self-harm on her stomach, and taken an underwear stained with semen to lodge a false police case, because she was afraid that she had become pregnant through her boyfriend, and wanted to find an excuse to give to her parents. She identified young 22 year old Gary Dotson from a mug book that the police showed her. Dotson was pronounced guilty by the court and sent to prison in July 1979. However, in 1985, Crowell confessed to her pastor that she had fabricated the crime and sent an innocent

man to jail. Another witness in the case was the state forensic police scientist who falsified his credentials by claiming to have done "graduate work" at the University of California at Berkeley and gave wrongful expert testimony. In 1987, the case was re-opened after the defense attorney heard about the DNA testing technology developed in the UK and thus, on August 15, 1988 the report came in that the semen on the underwear did not come from Gary Dotson. Finally, on January 9, 2003 the court granted him pardon based on innocence (Center on Wrongful Convictions; Center on Wrongful Convictions 2012).

However, soon enough the infallibility of DNA as evidence was challenged in the court. *People v. Castro*[47] was the first case to challenge the admissibility of DNA evidence in court in the world. This case concerned the murder of Vilma Ponce and her two-year old daughter in the Bronx on February 5, 1987 for which a local handyman José Castro was accused by the police, based on the match of DNA taken from his bloodstained watch with those of the victims. *Lifecodes* was once again the company that analyzed the samples. The court found in this case, that proper approved procedures were not followed by the testing laboratory, although it admitted the acceptance of DNA testing for both inculpatory and exculpatory purposes. The scientific evidence was itself put on trial successfully by the two maverick defence lawyers,

> Scheck and Neufeld persuaded several prominent molecular biologists, including Eric Lander of the prestigious Whitehead Institute for Biomedical Research, to examine the evidence for the defense. These experts found several disturbing problems with the laboratory's handling and analysis of the evidence. First, one of the autorads presented as evidence by Lifecodes showed three matching bands between the DNA found on the watch and the known DNA of Vilma Ponce. But the watch sample also clearly showed two additional bands. These bands were not mentioned at all in the Lifecodes report; they had simply been dismissed as either laboratory artifacts or nonhuman contamination. The same laboratory report also cited three matching bands between Natasha and the watch. But the autorad showed only one matching band. On the witness stand, none of the Lifecodes technicians could find the missing bands that their report claimed were there. These two errors suggested that Lifecodes technicians were looking at the evidence expecting to see matches, rather than evaluating it dispassionately. (Cole 2009,296-97)

[47] *People v. Castro545 N.Y.S.2d 985 (Sup. Ct. 1989)*

The court also commented on the admissibility of DNA evidence in courts based on the *Frye test* [48], but it modified the standards to suit this new technology by insisting that accepted and rigorous scientific techniques and controls should be followed. This case also highlighted the significance of proprietary technologies in DNA identification by private companies because *Lifecodes* refused to share the details of its methodology beyond a certain point citing trade secrets and business interests (Patton 1990).

People of the State of California v. Orenthal James Simpson[49]was a high-profile murder case involving the actor and former football star O.J. Simpson who was accused of murdering his ex-wife Nicole Brown along with her companion Ronald Goldman in June 1994. The trial occupied prime time television for eight months where in ultimately the jury acquitted Simpson of the crime although there was substantial evidence that matched the case including the DNA found in the crime scene that matched with his. Despite a plethora of evidences Simpson's defense lawyers cross-examined every iota of evidence and found loopholes in those so that the "guilty beyond a doubt" tag could not be established in the trial. Further, forensic evidence handling techniques by the police and expert testimony were put into disrepute at the trial (Thompson 1996; Jasanoff 1998; Fisher 1997). "…the Simpson case demonstrates how difficult it is to sustain claims of truth—even the truth of supposedly "ironclad" scientific evidence—against determined,

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[48] *There are two tests used to consider admissibility of scientific evidence in US courts; Frye Standard and Daubert Standard. The Legal Information Institute webpages of the Cornell University Law School defines both as:*

Frye standard

Standard used to determine the admissibility of an expert's scientific testimony, established in Frye v. United States, 293 F. 1013 (D.C. Cir. 1923). A court applying the Frye standard must determine whether or not the method by which that evidence was obtained was generally accepted by experts in the particular field in which it belongs. The Frye standard has been abandoned by many states and the federal courts in favor of the Daubert standard, but it is still law in some states.

Daubert Standard

Standard used by a trial judge to make a preliminary assessment of whether an expert's scientific testimony is based on reasoning or methodology that is scientifically valid and can properly be applied to the facts at issue. Under this standard, the factors that may be considered in determining whether the methodology is valid are: (1) whether the theory or technique in question can be and has been tested; (2) whether it has been subjected to peer review and publication; (3) its known or potential error rate; (4) the existence and maintenance of standards controlling its operation; and (5) whether it has attracted widespread acceptance within a relevant scientific community. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993). The Daubert standard is the test currently used in the federal courts and some state courts. In the federal courts, it replaced the Frye standard.

[49]*http://law2.umkc.edu/faculty/projects/ftrials/Simpson/simpson.htm*

well-funded, highly skilled opposition operating in a highly charged emotional atmosphere" (Cole 2009,300).

In an ironical twist of fate, President Bill Clinton, who presided over the completion of the Human Genome Project in 2001, underwent a DNA identification test in the sex-scandal that erupted regarding his affair with a twenty-two year White House intern Monica Lewinsky in 1995. The (in)famous "Blue Dress" that Lewinsky had preserved contained Clinton's semen stains and FBI confirmed that it matched to those of the President's. The scandal broke out in January 1998. Initially Clinton vehemently denied having an affair with Lewinsky under oath, but the DNA found in the dress proved to be incriminating evidence and ultimately Clinton had to confess to the liaison. This resulted in impeachment proceedings against him which he won and continued to complete his term in office (Butler 2005, 9; Posner 2000).

It is an interesting and important point to note that the same two lawyers, Barry Scheck and Peter Neufied, were the first to question the accuracy of DNA evidence in court in the Castro case, the same lawyers who defended OJ Simpson in his trial; they are also the same people who started the Innocence Project to exonerate criminals serving sentences, some on death row, by petitioning the court for a re-trial based on DNA profiling technology (Cole 2009).

What we can learn from the cases mentioned above is the way in which DNA as a tool of justice *flows* and becomes normalized in the legal system. Ewald writes that,

> Normalization is thus the production of norms, standards for measurement and comparison, and rules of judgment…Normalization produces not objects but procedures that will lead to some general consensus regarding the choice of norms and standards. (Ewald 1990,148)

The cases mentioned above provide a glimpse into the internal logic of how this normativization works by including the scientific, political, economic, legal and social apparatuses that create the 'norms,' in co-production (Jasanoff 2004) with each other and provides DNA with its legitimacy.

DNA however, still remains, a much contested proof of evidence in the courtrooms, because crime cannot be proved by saying that A's DNA was found at B's place. It needs to prove that A was indeed there at the same time and the same instant when B was being murdered, and why? As Cole and Lynch write,

> A man whose DNA profile matches the profile from the semen recovered from examination of a rape victim may also be excluded from being a suspect when his and/or the victim's testimony satisfies investigators that the two had consensual intercourse. A similar logic holds for DNA evidence. To stand proxy for a unique suspect, a DNA sample must somehow be deemed uniquely suspicious. Much like a fingerprint recovered from a burglary scene, the evidence must have a material relation to the crime that renders it suspicious—that is, it should not match the prints of persons who had legitimate access to the scene, it should be found on an apparent entry point such as a window or at the surface of the safe or jewelry box from which items were pilfered. In other words, the suspect character of the material evidence depends on how it fits into the story of the crime and of the circumstances of that crime.(2006,54-55)

This contextuality of the crime has been a theme running since the very first case. Jasanoff notes that,

> A starting point for creating a framework of more reasonable expectations for the relationship between law and science is to recognize that science enters the courtroom not in the form of bare facts or claimed truth about the world, but as *evidence.* That is, science must be worked into the particular kinds of propositions, representations, or material objects that the law regards as germane to establishing which party is telling the more plausible story. Scientific and technical evidence presented by expert witnesses, in particular, has to meet a number of criteria specific to the epistemological needs of law. (Jasanoff 2006,329)

Recently, sexual assaulters have started wearing condoms while raping women, or making sure that they take a bath and clean themselves (Mulla 2014,53-54). As crime technologies become more effective so do the criminals become more aware and use methods to confuse/fool the police. One cannot claim that because of DNA profiling coming in, cases of rape and murder have come down.

What the cases also highlight is the power of money in deciding on the consequences of the crime. In the case of Pitchfork, Andrews and Castro, the DNA technology was useful in implicating them for their actions. But in the case of Simpson and Clinton, although there was a certain proof of their DNA matching, the ultimate result was that both persons did not get convicted or punished.

These cases provide a sampling of how DNA entered the legal system and how it has been used as a fantastic tool for fighting crime and convicting those criminals who would have escaped otherwise due to lack of clinching evidence. As Foucault writes, "the 'subjects' were presented as 'objects' to the observation of a power that was manifested only by its gaze" (1977,188). I call this the '*genetic gaze'* that is made to confess its own 'crime' in which the gene stands as a witness to the act of the criminal and produces proof of confession that is generated from its placement in a certain time and space (Foucault 1980, 194-228): this is a micro-physics of power at the genetic level. As Foucault wrote in the *History of Sexuality: Vol. 1*, "Western man has become a confessing animal" (quoted in Gibson 2001,67). The body 'secretes' its own confession. As Margaret Gibson succinctly puts it in the case of the polygraph test, which can be equally valid in DNA profiling, "*The secret, if there is one, graphically secretes*" (2010, 72). In the case of DNA, however, "the secret secretes statistically".

DNA fingerprinting seems to have become a 'gold standard' and 'fool-proof' method of catching criminals based on the biological samples that are found at the site of the crime. The fact that technology now enables DNA fingerprinting from very small samples, and, that it is possible to create a DNA profile report even from samples that have been highly polluted with other biological samples, has meant that law enforcement agencies worldwide are willing to invest their time and resources in creating a framework in which forensics plays a central part in the fight against crime. The 'genetic imprint' embedded in a person's body confesses to his/her crime. As Foucault notes, "truth is centered in the form of scientific discourse and the institutions that produce it…" (1980a,131).

DNA also provides us a proof of what Foucault refers to as the pivot that connects biopower with governmentality, i.e. sex.

> It was at the pivot of the two axes along which developed the entire political technology of life…Broadly speaking, at the juncture of the "body" and the "population," sex became a crucial target of a power organized around the management of life rather than the menace of death. (Foucault 1984, 267-268)

Most of the cases involving DNA as evidence highlighted above, involve women, whether it is the question of rape and murder, or disputes regarding paternity. However, as Tadros has noted, Foucault did not return to this question of sex as the pivot between biopower and governmentality again. I second Tadros' postulate that, "…alongside the dispositif of sexuality, it is the law, in modern society, which is the predominant institution through which this connection is made" (1998,99).

Next, let us look at the manner in which the DNA becomes a bio-political instrument for fighting crime and a way to ensure the security of the population; i.e., how it shifts from an *anatomo-politics* of the convict's body to the *governmentality* of the state which needs to control and prevent crime in the population.

3.1.2. Gene-mentality: Bio-governance of suspect populations in the US and UK

The paradigm of governing the population became manifest in the control of genetic information of its subjects by the government of the United States. For this purpose a great labyrinth of regulations, institutions and laws were created that enabled the "governance of things." It began as an effort to catch criminals, and specifically, criminals involved in rape and murder, as DNA fingerprinting was deemed a singularly efficient method of finding a fool-proof way to catch criminals based on somatic evidence. The ever greater increase in efficiency of the sequencing machines, with the lowering of cost, helped to put into machinery a "technology of government", that would ideally have solved the problem of previously untraceable crimes. It quickly came to pass that the gathering of the DNA of only convicted criminals was found to be insufficient. Thus, a call was made to gather the DNA of anyone who had a scuffle with the law. The 'potential' to commit a crime then became the key rationale in the efforts to 'control' it, producing '***genetic suspects***' and creating ***'suspect populations'*** (Duster 2004). DNA fingerprints were gathered by the state without the permission of citizens. The aim was to populate all those profiles in a central database that could be quickly cross-referenced in case of a crime occurring, in an attempt to enhance security. What this also meant was that bodily fluids found at the crime scene could be given for DNA analysis and the profiles generated from it could be checked in the central database to see if any particular

person who is already in the database was a match. This enabled the police to 'zero in' on the potential suspect in the crime.

With rapid pace most states in the union passed laws that created the legitimacy to gather and profile the DNA fingerprints *of any person* with a view to control and prevent crime. The US Federal Government passed a mandate to create a National DNA database maintained by the FBI. State forensic labs were created in most states so that genetic profiles could be quickly generated in the US. The FBI took the lead in creating processes of standardization of DNA fingerprinting and profiling by training experts in forensics and law enforcement. The FBI also created a computer software called CODIS specifically designed to input DNA profiles into the databank. Millions of profiles have been added to this database that is connected with law enforcement agencies throughout the nation. The added risks of illegal immigration and counter-terrorism post 9/11 gave legitimacy to put a system in place that would create a 'secure' social space for its citizens to live and work in. Any activity that is considered to be illegal now allows the police to take a buccal swab[50] from that person and put her/his information in a database. Let us see how this technology of control became normalized in the United States.

The *DNA Identification Act* established in 1994[51] created a national database in the United States. The act allowed for the creation of a National DNA Index System (NDIS) by the Federal Bureau of Investigation (FBI) by creating the index in CODIS (Combined DNA Index System).[52] The indexes defined in the CODIS were: 1) Convicted Offender (Legal) 2) Missing Persons 3) Relatives of Missing Persons 4) Unidentified Human (Remains) 5) Forensic Unknown 6) Population Database (if personal identifying information is removed). It also mandated that DNA profile generators be tested for proficiency every 180 days and that the DNA advisory board recommend the Quality Assurance Standards that are to be released by the Director, FBI. These quality standards were to be used for accrediting laboratories every two years. The DNA Backlog

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[50] *A sample taken from the lining of the mouth for DNA analysis.*

[51] *42 U.S. Code § 14132 - Index to facilitate law enforcement exchange of DNA identification information.*

https://www.law.cornell.edu/uscode/text/42/14132

[52] *Frequently Asked Questions (FAQs) on the CODIS Program and the National DNA Index Systemhttp://www.fbi.gov/about-us/lab/biometric-analysis/codis/codis-and-ndis-fact-sheet*

Elimination Act of 2000[53] amended the 1994 Act to include the following crimes: "murder, homicide, voluntary manslaughter, sexual abuse or exploitation, peonage and slavery, kidnapping, robbery or burglary, crimes in Indian country, etc." The U.S.A. Patriot Act of 2001 amended the 2000 Act to include, "federal crimes of terrorism and any crime of violence as well as any attempt or conspiracy to commit a crime of terrorism or violence."[54]*The Justice for All Act 2004* as the law was ironically named, amended the 2000 Act to include any federal felony conviction along with mandatory accreditation for participating laboratories either from the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) or Forensic Quality Services (FQS). This was followed by the DNA Fingerprint Act 2005 further amending the 2000 Act to include, "individuals who are arrested or from non-U.S. persons who are detained under the authority of the United States." It also allowed for, "laboratories to have an expungement policy and procedures for individuals who had their charges dropped, not filed, or were acquitted of charges." (Federal Bureau of Investigation 2015) The *Violence Against Women Act of 2006* and the *Adam Walsh Child Protection and Safety Act of 2006* included the authorization to include DNA profiles, "from any federal arrestee and from individuals detained by federal officials who are not U.S. citizens or lawful permanent resident aliens." (Maschke 2008, 46) Christine Rosen writes that, "the first Virginia database stored DNA samples only from convicted sex offenders, but within a year, the law had expanded to require DNA samples from all adult felons. Juveniles over the age of fourteen who committed serious crimes were added in 1996, and beginning in January 2003, any person *arrested* for a violent felony or burglary must give the state their DNA" (2003, 40; *emphasis in original*).

The introduction of DNA fingerprinting and profiling has also fashioned key words like a 'cold hit'[55] which refers to a direct match between the DNA in the database with the one found in the sample; '***DNA dragnets'*** are used to collect the DNA from the population in a certain area to see if there is a database match. By 'familial searching'

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[53]*http://www.gpo.gov/fdsys/pkg/PLAW-106publ546/html/PLAW-106publ546.htm*

[54]*DNA TESTING PROVISIONS IN PATRIOT ACT IIhttp://www.cga.ct.gov/2003/rpt/2003-R-0411.htm*

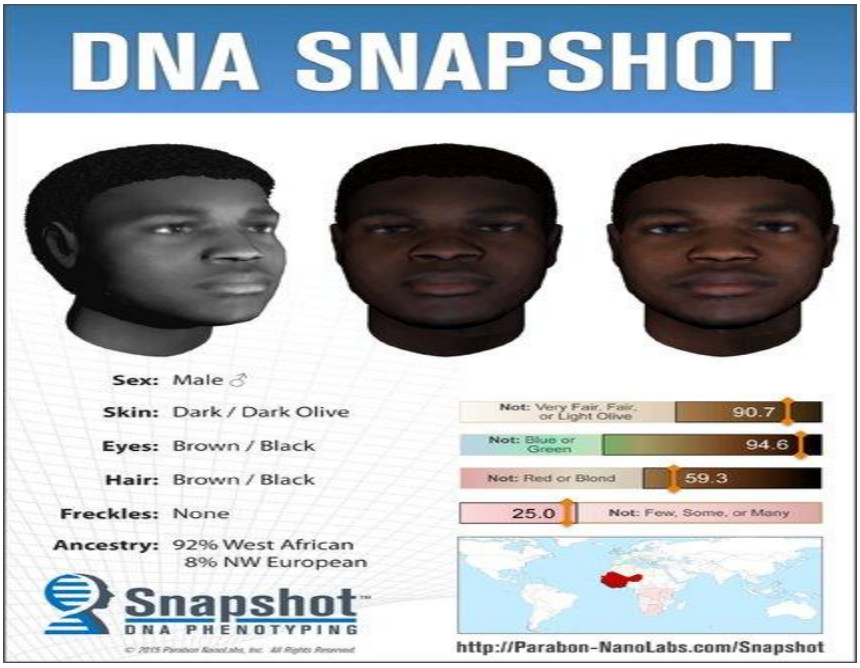
[55] *"For there to be a CODIS "hit", two DNA profiles must be perfect matches on 13 regions, or loci, of the individuals' DNA." (Maschke 2008, 46-47) For details regarding the exact loci used in DNA analysis by the FBI, refer to footnote 8.*

within the database the police can find blood relatives who might lead them to the offender. 'Retrospective sampling' is the gathering of the DNA profile of a convict who is serving or has already served his prison term.[56] What this shows is that DNA has created its own 'language' in the process of being introduced in the court system. Recently, '***DNA phenotyping'*** tries to create the physical 'profile' of the criminal by looking at their genetic markers, for example, it will tell the police whether the suspect is white/black, eye/hair color etc. This could lead to what Cole (2009) warns us about when he writes, "…the ultimate solution to the problem of crime – either breeding potential criminals out of the species (positive eugenics) or actually executing, sterilizing, or incarcerating for life those stigmatized as inherently criminal (negative eugenics)." (304) This profiling is not a new phenomenon but as shown by Cole, is appended in the history of the creation of fingerprinting as a 'science' as well. He mentions the work of Cesare Lombroso, who is considered the progenitor of criminal anthropology. In his book "*Criminal Man",* he argues that criminality can be read in the body of the person. Cole explains what came to be called the Italian School, "Criminality should be visible to the trained eye in certain bodily stigmata, such as "sugar-loaf" skull shapes, pointy heads, heavy jaws and receding brows" (2009,1-2).

An article in *The New York Times* reproduces the "DNA snapshot" of a suspect developed by Parabon Nanolabs and released by the police in Columbia, S.C.,[57] as given below in the picture

[56] *As an example, see news item from New Zealand, "Retrospective DNA samples scores hits on database." http://www.police.govt.nz/news/release/1588*

[57] *"Building a Face, and a Case, on DNA" by Andrew Pollack, Feb. 23, 2015. http://www.nytimes.com/2015/02/24/science/building-face-and-a-case-on-dna.html?_r=0*



What kinds of criminal men does the new genetic forensics produce? As was the case with criminal anthropology, the criminal is overwhelmingly the non-white person. If you look at the above 'DNA snapshot' then, you cannot help but see that it is the face of a *black man*. Is it a coincidence? Does it not point to a whole history of criminalizing the body of the black man in America? Further, the snapshot provides 'ancestry' markers. Is it to point out that the black man is never truly an American? What does 92% West African mean? How can you homogenize the whole gene pool (if there is such thing as a 'gene pool) of West Africa (or as is done in this profile of North West Europe)? What does this achieve if not a contrast between white and black (92 vs. 8)?

This criminalization of ethnic groups in the US is embedded in the cultural life of the country where in most of the crime sit-coms also attest to the drug peddler, gang member, rapist, murderer as overwhelmingly black. This unconscious consciousness is noted by social scientists to have impacted the judiciary also when giving their judgments involving DNA evidence. Hence, besides the rich/poor dichotomy that affects judgment outcomes and police arrests, there is also the black/white dichotomy (or the non-white/white) which is based on skin color. One of the reasons the OJ Simpson case occupied the public imagination so prominently was also because it was perceived by the blacks in US as a racial witch-hunt of a successful black person by the white majority.

Crime sit-coms have been argued to have produced a 'CSI effect' that is supposed to affect the decision making process of law enforcement officials including judges and juries as they are swayed by the portrayal of DNA forensics in the television serial called CSI (Crime Scene Investigation) and similar others (Cole 2013; Byers and Johnson 2009). This is despite the fact that research has shown that most of the science that is shown in these television serials is actually non-existent (Penfold-Mounce 2015, 5). The police use "Surreptitious DNA harvesting" to get samples from suspects by stealth and then analyze it to check whether it matches with their sample.

Yet "DNA exonerations" have been spearheaded by the NGO "Innocence Project"[58] which helps convicted criminals serving prison sentences to re-open their case on the basis of DNA identification, so that their innocence can be established, because at the time of trial the technology was not available to them and hence a fair trial is denied. Till date, the overwhelming number of exonerees are blacks and other ethnic minorities. Some of them were saved from execution by the use of DNA profiling techniques. What this also points to again is the composition of the criminal population in the US and how it came about. How is it that there is such a great difference in the *kind* of people who got convicted in the first place?

California enacted Proposition 69 which was created in 2004 but went into effect on January 1, 2009, which mandates DNA collection from anyone arrested for a felony, irrespective of whether they have previously been charged or convicted.

> Under Prop 69, anyone who is merely arrested for a felony must provide a DNA sample that will then be stored in a criminal database accessible to local, state, national, and international law enforcement agencies. Instead of being limited to serious, violent offenses, the new requirement even applies to someone accused of writing a bad check and could be used to take DNA from victims of domestic violence who are arrested after defending themselves as well as people who are simply wrongfully arrested. (Risher 2015)

[58] *http://www.innocenceproject.org/*

In Maryland v. King, the US Supreme Court upheld a decision to allow for the collection of DNA from a suspect in 2013.[59] The mandatory collection of DNA from military personnel is legitimized by the judgment in *Mayfield v. Dalton,* 901 F. Supp. 300 (D.Haw 1995) vacated as moot, 109 F.3d 1423 (9th Cir. 1997) which states that it is not against the First Amendment rights of its citizens against unreasonable searches and seizures.[60] A report created for the Department of Defense by a think tank of scientific advisors called JASON recommended that the DoD take advantage of its membership to research on epigenetic phenomena.

> . . . determine which phenotypes that might reasonably be expected to have a genetic component have special relevance to military performance and medical cost containment. These phenotypes might pertain to short- and long-term medical readiness, physical and mental performance, and response to drugs, vaccines, and various environmental exposures, all of which will have different features in a military context. More specifically, one might wish to know about phenotypic responses to battlefield stress, including post-traumatic stress disorder, the ability to tolerate conditions of sleep deprivation, dehydration, or prolonged exposure to heat, cold, or high altitude, or the susceptibility to traumatic bone fracture, prolonged bleeding, or slow wound healing. (Mehlman and Li 2014, 245; McMorrow 2010, 43)

The collection of DNA samples from juvenile delinquents is almost universal in the United States. *The Office of Juvenile Justice and Delinquency Prevention* reports that as on October 26, 2012 there were 57,190 juvenile offenders inside residential placement on a given day within the US.[61]

> The federal government and 49 states compel DNA collection from juveniles as a result of contact with the criminal justice system. A criminal conviction, an adjudication of juvenile delinquency, or an arrest can all trigger mandatory DNA collection…Thirty states and the federal government compel DNA collection from juveniles based on a finding of juvenile delinquency. Federal law has the broadest DNA collection scheme. It mandates DNA collection from anyone (including juveniles) arrested, facing charges or convicted, regardless of the charge. Because federal DNA collection law does not distinguish between cases handled as a criminal or delinquent matter, and because federal law does not require a conviction before DNA collection is required, it does not matter to federal DNA collection whether a juvenile is charged as an adult and found guilty or charged with delinquency. Either way, federal law subjects any juvenile charged or convicted in federal court to compulsory DNA collection.

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[59] *"Maryland v. King: An unfortunate supreme court decision on the collection of DNA samples." The Brookings Institute. http://www.brookings.edu/blogs/up-front/posts/2013/06/06-maryland-king-supreme-court-dna-samples-lempert [Accessed July 27, 2015]*

[60] *https://epic.org/privacy/genetic/*

[61] *http://www.ojjdp.gov/ojstatbb/corrections/faqs.asp*

> State laws vary in the scope of their collection from juveniles following an adjudication of delinquency. Of the thirty states that collect DNA from juveniles processed in the juvenile justice system, twenty–five collect from those juveniles adjudicated delinquent for legally specified qualifying offenses regardless of the punishment imposed. Five states require a qualifying adjudication plus a qualifying sentence. Twenty states collect following an adjudication for any felony offense, with sixteen of those collecting for additional select misdemeanors. Ten collect for select felony adjudications, with five of those collecting for additional select misdemeanors. All told, twenty–one states mandate DNA collection from juveniles adjudicated delinquent for certain misdemeanors.(Lapp 2014, 58-60)

Collection of DNA samples from the prison population is mandatory as per 42 U.S. Code § 14135a.[62] It came into effect on January 9, 2009 directing federal agencies to, "collect DNA samples from individuals who are arrested, facing charges, or convicted . . .under the authority of the United States."[63] The President enacted the *Newborn Screening Saves Lives Act of 2007* on April 24, 2008 authorizing collection of DNA from all newborn babies in the US and their databasing.[64](Brase 2008) The latest news coming in reports that now citizens will have to pay for DNA tests done by cops on them, "A related state statute also requires that any person who is found guilty of a misdemeanor pay a DNA analysis surcharge: $250 for each felony conviction and $200 for each misdemeanor conviction."[65] What this news point towards is the fact that you cannot really separate the US state as a capitalist nation and its law enforcement architecture (the prison-industrial complex) which is increasingly being privatized. In a way, the whole justice delivery mechanism is on the way to being privatized. I now turn to the emergence of DNA database as it unfolds in the UK.

The National DNA Database (NDNAD) was established in the UK in April 1995 and it currently holds more than 5 million[66] profiles in the database. It is the largest collection of DNA profiles in the world as percentage coverage of the population

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[62] *https://www.law.cornell.edu/uscode/text/42/14135a.*

[63] *http://www.justice.gov/sites/default/files/ag/legacy/2010/11/19/ag-memo-dna-collection111810.pdf*

[64] *See http://www.naturalnews.com/025116_DNA_screening_health.html and https://www.govtrack.us/congress/bills/110/s1858 also http://www.newscientist.com/blogs/shortsharpscience/2010/02/ewen-callaway-reportertexas-he.html*

[65] *"State requires DNA tests, but who pays what?." Stevenspointjournal.com. See http://www.stevenspointjournal.com/story/news/local/2015/06/26/state-requires-dna-tests-pays/29361693/ [Accessed June 27, 2015]*

[66] *Council for Responsible Genetics: http://www.councilforresponsiblegenetics.org/blog/post/17m-DNA-profiles-cut-from-UK-DNA-database.aspx*

including a volunteer's database and a missing person's database. The responsibility for running the NDNAD was transferred from the *National Policing Improvement Agency (NPIA)* to the Home Office on October 1, 2012.

> Significantly, there has never been one legislative instrument or Act of Parliament to establish either the database or the powers of the police on which it relies. Rather, the NDNAD has been facilitated piecemeal by successive amendments to existing legislation, in particular to PACE (1984). To date, there are three elements that characterise a progressively 'layered' set of PACE amendments: first, changes in measures which allow the police to take CJ samples from individuals; second, changes in the provisions which allow the police to retain CJ samples and profiles; and third, changes in the powers granted to the police to speculatively search all retained profiles. (Williams and Johnson 2013, 79)

The Royal Commission created a report in 1993 which recommends three important points,

> …the first is that the police should be allowed to take certain reclassified non-intimate samples without consent; the second is that the police be empowered to obtain such samples in instances of 'serious criminal offences'…and the third is that the police be allowed to obtain a non-intimate sample regardless of its relevance to the investigation in question. (Williams and Johnson 2013, 81)

The creation of the database was made possible by the *Criminal Justice and Public Order Act* of 1994, "in line with the Royal Commission's recommendation, the CJPOA redefined mouth samples as non-intimate and empowered the police to take them without consent. Yet the CJPOA amendments to PACE went beyond the suggestions of the Royal Commission by permitting non-intimate samples to be taken without consent in connection with the investigation of any 'recordable offence' (as opposed to 'serious offence')" (Williams and Johnson 2013, 83). In 2000, Tony Blair predicted that by 2004 an estimated 3 million people, which he deemed to be the entire 'criminal population', would be on the database thereby accelerating the 'war against crime' (H. Wallace 2006).

The Home Office, the Association of Chief Police Officers (ACPO), the Association of Police Authorities (APA) along with independent representative from the Human Genetics Commission manages the data gathered by NDNAD. There are different legislations that apply for Scotland and Northern Ireland; however, both link and export their profiles to NDNAD (Wallace 2006, 27).

The Criminal Justice and Police Act 2001 created a platform for the creation of active profiling of citizens in the UK (Swergold 2010).

> The 2001 legislation can be seen to be the key foundation for the construction of a database comprising the 'active criminal population'. It allowed the police to retain, for indefinitespeculative searching, the profiles of those who, acquitted of previous offences, may come to their subsequent attention as suspects of further crime. With the ability to enact such searches the potential for detection using the database was vastly increased. An inherent proposition of this legislative framework was that the database will hold the profiles of people who, in all other circumstances, are deemed to be innocent.(Johnson, Williams, and Martin 2003, 8-9)

> The enactment of the Criminal Justice Act (2003) further extended the powers of the police to obtain non-intimate CJ samples without the consent from any person in police detention following their arrest for a *recordable offence.* The Act, which grants the police powers to sample, profile and database individuals arrested but not subsequently charged or convicted in connection with a recordable offence, adds a new 'category' of person to the database: the one-time suspect who may never have been charged with a recordable offence and has no criminal record. (Williams and Johnson 2013, 87)

The Forensic Science Service (FSS) was formed in December 2005 under the Home Office and dealt with DNA analysis and maintenance of crime samples. However, it was shut in March 2012 and currently DNA analysis and data-basing is outsourced to private firms in the UK (Goulka et al. 2010).

> …the Council for the Registration of Forensic Practitioners (CRFP) accredits individual forensic practitioners, the UK Accreditation Service (UKAS) accredits laboratories in line with the two major standards: ISO/IEC 17025 and ISO 9000:2000, and the Custodian also has stringent quality criteria and checks. (Nuffield Council on Bioethics 2007, 93)

> In addition to the initial cost of the DNA profiling of the sample, the private companies that perform the DNA analysis charge approximately £4.50 for the first five years of storage of each biological sample, and slightly under £1.00 for each year thereafter. With the number of samples now standing at four million, this is a considerable drain on police budgets, and costs will increase as the NDNAD expands (not least because of energy costs involved in keeping an increasing number of biological samples frozen). (2010,49)

The UK system uses ten loci for DNA testing called the Second Generation Multiplex Plus (SGM+) which is different from the US CODIS; it is in the process of shifting to a sixteen loci system called DNA-17. (NDNAD Strategy Board 2013, 15) *The Counter-terrorism Act 2008* allows for the collection of DNA for identification purposes. (GeneWatch 2011) The DNA Ethics Group is an independent group set up in 2007 to provide advice to Ministers and the Strategy Board on the ethical dimensions of the

database, in 2008 a Forensics Science Monitor was appointed to set standards and monitor for forensic analysis used in court cases. Further a Biometrics Commissioner has been appointed since 2013 to oversee the retention and use of DNA fingerprints. Since 2012, DNA checks are done for prospective police personnel and the results sent to each of the home departments for their discretionary action (NDNAD Strategy Board 2013, 15).

A landmark judgment by the European Human Rights Court (EHRC) given in the case of *S & Marper* delivered on December 4, 2008 decided that the retention of the DNA information and profiles of citizens who have not been convicted is against human rights law. It was found in violation of Article 8 of the European Convention for the Protection of Human Rights and Fundamental Freedoms:

> In conclusion, the Court finds that the blanket and indiscriminate nature of the powers of retention of the fingerprints, cellular samples and DNA profiles of persons suspected but not convicted of offences, as applied in the case of the present applicants, fails to strike a fair balance between the competing public and private interests and that the respondent State has overstepped any acceptable margin of appreciation in this regard. Accordingly, the retention at issue constitutes a disproportionate interference with the applicants' right to respect for private life and cannot be regarded as necessary in a democratic society (GeneWatch UK, n.d.)

This judgment came after the courts in the UK had found it to be constitutional and legitimate to collect DNA profiles and had given their approving judgments.(Toom 2010, 314-15) As a result of the Marper judgment, there was a complete overhaul of the DNA collection enforcement paradigm in the UK. "In May 2011, the Supreme Court made a declaration that that old Association of Chief Police Officer (ACPO) guidelines on the retention of DNA, fingerprints and Police National Computer (PNC) records are unlawful because they are incompatible with the European Convention on Human Rights." The *Crime and Security Act 2010* allows for the capture of DNA from persons already in prison or from those detained under the Mental Health Act. "UK nationals or residents convicted of a serious offence (or found not guilty for reasons of insanity) outside England, Wales or Northern Ireland (whether or not they were punished for it) may have their DNA and fingerprints taken at any time if their records are not already on the relevant databases." (GeneWatch UK, n.d.) The UK also preserves the right to collect

DNA from people for purposes of national security and counter-terrorism. The Independent news website reports that[67],

> The counter-terrorism database contains thousands of DNA samples picked up at crime scenes or after arrests – but often taken covertly during searches of suspects' homes. Ministers have conceded that it can include samples retrieved elsewhere – without permission – from discarded cigarettes or drinks containers, during surveillance operations or when a suspect visits the home of an informer. The ethics advisory group, set up to advise ministers on the proper use of DNA samples, recommended in its last annual report: "All databases containing DNA information including the counter-terrorism database held by the police service should be subject to a robust statutory governance framework, appropriate systems and controls, and should be transparent and only be used for statutory purposes."

Further, a very important *Protection of Freedoms Act 2012* was passed that had specific guidelines and legislation in order to control the unwarranted use and profiling of UK citizenry. (Cape 2013) The NDNAD Strategy Board Annual Report (2014) informs that, "In 2013-14, 1,384,905 DNA profiles from individuals were deleted from the NDNAD. Of these, 1,352,356 of these were deleted under the provisions of PoFA; 31,690 profiles taken by Scottish forces were deleted under Scottish law. A further 6,837 crime scene profiles were deleted because the crimes had been solved."

Mansel and Davies (2012) mention that there are currently over 250,000 children between ages 10 to 18 whose DNA are stored in the NDNAD. The collection of DNA from children reflected in the S and Marper case because it involved the DNA profile of S who was a twelve year old male child who petitioned to have his information removed from the database but was declined until the ECHR judgment intervened on his behalf. The profiles of juveniles and children in the UK are added to the same database that is used for all. Since the creation of the Protection of Freedoms Act in 2012, it has become mandatory for the government to delete the profiles of innocent people from the database. [68]

[67] *Police told to explain use of unregulated DNA database: http://www.independent.co.uk/news/uk/home-news/police-told-to-explain-use-of-unregulated-dna-database-8651380.html*

[68] *For a timeline of the debate on DNA profile retention see webpage of Liberty UK: https://www.liberty-human-rights.org.uk/human-rights/privacy/dna-retention*

The National DNA Database Annual Report (2014, 20) provides the following information regarding DNA retention:

Convictions *

Occurrence	Fingerprint and DNA Retention
Adult – all offences	Indefinite
Under 18 – Qualifying offence**	Indefinite
Under 18 – Minor offence	First conviction: five years (plus length of any custodial sentence), or indefinite if the custodial sentence is five years or more.
Under 18 - Second conviction	Indefinite

Non-convictions

Occurrence	Fingerprint and DNA Retention
Qualifying offence** - arrested and charged	Three years plus possible two year extension by court
Qualifying offence** - arrested not charged	None, but in exceptional cases on application to the Biometrics Commissioner, three years retention may be authorised, plus two year extension by court
Minor offence - Penalty Notice for Disorder	Two years
Minor offence – arrested or charged	None – but speculatively searched

*Convictions include cautions, reprimands and final warnings.

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

The introduction of privacy protection guidelines and their impact on the enforcement and collection of DNA from the population might make it seem that the government is constrained in their data-basing intentions by the efforts of civil liberties groups in the UK. However, as attested by renewed guidelines, any suspect's DNA can be taken and uploaded in the database without them being charged. If the laws demand that the profiles be deleted, even then there are labyrinthine guidelines that enable the containment of the profiles as shown in the figure above. Thus, a person who has once entered the database will be considered a suspect and a possible criminal by the law enforcement machinery. This can be a child, an old woman, a rights protestor or a terrorist suspect. Each one of them will inhabit the NDNAD system to be designated for possible crime detection in the future. The UK is essentially moving towards the data-basing of the whole population that is 'suspected' to be criminal. DNA profiles sketch the criminal profile. (Troy Duster 2004) The UK has the largest population percentage in the world under its DNA database and it is increasing.

Thus we find that in the case of both the US and the UK, what started as a tool of conviction by providing scientific evidence in the court has become a database of current and potential criminals. The ability to check anyone's DNA profile in a database and get a lead for investigation is a powerful tool for the police and other law enforcement authorities. Thus, we see how the body of the criminal is linked with the security of the population. Next, let us look at the transnationalization of these databases due to the impact of globalization. As someone has rightly said, "Globalization is not only about the globalization of jeans, it is also the globalization of germs." Thus we find that globalization has also created its own challenges for the advanced liberal democracies in Europe and beyond.

3.1.3. Transnational DNA assemblage: DNA databases in the EU

DNA has cross-pollinated across the globe via the technological apparatus of the western biotechnological revolution which has been globalized. Hence, almost all the countries of the world have set up their databases or are in the process of setting one up. (Thibedeau 2011) All of them are in awe of the traceability of the criminal and they hope that it will legitimize their justice delivery systems (H. M. Wallace et al. 2014). A singularly unique feature of this phenomenon is that of the European Union because it is composed of twenty-eight nation-states[69] with a common goal of economic and political integration. It is believed that the open borders of the EU countries also create a variety of problems that requires inter-nation co-operation and dialogue. Organized crime (drug trade, prostitution etc.), illegal immigration and the threat of terrorism post a 9/11 world define the locus in which DNA profiling and information exchange takes place in the EU (Prainsack and Toom 2013).

The Interpol is a central collaborator in the effort to fight crime across the world and has its own DNA data-sharing framework which enables the police force of a country to trace a particular sample to a suspect. However, it only acts as a go between and does not database profiles of criminals. The Interpol DNA Gateway was established in 2002 and it contained the profiles of 150,000 people by 2014 that were contributed by police

[69] *"EU member countries" from the European Union Webpage: http://europa.eu/about-eu/countries/member-countries/*

forces from 73 member countries. (INTERPOL 2015) The webpage of Interpol reports that,[70]

> INTERPOL serves only as the conduit for the sharing and comparison of information. We do not keep any nominal data linking a DNA profile to any individual. A DNA profile is simply a list of numbers based on the pattern of an individual's DNA, producing a numerical code which can be used to differentiate individuals.
>
> This profile does not contain information about a person's physical or psychological characteristics, diseases or predisposition for diseases. Member countries that use the DNA Gateway retain ownership of their profile data and control its submission, access by other countries and destruction in accordance with their national laws.

However, with the Prüm Convention being signed by the EU countries there is now an architecture to share DNA profiles across the countries, this has made DNA profiling transnational in Europe. The declaration is a commitment by the EU nations to collectively ensure the security of its citizens by fighting common threats together. It was signed in 2005 between Belgium, Germany, Spain, France, Luxembourg, the Netherlands and Austria. "The Treaty entered into force between Austria and Spain on 1 November 2006, and between those States and Germany on 23 November. Luxembourg has ratified it, and the ratification processes in the other three States party are well advanced. Four other States applied last year to accede: Finland, Italy, Portugal and Slovenia." (House of Lords 2007, 8) The framework is based on the networking power of modern information and communication technologies that enable the capture, retention and transmission of data of subjects from one jurisdiction to another making it accessible to any governmental machinery to check and validate. The webpage of the European Commission details the working of the treaty as providing for, "…the automated exchange of DNA, fingerprints and vehicle registration data, as well as for other forms of police cooperation between the 27 EU States. Access to DNA profiles and fingerprints held in national databases is granted on a "hit/no-hit" basis, which means that DNA profiles or fingerprints found at a crime scene in one EU State can be compared with profiles held in the databases of other EU States. Car registration data (including license plates and chassis numbers) are exchanged through national platforms that are linked to

[70] *Interpol webpage: http://www.interpol.int/INTERPOL-expertise/Forensics/DNA*

the online application "EUCARIS".”[71] For this purpose a Prüm software has been developed jointly by the Bundeskriminalamt (BKA) in Germany, the Ministry of the Interior of Austria and the Netherlands Forensic Institute in the Netherlands. The FBI has also updated its CODIS software to make it compatible with the Prüm software and has provided the updated software to those EU countries that were using the CODIS program to integrate themselves with the Europe network (Van der Beek 2011). The European Standard Set (ESS) is the set of loci used in DNA data-basing for the Prüm software, initially till December 2009 only 7 loci were used however on being found insufficient an additional 5 loci has been added to the ESS from 30 November 2009 onwards (ENFSI DNA Working Group 2014, 9-10). The number of loci in ESS is equal to that of the Interpol Standard Set of Loci (ISSOL) but an Amelogenin[72] locus is added to the ISSOL. (ENFSI DNA Working Group 2015, 8) The task of a common database in Europe involves the humongous aligning of the different legislative criteria which inform the collection and profiling of DNA as elucidated by Christopher Asplen (2012) in a report for the ENFSI where he points to the variety of laws that inform profile entry criteria (convicted offenders, suspects and stains) and sample retention protocols across EU countries. The UK is also legitimately concerned regarding the fact that it holds the largest number of DNA profiles in its database and linking with a Europe wide database will lead to it contributing the most profiles vis a vis other countries (House of Lords 2007, 17). However, the logic of being able to solve unsolved crimes by connecting bioinformation databases trumps the question of inconsistencies in the design of the network. Prainsack and Toom highlight that, “…the Prüm regime also enables law enforcement authorities to link unsolved crimes in their own countries to unsolved crimes in different member countries to the same (as yet unidentified) person; to expose individuals who are registered with different identities in different member countries, and

[71] *“Prüm Decision”: http://ec.europa.eu/dgs/home-affairs/what-we-do/policies/police-cooperation/prum-decision/index_en.htm*

[72] *“Most commercial kits contain the amelogenin marker which is present on both the X- and Y-chromosome. The amelogenin gene on the X-chromosome contains a 6 basepair deletion which results in different PCR fragment lengths and the ability to distinguish male and female DNA-profiles. In rare cases a mutation or a deletion in the amelogenin gene can result in the inability to produce a PCR-fragment which then gives a wrong impression about the gender of the DNA-profile donor.Because the amelogenin marker does not give full-proof results, some companies have added additional Y-chromosomal markers to their newest kits (e.g. Globalfiler, Powerplex Fusion).” (ENFSI DNA Working Group 2015, 15)*

possibly establish their 'true' identity; and to search requests for arrests and whereabouts" (2013,73). These authors have noted that the Prüm regime is an apparatus for the consolidation of bioinformation that is intended to glue Europe together (2013,77-78). Silvia Kierkegaard terms this as an, "uncontrolled fishing expedition in 'Big Brother' Europe" (2008). Standardization procedures have been recommended across the EU countries to enable the interconnection of DNA and biometric profiles which includes the linkability of the different ways in which each country has created their DNA forensics profiling and database architecture. For example, some countries have their own in-house computer software for creating the DNA profiles while others use the US CODIS, both will have to synchronize (see ENFSI DNA Working Group 2015; ENFSI DNA Working Group 2014; Asplen 2012).

The problem of database access has also been noted in the report by the Council for Responsible Genetics, for example, it notes that France uses an Oracle database with WEB architecture while Germany uses BS2000 and the Dutch use CODIS based on MS SQL server (Thibedeau 2011, 76, 81, 113). As Linda Derksen has noted in the case of the US, the creation of the architecture of DNA profiling and data-basing using CODIS involved a lot of micro/macro translations that were intermediated via a construction of normativity in the eyes of the forensic scientists and technicians involved. She highlights that in the beginning most of the people who came together to discuss the set-up did not agree with one another however, consensus was as much manufactured as accommodated by the FBI via a significant expenditure in effort and money. She notes, "the scientific procedures that were used…were very similar, but by 1997, there was a wide-reaching and stable network of social structures supporting the knowledge" (2010, 215-16). The agencies in Europe are also going through this process of consensus creation and the normalization and standardization of their forensic DNA processes and institutions with massive expenditure in manpower and finances.

The sharing of DNA profiles has become international with co-operation between the United States, Canada, the UK, Australia and New Zealand. For example, the *Guardian* reports on November 6, 2014 that the Australian and British Police were going

to share their DNA databases.[73] Also, same newspaper reports on January 15, 2008 that, "Senior British police officials are talking to the FBI about an international database to hunt for major criminals and terrorists…The US-initiated programme, "Server in the Sky", would take cooperation between the police forces way beyond the current faxing of fingerprints across the Atlantic. Allies in the "war against terror" - the US, UK, Australia, Canada and New Zealand - have formed a working group, the International Information Consortium, to plan their strategy."[74]

Besides the industrialized countries, most other countries have DNA profiling facilities and are evaluating the possibility for setting up their own centralized databases. As Kees van der Beek notes, there is currently no detailed and comprehensive study of DNA databases being set-up globally. The only study that is comprehensive is the outdated 2011 report by the Council for Responsible Genetics which evaluates the status of databases and laws pertaining to each country. It informs that fifty four countries had operational databases and twenty six countries were planning to have one. However, as warned by van der Beek, the information is not up-to-date nor all of it correct (ENFSI DNA Working Group 2015,45; Thibedeau 2011). What is clear though is that most law enforcement parties in the world see a lot of benefit in instituting DNA databases of the populations within their territories for fighting crime and other illegal activities and they are willing to expend enormous resources to create a centralized database to this effect. For example, there has recently been much debate in Jamaica over the creation of a DNA law in parliament.[75] There is still a great deal of work to be done to sieve out the creases regarding the threat posed by DNA profiling and data-basing upon the civil liberties enjoyed by citizens in liberal democracies (see H. M. Wallace et al. 2014).

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[73] *"Australian and British police to share their DNA databases" http://www.theguardian.com/australia-news/2014/nov/06/australian-and-british-police-to-share-their-dna-databases*

[74] *"FBI wants instant access to British identity data" http://www.theguardian.com/uk/2008/jan/15/world.ukcrime*

[75] *"Security minister confident DNA Bill will withstand any challenge" http://www.jamaicaobserver.com/latestnews/Security-minister-confident-DNA-Bill-will-withstand-any-challenge*

"Why I oppose DNA law" http://jamaica-gleaner.com/article/focus/20150510/why-i-oppose-dna-law

A very short note at this time is necessary on China's tryst with DNA profiling and databases because of its unique political system, scientific expertise and dense population. I have not been able to find a good and comprehensive article on Chinese DNA databases in my literature review. *GeneWatch* UK informs that their DNA database was set up in 2004[76] and Jianye Ge et al mention that as of May 2013, China had more than 20 million profiles on their database generating 410,000 hits as against the US's 12 million profiles generating 185, 000 hits (Ge et al. 2014, 163). Newspaper reports inform that 5000 students were asked for their DNA samples in a university in China to control theft[77] and that police authorities in Guangzhou collected the samples from 4233 nightclub workers.[78] In a note on promega.com, there is a comment on the creation of firstly, a database on women and children missing or abducted and then a national wide criminal database (Jiang, Li, and Liu, n.d.).

What all of this points to, is the creation of a "***surveillance assemblage***" beginning from the US and UK along with the European countries which has now grown into a worldwide process in which each nation is busy building the infrastructure to replicate the DNA databases. This cuts across any political divide from the most liberal to the most totalitarian countries. All of them are enamoured with the ability of the DNA to catch the criminal as may be defined in each countries laws. As Williams and Johnson note, "The database promises nothing short of a spectral intervention into criminal activity by forming the permanent shadow of an ever present witness" (2004,11). The ability of DNA to produce the criminal and bring him/her to the law for judgment is one of the greatest strengths it possesses. It also gives tremendous legitimacy to the legal apparatus which might be questioned in several ways regarding the ability to deliver justice. Thus, every day we get to hear news about a certain person being caught through DNA profiling and how the bereaved persons loved ones have finally received justice from the law. The law is able to deliver justice it seems better and quicker due to the technology of DNA which provides a clinching proof of evidence. The law is in the business of delivering justice and it does not take into question the social contexts in

[76] *http://www.genewatch.org/sub-566757*
[77] *http://www.globaltimes.cn/content/817443.shtml#.UlqjFhA7I5A*
[78] *http://timesofindia.indiatimes.com/world/china/China-begins-DNA-tests-of-nightclub-workers/articleshow/4896997.cms?*

which crime happens or the criminal is created. The law is concerned only with the criminal as a person and delivers its judgment based on the laws that it has framed for that purpose. Thus, as a tool for identifying the criminals, DNA technology it seems, is unsurpassed in history. For example, recently two inmates from a high-security US prison in New York have escaped and now the police are in a manhunt for these two convicts. They have chased their DNA to some woods in a remote forest where the escapees are supposed to have stayed. This trail of somatic evidence that can be matched with only one person at one time produced the body of the condemned before the sovereign eyes of the law.[79] However, there are consequences that go far beyond the role of the law in delivering a judgment. The law can find out who committed the crime using DNA, however it is also a political-technology.

This political technology of the gene is enabled by the modality of how it functions in society and the way it interacts with already sedimented notions of hierarchies and biases inherent in it, what Foucault calls 'regimes of truth.' Let us take a closer look at it now, firstly, let us look at the infallibility of DNA as evidence on which the whole discourse is based. Many experts in the field have noted that DNA is not fool proof either as a technology or in other forms because it is a part of the network of policing and Simon Cole (2009) has made a correspondence between the historical evolution of DNA and with that of fingerprinting, the same notions of infallibility were also used for fingerprinting and it was only by the normalization of the norms of fingerprinting that it came to be accepted. DNA is also based on a culture in scientific policing which has its own phases of normalization and standardization, leading to a phase of normal science, which remains always a contested space till another paradigm emerges. DNA is as much manufactured knowledge as it is fool proof. There are examples replete on how fallible DNA is in the legal system. Still in spite of this, the judicial framework looks at it as a great tool to fight crime. It believes that the more people there are whose DNA profiles can be known by the state, the easier it will be to control and prevent crime. Whether this has in fact happened is a valid empirical question to ask.

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[79] *"DNA of escapees found in burglarized cabin" USA Today. http://www.usatoday.com/story/news/nation/2015/06/22/escaped-killer-manhunt/29095351/*

However, the idea that there is a potential population of criminals out there creates a dichotomy of the normal and the pathological in society i.e. "the criminal suspects and the law abiding citizens" with the interesting thing being to monitor "how individuals from one group are moved into another, and where the line between the two is drawn…" (Williams and Johnson 2004,10) with this leading increasingly to the whole of society being criminalized as 'genetic suspects' (See Hindmarsh and Prainsack 2010). This is done by '***genetic policing'*** (Williams and Johnson 2013) where you take the sample found in the crime scene, run it in the database, get a 'hit', and then weave your story around the suspect. So, instead of 'innocent until proven guilty' it becomes 'guilty until proven otherwise' (Toom 2010,290).

Next, the question of race surfaces again and again. Dorothy Roberts (2013) has pointed out the way in which genetic technologies discriminate against black people. Here again, Simon Cole and Michael Lynch note that,

> To be sure, new technologies promise to wreak great changes in the making of suspects through police investigation, changes that are both welcomed and feared. But new data mining technologies do not simply create new kinds of suspects; they do so in conjunction with conventional forms of criminal investigation. Moreover, they reproduce many of the racial and other forms of discrimination that characterize discretionary criminal justice practices. Although identified in novel ways, the suspect of the future may end up looking very much like the suspect of the past. (2010,56)

In the US prison system already stuffed with a disproportionate number of minorities it is no wonder where the focus of gathering DNA and utilizing it will lie. It is estimated by Krimsky and Simoncelli that although African-Americans are only 13% of total population they make up 40% in the CODIS (D. E. Roberts 2013b,157). DNA is a tool of law enforcement and it will only enforce its dominion in the social spaces that it finds relevant. Roberts terms this the biopolitics of race based on genetic technologies that leads to mass incarceration of the black male population akin to the effects of the Jim Crow laws in the past. This, she argues, has lead to a racialization of the DNA database. She writes, "while it appears DNA database would decrease mass incarceration…DNA databanks are more likely to intensify it and its collateral consequences" (2010,585). Besides, there is a rich historical record of the US state using identification technologies to control immigration from other countries.

In other words, this discussion illustrates the question posed to Foucault in *Truth and Power* by Alessandro Fontana and Pasquale Pasquino as,

> One would then have on the one hand a sort of global, molar body, the body of the population, together with a whole series of discourses concerning it, and then on the other hand and down below, the small bodies, the docile, individual bodies, the micro-bodies of discipline. Even if you are only perhaps at the beginning of your researches here, could you say how you see the nature of the relationships (if any) which are engendered between these different bodies: the molar body of the population and the micro-bodies of individuals? (Foucault 1980a,124)

It is the relationships engendered between 'the molar body of the population' and 'the micro-bodies of individuals' that describes the movement of DNA from its databases to its singular traits.

Conclusion

A 'genetic governmentality' seems to have emerged in which the individual and society are increasingly geneticized. We have seen how in crime it began as a solution to solving difficult cases and then went on create a database nation in various countries. Also in health, we see how individual genetic risks due to various factors have now been defined based on the overall population as a generator of data to understand diseases. And also, how humans have become the units of the genetic enterprise because each person contributes their unique genetic information to build disease profiles and treatment programmes; this is being commercialized to generate revenue for the companies and nations involved. We have also seen how insurability is increasingly being judged depending on the risk profiles generated from the information that individuals share about their health and in what modality their genetic profiles are linked to criminal records. This has far reaching implications for how humans will enjoy the benefits accruing from the knowledge that their genes provide about themselves and in what way the social landscape defined by the genetic profile is constructed.

Indi*gene*ization

> Yes, science is indeed politics pursued by other means, means that are powerful only because they remain radically other. (Latour 1993, 111)

4.1. India's entwinement with the global genome

This chapter looks at the modality in which the trope of the gene has entered the Indian *terroir*. To achieve this, we need to create a 'cartography of the gene'; an exercise in mapping the terrain that can illuminate the position of this noun in the schema of our everyday reality. To do this, I will present a biopolitical reading of the situation in alignment with Michel Foucault's concept of 'governmentality'(1991a).

The relationship of the gene with India goes a long way back, in my presentation, right to the middle of the revolution in molecular genetics, in the personage of the Indian scientist HarGobind Khorana. He was instrumental in enabling the cracking of the genetic code by Nirenberg and Matthai.Nirenberg writes, "In a remarkable series ofstudies over many years, Khorana and his associates established chemical methods for oligo- and poly-nucleotide synthesis. They were able to synthesize the 64 trinucleotides by chemical methods whereas enzymatic methods were used in our laboratory" (1963, 379; also see 2004, 53). For his contribution in cracking the genetic code, he received the Nobel Prize for Medicine in 1968 and retired as Professor Emeritus at the Massachusetts Institute of Technology (MIT).[80] However, I was surprised to find that as yet, no study exists that tries to gauge the impact of his work and influence on the biotech scientific enterprise in India. In an interesting move, Du Pont, while filing a patent challenge against Cetus Corporation regarding the technology used in Polymerase Chain Reaction (PCR) claimed that there was nothing new in the technology and, "that all of its constituent elements had existed since the late 1960s, when they had been invented in the lab of Nobel laureate H. Gobind Khorana" (Rabinow 1996, 9). Despite Khorana's pioneering work in biotechnology, India 'missed the boat' of sorts when it did not become a part of (or was not interested in becoming a part of) the Human Genome

[80] *Obituary in The New York Times. See http://www.nytimes.com/2011/11/14/us/h-gobind-khorana-1968-nobel-winner-for-rna-research-dies.html?_r=0 [Accessed June 18, 2015].*

Project while being a world leader in both computer software and biotech.[81] India produced the full human genome sequence of an Indian (a 52 year old 'healthy' 'man' from Jharkhand) in December 2009, six years after the Human Genome Project.[82]

This is not to say that India has not engaged with or was isolated from the global genome. Indian researchers have been an intrinsic part of the story of the evolution of genomics. For example, Rabinow mentions that one of the labs in the Cetus Corporation was headed by ChanderBahl, a student of Saran Narang, who was Khorana's collaborator (1996,84). Further, the technology behind the *Illumina* sequencers (http://www.illumina.com/), which is arguably the biggest and best company in the sequencing market right now, heavily owes it leadership to having bought over *Solexa* which was started by the Cambridge chemist Shankar Balasubramanian along with his friend David Klenerman in 1997.[83] The first genetic patent *Diamond v. Chakrabarty*filed by General Electric also involved an Indian scientist Ananda Mohan Chakrabarty, for patenting a genetically modified microorganism strain from *Psuedomonas*that had the capacity to degrade oil and could be used in controlling oil spills (Krimsky 2004, 62).

Further, Rajan (2006, 242-76) mentions an Indian start-up e-learning company called *GeneEd* that created content related to genetics for its clients in Silicon Valley. *Biocon* (http://www.biocon.com/), India's first private bio-tech company was started in 1978 by KiranMazumdar-Shaw (although the company did not do genomics related research) (127-28). Contrast this with Genentech (http://www.gene.com/), which was founded in 1976. We see that corporate biotech also began in India at about the same time the genomics boom began. There is a deep imprint of the American universities and government in setting up the elite institution of science and technology in India

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[81] *It is revealing to know how India missed the boat. Pushpa M. Bhargava, Former Director, Centre for Cellular and Molecular Biology, Hyderabad explicitly explains how the proposal for starting a genome sequencing program in India which was proposed to the Department of Biotechnology (DBT) went into cold storage due to what he refers to as the 'scientific mafia' in the Indian scientific community. See http://www.thehindu.com/2000/11/02/stories/08020005.htm [Accessed June 19, 2015]*
However, as per a news item in Nature, the issues were about the cost of importing equipment, reagents and enzymes and also the focus towards the, "…sequence of DNA of a pathogenic organism that causes disease in Indians than that of a human being." (Jayaraman 1989b)

[82] *"It's here: India's first human genome sequence."*
The Tribune.http://www.tribuneindia.com/2009/20091209/main6.htm[Accessed June 19, 2015]

[83] *See http://www.bio-itworld.com/2010/issues/sept-oct/solexa.html [Accessed June 18, 2015]*

historically, be it the IIT's or IIM's.[84] Also, migration of the *brightest* Indian students to work in America is a reality, the so-called 'brain-drain'. Hence, my argument is that the 'genomic story' in India is coterminous with and deeply influenced by the American story. So, while India was not a part of the Human Genome Project, it definitely has a 'genomic story' which is deeply influenced by scientific developments in America.

Just as in the revolution in IT, we cannot understand the domain of the biotech revolution without taking into consideration the influence of the United States and to a lesser extent, UK and Europe, in molding the paradigm of technology (society) for India. What we also need to consider is that, the imagination of the US as a Mecca for entrepreneurship is still an influential blueprint in the context of India. For example, it is well-known that the shaping of India's policy regarding GMO's has been heavily influenced by the interests of the U.S.(see Engdahl 2007), although there has also been a grass-roots movement to contest this hegemony. For example, Vandana Shiva wrote a book called *Biopolitics: A feminist and ecological reader in biotechnology* (Shiva and Moser 1996) and has fought claims by multinational companies to patent India's biological resources. Suman Sahai initiated 'Gene Campaign'(genecampaign.org) which has been instrumental in pushing for legislation in India protecting bioresources (see Sahai 1999).In the words of Max Weber, "permit me to take you once more to America, because there one can often observe such matters in their most massive and original shape" (1946,149). I too will follow this path to comprehend the contours of India's tryst with the gene.

This is a story that is mediated by the global flows in capital (not only economic capital per se). Arjun Appadurai writes in his book *Modernity at Large,*

> Thus, the central feature of global culture today is the politics of the mutual effort of sameness and difference to cannibalize one another and thereby proclaim their successful hijacking of the twin Enlightenment ideas of the triumphantly universal and the resiliently particular…global cultural processes today are the products of the infinitely varied *mutual contest of sameness and difference on a stage characterized by radical disjunctures between different sorts of global flows and the uncertain landscapes created in and through these disjunctures*. (1996,43; *emphasis added*)

[84] *See http://web.mit.edu/india/pdf/India-Prospectus-11.30.07.pdf [Accessed June 21, 2015]*

He projects five "*scapes"* that mutually inform each other, namely: *ethnoscapes, mediascapes, technoscapes, financescapes and ideoscapes* (1996,33). For my purpose, I will focus on *technoscapes;* which he defines as, "the global configuration, also ever fluid, of technology and the fact that technology, both high and low, both mechanical and informational, now move at high speeds across various kinds of previously impervious boundaries" (1996,34). *Technoscape* is equally dependent on all the other scapes and they over-determine each other by mediating and composing each other at different and disjunstural levels.

> But the critical point is that the global relationship among ethnoscapes, technoscapes, and financescapes is deeply disjunctive and profoundly unpredictable because each of these landscapes is subject to its own constraints and incentives (some political, some informational, and some techno-environmental), at the same time as each acts as a constraint and a parameter for movements in the others. Thus, even an elementary model of global political economy must take into account the deeply disjunctive relationships among human movement, technological flow, and financial transfers.(Appadurai 1996,35)

He proclaims that this leads to two effects: *fetishism of the consumer,* whereby,

> the consumer has been transformed through commodity flows into a sign, both in Baudrillard's sense of a simulacrum that only asymptomatically approaches the form of a real social agent, and in the sense of a mask for the real seat of agency, which is not the consumer but the producer and the many forces that constitute production (1996,42)

And *production fetishism,* that is,

> an illusion created by contemporary transnational production loci that masks trans-local capital, transnational earning flows, global management, and often faraway workers (engaged in various kinds of hi-tech putting-out operations) in the idiom and spectacle of local (sometimes even worker) control, national productivity, and territorial sovereignty…This generates alienation (in Marx's sense) twice intensified, for its social sense is now compounded by a complicated spatial dynamic that is increasingly global. (1996,41-42).

Hence, keeping in mind this logic of *global flows* mediated by the *five scapes*, which release both *fetishism* in the *consumer* as well as *production,* we can locate how the global genome (Thacker 2006) interacts with, and informs the political, social, economic and cultural existence in India. This phenomenon of situated-ness at the center of these flows, and the interactions with it by constant negotiation on multiple levels, is

what is defined as 'network governance'[85]. The gene that I will talk about in this chapter is both a globalized gene and a localized gene at the same time. Only by situating the local gene at the context of the global gene and vice versa can we make any sense of the modality in which gene 'flows' here.

I will begin with a question, "what is in it for India to pursue genetic technology?" This question will have many answers depending on whom one asks this question to. For my purpose, I will look at the placement of India in the stage of global powers whose might as a competitive nation depends crucially on its expertise in scientific technology and how it can use it for economic, societal or political gains. If we look at the question this way, then the issues related to why India is moving in a particular direction in the use of genetic technologies might be fruitfully probed and conceptualized. As the saying goes, "There is no economy outside of political economy" (and here I take 'economy' in the Foucauldian sense of 'the art of government'(see Tadros 1998,91)).[86] Or in the words of Eugene Thacker, "genomics as a political economy of the genetic body" (2006,94). Here, it is important to highlight, that for me, the 'genetic body' is *both* the body of the individual and the social body. In the Indian context, I can describe the dialogue with the gene as one of 'Keeping up with the Joneses'. In the remainder of this chapter, I will highlight specific instances of how I reach this description, and also, the specific localization of such a commitment for the Indian citizenry.

First, I would like to locate the trajectory of the gene in the larger framework of the pursuit of techno-science in India. As I have already mentioned, India 'missed the boat' when it did not pursue the human genome profiling program of the Human Genome

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[85] *Today the political arena is populated by a multitude of autonomous actors who create patterns of structured co-operation despite the absence of a central organizing authority. Increasingly, local and national patterns of governance blend into transnational and global forms of policy-making. At the same time, new forms of governance emerge that take on a variety of forms that coexist in one and the same field. Unidirectional forms of governance such as top-down governance or bottom-up governance coexist with multidirectional forms of governance, such as network governance. (Gottweis 2005,176) Also see "Biobank governance: heterogeneous modes of ordering and democratization" (Gottweis and Lauss 2012)*

[86] *"The art of government, as becomes apparent in this literature, is essentially concerned with answering the question of how to introduce economy – that is to say, the correct manner of managing individuals, goods and wealth within the family (which a good father is expected to do in relation to his wife, children and servants) and of making the family fortunes prosper – how introduce this meticulous attention of the father towards his family into the management of the state." (Foucault 1991,92; emphasis mine) Also see Lemke (2002,57-58).*

Project (HGP) in which countries like Japan and China participated. Japan already had a long tradition of being world class in all sectors of technology, however, the experience that China gained from participating in the sequencing of the human genome has catapulted it to being a world leader in sequencing, with the Beijing Genomics Institute (BCI)[87] being the frontrunner in genomic sequencing worldwide today.

This incident and the increasing importance of genetic sciences in the world, which is linked to the 'might' of a country, has pushed India to create an ecosystem which will enable it to 'leapfrog' its way into the global genome enterprise. Biotechnology, and within it, genetic sciences (here I include all the variants of the scientific study of genetics), is a strategic tool for national security as it is closely linked with military and industrial use. It can also be highly advantageous in terms of increasing the health of the population. Thirdly, the economic advantages also come to the fore, wherein India can project itself again as a world class, low cost destination for genomic research. Finally, India has all the population it needs to do clinical trials and population genomic studies to make it a world leader in this technological domain. As Glasner (2009) notes,

> For the first time, the Indian state is attempting to generate biovalue by reinvesting its surplus of viable citizens in the liberalized and booming economy. The fact that this (re)investment of surplus citizens is seen as morally unproblematic validates the process. The trials are reportedly conducted by fastidiously keeping to the twin (neoliberal) legitimating mantras of "informed consent" and "ethical review". This has a sanitizing effect on the process of clinical trials, bestowing official legitimacy through state-sponsored ethical guidelines and safeguards. In reality, however, there is growing evidence to suggest that a majority of participants remain unclear about the exact modality of administering drugs and the intricacies involved in consenting to the received information. (2009,285)

To achieve this end, the government of India has pursued an aggressive policy of supporting biotechnology and related disciplines so that it can once again become self-sufficient and independent in its position *vis a vis* other competing nations in both the developed and developing countries. India has always placed itself as the 'technology transfer power' for the rest of the developing nations in their scientific pursuits, and for meeting their medicinal requirements. Further, Prasad (2009) succinctly highlights the

[87] *http://www.genomics.cn/en/index [Accessed July 20, 2015]*

selling of the poor and desperate Indian's (most likely females/Muslims/dalits/adivasis) diseased body as a resource for clinical trials to pharmaceutical companies in the global market, when he writes that "…characteristics of the Indian population, which were for long considered hindrances to India's development…have become 'assets'. They have come to constitute a human capital with starkly different characteristics from, say, the software engineer who has become the iconic Indian human resource" (2009,6).

Sribhargava Natesh and M.K. Bhan, two scientists working in the Department of Biotechnology of the Government of India explain the relevance of pursuing biotech in India and how it is being designed by the technocrats. The government is investing a huge amount of money in creating and supporting academic institutions with large numbers of scholarships for pursuing studies in science esp. biological (life) sciences. It also has a tie-up with many foreign universities and governments to enhance the current level of scientific knowledge in India. This partnership with private players is aligned to replicate the US model of academic-industry tie-up and innovation that gave birth to the molecular genetic revolution in the US. For this, the government has set-up the Biotechnology Industry Research Assistance Council (BIRAC)[88] to facilitate the smooth transfer of knowledge from academia to industry, and to incubate potential biotech start-ups into profit making companies. This is in alignment with the observations of Rajan (2006) wherein he locates the Indian state as itself acting like a corporate (India Inc.) that positions itself in the global market of techno-science (in his case biotech), giving direct competition to firms in the global arena. Thus he maintains that we should look at India as a part of the capitalist landscape of biocapital, in which there is an alignment of the biological sciences with capitalist profit making; *biocapitalism*.

Vijay Raghavan, secretary of Department of Biotechnology, who is currently working on creating this architecture, is a graduate of Caltech, which, as I have pointed out in Chapter 1, was closely linked with the birth of molecular biology; what Lily Kay terms, 'the molecular vision of life', *and* also has its own eugenic past (1993,1-21). He looks at the current situation of the 'life sciences' (or in simple parlance: biology) in India and has a vision of creating a 'world-class' human and technical expertise which

[88] *http://www.birac.nic.in/*

will catapult India into the *select league of nations*. This will specifically be a profitable enterprise. Hence the idea of techno-scientific pursuit is never divorced from the economic gains that it will present to the nation.[89] He advocates using the locational advantage of South Delhi with institutions like Jawaharlal Nehru University, National Institute of Immunology, the Indian Institute of Technology, Delhi, the National Institute of Plant Genomic Research and the All India Institute of Medical Sciences.[90] He plans on building an inter-institutional network for research and development, leading to outcomes that are directly linked to new discoveries, and thereby creation of new drugs and treatment plans. Therefore, his vision is to build an ecosystem where basic research (in JNU for example), will be partnered with bio-engineering (IIT), which will be linked to clinical trials (AIIMS), which can then be aligned with the private-public model of biomedicine in India and the world. Taking the example of JNU alone, there is the Centre for Biotechnology which came up in 1985, the Centre for Life Sciences which came up in 1970, the Special Center for Molecular Medicine, the School of Nanoscience (estd. 2010), The School of Computational and Integrative Sciences (estd. 2010). All these institutions, if you examine closely, are linked with the 'molecular vision of life'. All the centers are also interlinked, for example, the Centre for Bioinformatics is a crucial component that can be linked with Molecular Medicine and so on. It is a package in which the current paradigm of computational biology functions. These new age centers are crucial in re-designing the way in which biological sciences are researched and also align with global knowledge networks. Plus, there is close contact between the leadership in each of these institutions within South Delhi and nationwide.

This is just a part of the nationwide network of institutions that have been created with the explicit agenda of putting India into the global biotech map as a world leader (See Natesh and Bhan 2009). Ranjan (2006,79,90) talks about Genome Valley, which Chandrababu Naidu, when he was the Chief Minister of undivided Andhra Pradesh, created to bring together 'biotech entrepreneurs' so that it can become a sort of Silicon Valley in India. He notes that,

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[89] *"The Anti-bureaucrat."Nature.Seehttp://www.nature.com/news/indian-bioscience-the-anti-bureaucrat-1.17517 [Accessed June 21, 2015]*

[90] *DNA@70, Wellcome Trust – DBT India special talk at National Institute of Immunology, New Delhi.*

> Hyderabad, which, along with Bangalore, has been the favoured city for the repatriation of capital and expertise to set up high-tech industries in India (initially mainly information technology, but now increasingly biotechnology as well), has designated six hundred square kilometers of land called "Genome Valley," explicitly conjuring an image, and thereby, it is hoped, eventually a reality, of an entrepreneurial technoscientific haven on the model of Silicon Valley. (2006,227-28)

Not only this, there are other places like Genome Valley viz. Technology Business Incubators (DST) (www.nstedb.com); ICICI Knowledge Park, Hyderabad; S&T Park, Bangalore; TICEL Park, Chennai; Agri-food Biotech Park, Mohali; Agri-Incubator, University of Agricultural Sciences, Dharwad; Agri Business Incubator and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad (DST) (Natesh and Bhan 2009,165). There are a lot of tie-ups happening with foreign (mainly US) institutions for enhancing the manpower in biotech in India, for example, there is the MIT-India Initiative (http://web.mit.edu/india/), the Stanford - IIT Delhi - AIIMS collaboration (http://biodesign.stanford.edu/bdn/india/) specifically. At a larger level, there is the Indo-US Science and Technology Forum (http://www.iusstf.org/). The website mentions that

> The Indo-US Science and Technology Forum (IUSSTF), established under an agreement between the Governments of India and the United States of America in March 2000, is an autonomous, not for profit society that promotes and catalyzes Indo-US bilateral collaborations in science, technology, engineering and biomedical research through substantive interaction among government, academia and industry. As a grant making organization, the principle objective of IUSSTF is to provide opportunities, to exchange ideas, information, skills and technologies, and to collaborate on scientific and technological endeavor of mutual interest that can translate the power of science for the benefit of mankind at large.

Further, the *Wellcome Trust* of UK which is at the forefront of molecular genetic research in the world, has a tie-up with the Department of Biotechnology in India. (http://www.wellcomedbt.org/). Its website states that,

> The Wellcome Trust/DBT India Alliance is an £160 million initiative funded equally by The Wellcome Trust, UK and Department of Biotechnology, India. The broad aim of the India Alliance is to build excellence in the Indian biomedical scientific community by supporting future leaders in the field.

The Translational Health Science and Technology Institute (Faridabad) has a tie-up with the Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of

Technology. Another example of the creation of the eco-system is to be found near Surajkund in Faridabad. Shiladitya Sengupta, Professor, MIT writes that

> The new campus is being developed on a 200 acre land on the scenic Aravalli Ranges, right next to Badhkal Lake in Faridabad area of the NCR Delhi, and very close to Surajkund, a tourist attraction. The close proximity to the other cluster institutes and centers, including a Center for Vaccine and Infectious Disease Research, Center for Child Biology, Center for Chronic Biology, a Center for Nanomedicine, and the more disciplinary Regional Center for Biotechnology Training and Education (RCB) under the aegis of UNESCO, will offer unique collaborative opportunities and access to cutting edge technology platforms and intellectual capacity. While the infrastructure comes up in Faridabad, THSTI has already started operating from leased laboratory and office space in Gurgaon.
>
> The final composition of the entrepreneurial faculty will be a rich and diverse mix of expertise bridging basic sciences, engineering sciences and medicine, which can enable translation of an idea from the bench to the bedside[91]

This network of manpower and materials defines the global genome in the sense that, it is quite impossible to diagnose the pathway of genetic technologies in India without taking into consideration the political economy of technoscience in the world mediated by the forces of globalization and neo-liberalism. Looking at all the examples mentioned above, I am inclined to agree with Rajan's analysis when he writes,

> The larger theoretical question here becomes one of mapping the articulations of technoscience, capital flows, and global governance, and of asking how these articulations enable us to understand emergent forms of knowledge production and technological innovation, emergent forms of capitalism, and the relationship between various levels – global, regional, national, and sub-national – of governance. (2006,79)

Herbert Gottweis also noted this point when he wrote, "The state is only one actor next to many others in the shaping of biomedical futures. Finally, the governance of genomics clearly transcends the local and national sphere and operates economically, socially and politically on a global level." (2005,188)

Having laid out this globally mediated aspect of biotech research in India, I will now look at specific instances to examine the modality in which the gene flows in the Indian terrain. I will attempt to trace the contours of the biopolitics of DNA within the Indian scenario. To do this, again, I will follow the two nodes of criminality and health.

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[91] *http://indiabioscience.org/jobs/translational-health-science*

3.2. Genes and Crime in India's DNA

DNA testing was first used in India in 1989, within five years of the creation of DNA fingerprinting by Alec Jeffreys (Jayaraman 1989a). 1991 saw a high profile case to settle a paternity dispute under the Kerala High Court (Verma and Goswami 2014,184). Interestingly, in this case, the person charged refused to accept the infallibility of the DNA report that came out of the Centre for Cellular and Molecular Biology in Hyderabad by stating that, "the process and techniques developed by him are in his own way and they are not having (sic) the reliability available for the test in western countries."[92]This is referring to the process developed by Dr. Lalji Singh to create the DNA probe by using the venom from the snake species 'Banded Krait' (*Bungarusfasciatus*)[93](see Singh et al. 1994). In this case, "it was thereafter that the parties were permitted to adduce evidence and they let inoral and documentary evidence."[94]Since then, the use of DNA testing has become common place in the Indian legal system. The police routinely use DNA fingerprinting as evidence to prove the crime that the accused is guilty of. For example, DNA fingerprinting was used in the high-profile murder case of Aarushi Talwar. This case can be likened to the OJ Simpson case in the publicity and media hype it generated, it also tellingly points to the way in which the police is ill equipped in handling sensitive crime scene samples. Further, as was in the case of OJ Simpson, the DNA 'evidence' could not 'prove' beyond reasonable doubt who killed the victim (see Sen 2015). It is a telling reminder of what this 'technology of truth' can and cannot accomplish.[95]Even politicians have not been able to escape its clutches as in the case of the Indian National Congress leader N.D. Tiwari, whose DNA tests confirmed that the appellant Rohit Tiwari

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[92]*KunhiramanvsManoj, II (1991) DMC 499.See http://indiankanoon.org/doc/115193/ [Accessed July 9, 2015]*

[93] *"Charm of snakes led this scientist to DNA fingerprinting" The Times of India. See http://timesofindia.indiatimes.com/city/varanasi/Charm-of-snakes-led-this-scientist-to-DNA-fingerprinting/articleshow/15162804.cms [Accessed July 9, 2015]*

[94] *See footnote 11.*

[95] *"Aarushi trial: A double murder of forensics and investigation". Firstpost.com. See http://www.firstpost.com/india/why-the-aarushi-trial-was-a-double-murder-of-forensics-investigation-1250025.html. "How circumstantial evidence held key to the Talwars' murder conviction". Dailymail.co.uk. See http://www.dailymail.co.uk/indiahome/indianews/article-2513462/How-circumstantial-evidence-held-key-Talwars-murder-conviction.html[Accessed July 10, 2015]*

was indeed his biological son after having vehemently denied it initially.[96] Further, Article 20 (3) of the Constitution of India protects citizens from 'self-incrimination', however, it is not really clear where DNA evidence falls in this criteria. As for the 'Right to Privacy' guaranteed by the Constitution under Article 21, various judgments like *Govind Singh v. State of Madhya Pradesh* and *Kharak Singh v. State of Uttar Pradesh*have pointed to it being not-so-fundamental at all. Basically, there is no equivalent of the Fourth Amendment of the US[97]in Indian law. However, it was only after Ratan Tata approached the courts with the plea that his privacy was compromised in the Nira Radia tapes issue[98] that the government began the process of producing a right to *Privacy Bill* which is pending for installation[99], however, the intelligence agencies have already begun demanding a 'blanket exemption' from this bill. *The Economic Times* reports,

> However, ET has learnt that the Home Ministry has informed the Department of Personnel and Training piloting the bill that Intelligence agencies are not satisfied with the rider. "The Home Ministry has said that establishing in each case, that an action of the agencies was in the interest of integrity, security and sovereignty of the country is not only practically difficult but will lead to litigation. The Home Ministry hence wants blanket exemption for the agencies from the bill," a senior DoPT official told ET.[100]

Commenting on the *Right to Privacy Bill 2014*, Greenleaf (2014) notes incisively,

> A 2012 report on proposed UID legislation by a parliamentary committee headed by BJP leader Yashwant Sinha, was severely critical of the UID on many grounds, including its registration of non-citizens, its duplication with the NPR, the security and integrity of its enrolment processes, and the lack of any corresponding data privacy legislation. Expanded use of personal identifiers such as the UID are one reason the Notes to the draft 2014 Bill say 'a need has been felt' for data privacy legislation. It remains a strong possibility that these two issues will be dealt with together.(5)

I would like to add another to this assemblage of UID, NPR and Privacy i.e., the *DNA Profiling Bill.* DNA forensics was pioneered by Dr. Lalji Singh, who also became an

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[96]*RohitShekharvs Narayan DuttTiwari&Anr. See http://indiankanoon.org/doc/170781909/ [Accessed July 10, 2015]*

[97] *"DNA Databanking : Selected Fourth Amendment Issues and Analysis." (Barbour 2011)*

[98] *See, "Ratan Tata & Right to Privacy?" Moneycontrol.com. http://thefirm.moneycontrol.com/story_page.php?autono=502063[Accessed July 20, 2015]*

[99] *"Leaked Privacy Bill: 2014 vs. 2011. Centre for Internet and Society. See http://cis-india.org/internet-governance/blog/leaked-privacy-bill-2014-v-2011 [Accessed July 25, 2015]*

[100] *"Intelligence agencies demand 'blanket exemption' from Right to Privacy Bill." Economic Times.See http://articles.economictimes.indiatimes.com/2015-03-17/news/60212173_1_intelligence-agencies-privacy-bill-home-ministry [Accessed July 11, 2015]*

expert scientific witness in many court cases(Madhusudan and Singh 2012; L. Singh 2012).He was also the brain behind setting up of the Centre for DNA Fingerprinting and Diagnostics in 1995.[101]In India, DNA samples are primarily sent to government research laboratories where scientists create the report and send it back to the court. They will also come as expert witnesses in the court if required. Till date, I am not aware of any case involving DNA in the Indian legal system where the evidence as has been seriously challenged on technical grounds. DNA evidence has quickly become a 'gold standard' in the Indian legal evidence system. As Jay Aronson in his book *Genetic Witness: Science, Law, and the Controversy in the making of DNA profiling* (2007) writes, "DNA is to justice what the telescope is to the stars: not a lesson in biochemistry, not a display of wonders of magnifying optical glass, but a way to see things as they really are. It is a revelation machine."(quoted in Caudill 2008,691) However, he further notes that,

> There is a general unwillingness to admit that for all the improvements made to the technique over the past two decades, the potential for serious error in DNA evidence still exists. As a result, there is still no effective means for calculating error rates in DNA testing, no explicit standards for interpreting the complex results that emerge from biological stains in which there are multiple contributions, and, most important, no agreed-upon method for conducting proficiency testing in the dozens of DNA labs around the country.(quoted in Caudill 2008,691)

Here it is important to highlight an important point regarding DNA evidence which isthe fact that the diagnostic center is only and strictly involved in receiving the sample, analyzing it, creating the report and then sending it back. If required, a scientist from the laboratory will go to the court for testimony to provide explanations regarding the validity and correctness of the DNA tests, it does not tell who committed the crime. For example, a politician can send in the sample of another person so that he does not have to go to prison by being convicted through his DNA samples although he might have committed the crime. In another example, we can look into cases related to DNA theft or DNA forgery, wherein Mr. X's DNA is implanted by Mr. Y with malicious intent. "Unfortunately in India the legislation to deal with the issues pertaining to 'DNA theft' or DNA forgery does not exist and no concern have been raised so far either by forensic scientists, legal scholars, legislators or judiciaries on this specific issue." (Verma and

[101]*http://www.ccmb.res.in/staff/lalji/*

Goswami 2014,187) The reason I point to these possible situationsis due to the fact that DNA evidence is embedded in a whole culture of how police investigations are conducted. The whole assemblage in which DNA forensics can function depends heavily on quick response from the police, trained forensic personnel, the crime scene being sanitized as soon as possible, the sample to be collected quickly and carefully and placed in a safe and secure place so that it is not polluted nor degraded due to environmental factors and the list goes on. This is to say that for DNA evidence to work, the whole machinery of law enforcement has to be synchronized. This requires a lot money, men and managers. Clearly, the current capacity of the Indian law enforcement system is not geared towards achieving this ideal scenario, hence the risk of police and local judicial and medical authorities smudging the evidence is very likely to happen. As Verma and Goswami (2014) point out,

> Many times lack of training to investigating agencies, about procedural aspects of DNA sample collection, also produces misleading results. During his scientific career as a DNA expert, SKV (one of the author of this review) has witnessed the forwarding authority sending – (i) ash collected after cremation of a body; (ii) one or even two bucket full of meat to establish the identity of the species of a deceased wild animal; (iii) flesh cut from the hands of alive couple to establish parentage with a mutilated dead body of the child. (184)

Even in places like the United States and other developed countries where the infrastructure of the police machinery is much more high-tech and robust incidences have come to the fore regarding how the authorities have contrived evidences to convict people(see Aronson 2007,203-12). However, it seems that the government is willing to take that risk and is judiciously working towards scaling up its ability to use forensic science based DNA policing with the creation of forensic science based institutions in India. The Ministry of Home Affairs even celebrated 2010 as the Year of Forensic Science.[102]As per the government's own consultancy report, India does not seem to have the capability to pursue DNA forensics without severely compromising on the quality of the cases (Ministry of Home Affairs 2010). Having said that, the number of forensic science courses in India has increased manifold in the last few years, thus producing

[102] *See http://www.anilaggrawal.com/ij/vol_011_no_001/others/editorial.html [Accessed July 20, 2015]*

more manpower to handle these tasks. However, as Simon Cole informs us, the 'quality' of manpower has historically deteriorated in the US and UK.

> When forensic DNA typing was new, it was performed by research scientists, who were the only people competent to do the work. Once the problems had been ironed out and the basic protocols set up, however, DNA typing became fairly routine. Those doing genetic identification work now range from Ph.D. scientists to technicians with hands-on experience and college educations. The recovery ofDNA evidence from crime scenes requires somewhat less training: how to locate, preserve, lift, store, and transport biological samples.(2009,298)

The government has also opened up institutes like LNJN National Institute of Criminology and Forensic Science, New Delhi (http://www.nicfs.nic.in/) in 2003, Gujarat Forensic Sciences University in 2009, the Institute of Forensic Science and Criminology, Panjab University in 2009. The Centre for DNA Fingerprinting and Diagnostics (http://www.cdfd.org.in/) in Hyderabad is the premier centre in India set-up in 1990. The Central Bureau of Investigation has its own lab named Central Forensic Science Laboratory (http://cbi.nic.in/cfsl/about.htm) that was created in 1968 with six branches in Chandigarh, Kolkata, Hyderabad, Bhopal, Pune and Guwahati under the Directorate of Forensic Science Services (DFSS).[103]Besides the CBI, many state police have also set-up their own state-specific forensic lab, for example, the AP Forensic Science Laboratories (http://www.apfsl.gov.in), Tamil Nadu Forensic Sciences Department (http://www.tn.gov.in/tamilforensic/default.htm),State Forensic Science Laboratory, Odisha (http://odishapolice.gov.in/?q=Forensic) and State Forensic Science Laboratory, Jharkhand (http://www.jhpolice.gov.in/sfsl). *The Times of India* reports that the Uttar Pradesh government is planning to create 18 new forensic labs with an investment of more than Rs 600 crore because it is, "struggling with poor conviction rates and sluggish investigations."while the same report mentions that,"more than 40% posts in the lower rung personnel are lying vacant."[104]Besides the facilities being run by the government, many private companies have opened shop to provide services in DNA fingerprinting. Some of them are DNA Labs India, Hyderabad (https://dnalabsindia.com);Bio-Axis DNA

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[103]*http://mha1.nic.in/par2013/par2013-pdfs/ls-110214/3300.pdf*

[104] *"UP to get 18 new forensic labs." Times of India.*

See http://timesofindia.indiatimes.com/city/lucknow/UP-to-get-18-new-forensic-labs/articleshow/46869792.cms [Accessed June 23, 2015]

Research Centre (http://www.bioaxis.in/) and Truth Labs, Hyderabad (http://www.truthlabs.org/).[105]

The Centre for DNA Fingerprinting and Diagnostics (CDFD) was set up in 1990. It has dealt with a lot of high profile cases and provided DNA reports in many cases as per the requirement of the police and the judiciary. As per my knowledge, till date there has been no independent audit of the facility as per quality guidelines for DNA forensic labs. Also, the facility is not certified as per world required quality standards. Further, news has come in recently that it has incorporated the CODIS software into its facility to enable building a database of missing persons, which I read to be a pilot project for expanding it to the National DNA database when the times comes for its implementation. It seems that the FBI will train Indian scientists in using the software and creating the database. This is being done without any consultation regarding the choice of software to use and whether this specific software is conducive to be used in the India population cohort. Further, for all the talk about India's strength in IT, the option of creating an indigenous software has not come about. In the lack of any open democratic and scientific debate for the incorporation of this software, it just means that India wants to replicate or clone, in the best possible manner, the surveillance infrastructure of the United States of America. Recently, the FBI has admitted to data errors in calculating DNA probabilities that put into serious question the applicability of using DNA as evidence in the court because it seems that DNA is not indeed as 'fool-proof' as it is made out to be. *USA Today* reports,

> The blunder stems from "allelic frequency tables" compiled by the FBI and used by nearly all crime labs in the country, Roth said.
>
> The tables contain 1,100 people meant to represent a sufficiently random sample to give a sense of how rare certain alleles — gene variants at different locations — are in the population at large.
>
> It's these tables, she said, that allow forensic scientists to calculate and explain to juries the statistical significance of a DNA match between a defendant's DNA profile and the DNA sample collected at a crime scene.
>
> So when prosecutors tell juries a certain profile will match one out of a certain number of people in a population, they typically are gleaning that probability from these tables.

[105] *"An Overview of DNA labs in India."The Centre for Internet and Society.See http://cis-india.org/internet-governance/blog/privacy/dna-overview [Accessed June 23, 2015]*

> But some of the profiles in the tables contained discrepancies, the FBI admitted.
>
> For instance, instead of one marker at a certain location showing up in 5 percent of the people in the table, it could actually show in 10 percent of the people in the table.
>
> In other words, "it's not as rare as the FBI made it out to be," Roth said in an e-mail.[106]

This story further notes that the FBI knew about this and did not do anything. Hasan Buker's book *Fraudulent Forensic Evidence: Malpractice in Crime Laboratories* (2012) provides a perspective of how crime laboratories are also prone to fraud and malpractice in the United States. Moreover, in a seminal study of 17 North American expert DNA examiners who were asked to interpret DNA to check on contextual bias, Dror and Hampikian (2011) report that they produced 'inconsistent interpretations'. They note, "the majority of 'context free' experts disagreed with the laboratory's pre-trail conclusions, suggesting that the extraneous context of the criminal case may have influenced the interpretation of the DNA evidence, thereby showing a biasing effect of contextual information in DNA mixture interpretation"(2011,204). Further, as beautifully explained by Katie Worth in her article *Can DNA testing be trusted? The shockingly imprecise science of a proven courtroom tool*, there is a plethora of errors that can happen in taking DNA as evidence from the crime scene to the courtroom. She writes,

> Scientists are still exploring the circumstances and ease with which DNA can travel. Many of our cells and fluids — skin, saliva, sweat, and mucus — routinely find their way into our environment. If conditions are favorable, our genes can wind up places we've never been. After Silicon Valley millionaire Raveesh Kumra was killed in his 7,000-foot mansion in November 2012, police discovered the DNA of Lukis Anderson, a 26-year-old homeless man, on his fingernails. But hospital records indicated that Anderson was unconscious in a hospital bed while Kumra asphyxiated nine miles away.
>
> Anderson spent five months in jail while lawyers and investigators pondered how he could have committed the crime. Finally, they realized that the paramedics who transported Anderson to the hospital had also responded to the homicide. They had clipped an oxygen-monitoring probe to Anderson's finger that morning, and to Kumra's that afternoon. Anderson's DNA had gone along for the ride.(Worth 2015)

From being used as evidence to prove crime in law enforcement, the plan of the Government of India (GoI) is to use it for preemptive and identification purposes. This is

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[106] *"Crime-scene DNA errors spark complex legal questions." USA TODAY.See http://www.usatoday.com/story/news/nation/2015/06/22/crime-scene-dna-errors-legal-questions/29119501/*
[Accessed June 23, 2015]

the reason why it is intent on creating a National DNA Database that will hold the profiles of its citizens; now, will that be the total population or only a subset? For example those convicted of crime or missing persons only? What about children and juveniles? The news that is coming out in the media point to the fact that the authorities are using the ability to identity missing persons as a tool of sell the idea that DNA databases should be created. The army already has a policy for the creation of a DNA database of its personnel in India.[107] However, this promise of 'genetic justice'(S Krimsky and Simoncelli 2013) does not seem to have materialized in the Shopian rape and murders of two sisters, one 17 year old and the other 22 years old. There is evidence that the samples of biological specimens were fabricated. *The New India Express* reports that,

> According to reports, the Central Forensic Sciences Laboratory (CFSL) in New Delhi has found that the DNA profile of tissue cells present in the slides sent by the Kashmir police do not match with the samples from the victims' blood and viscera.
>
> The slides, said to have been prepared from vaginal swabs of the victims, were apparently drawn from other women.[108]

The Committee on Reforms of the Criminal Justice System created by the Ministry of Home Affairs under Dr. Justice V.S. Malimath (2003) had already recommended the strengthening of forensic infrastructure and the amendment of the *Identifications of Prisoners Act 1920* to include, "taking from the accused finger prints, footprints, photographs, blood sample for DNA, finger printing, hair, saliva or semen etc., on the lines of Section 27 of POTA 2002" (2003,276) and the inclusion of DNA experts in court cases (2003,284). The DNA Profiling Advisory Committee consisting of members from the Department of Biotechnology and the Centre for DNA Fingerprinting and Diagnostics (CDFD) proposed a National *Human DNA Profiling Bill* in 2007 and then again due to severe criticisms by civil society actors, an updated and revised bill in 2012 which has been put on cold storage in the parliament because legislators have not been

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[107] *"Indian Army to store soldiers' DNA profile" The Hindu. See http://www.thehindu.com/news/national/indian-army-to-store-soldiers-dna-profile/article4643751.ece [Accessed July 14, 2015]*

[108] *"Government offers CBI probe into Shopian rapes" The New Indian Express. See http://www.newindianexpress.com/nation/article68683.ece?service=print [Accessed July 14, 2015]*

able to agree on it, and the government itself has proposed that it does not have the infrastructure (in terms of human resources, machinery et al.) to be able to create a DNA database. As reported by *DNA* news portal, the government had cited "privacy concerns, lack of experts and handful of laboratories" as reasons of delay in pushing the bill forward in response to the PIL filed by Lokniti Foundation asking for the status of a missing persons database, also the government made clear that,

> The country has only 30 to 40 DNA experts against an estimated requirement of around 800 technical examiners for its 1,200 million population. And, each test costs Rs 20,000 and the estimated cost of identifying 40,000 bodies would be Rs 80crore every year, in addition to the remuneration of the examiners and support staff.[109]

Besides the information provided by the government, civil society activists have also sounded alarms over the use of DNA databasing and its impact on citizen's rights and privacy in India. Most of the criticism to the bill have also stressed on the alignment of the DNA bill which is mandating the creation of a national and state DNA database with loss of civil liberties and the creation of a database nation. This 'biometric governance' and 'technological citizenship' (Abraham and Rajadhyaksha 2015) that is in the making has been pointed out by many notable people. Gopal Krishna, member of Citizens Forum for Civil Liberties (CFCL) has written a letter to the President of India dated August 15, 2012 (with copies to most legislative authorities like Chief Ministers, Chief Secretaries) pointing to the how it was *India's Panopticon: Mankind's Biggest Database Of Biometric Data And Unfolding Surveillance Regime*.[110] Usha Ramanathan, a legal expert and activist and Subhadeepta Ray, a sociologist researching on DNA and caste, have also come up with similar conclusions (Ramanathan and Ray 2013). Elonnai Hickok (2012), working for the Centre for Internet and Society (CIS), Bangalore has also commented on the draft bill and stressed on the implications of going ahead with the realization of the bill as it has been imagined and created. The *Forensic Genetics Policy Initiative (FGPI)*[111] which is created by *The Council for Responsible Genetics, Gene Watch UK*

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[109] *"Centre says its needs legislative sanction to DNA data bank" DNA. See http://www.dnaindia.com/india/report-centre-says-its-needs-legislative-sanction-to-dna-data-bank-2052323 [Accessed July 13, 2015]*

[110] *"India's Panopticon: Mankind's Biggest Database Of Biometric DataAnd Unfolding Surveillance Regime" Countercurrents.org. See http://www.countercurrents.org/gkrishna150812.htm [Accessed July 13, 2015]*

[111] *http://dnapolicyinitiative.org/*

and *Privacy International*, also prepared a critical report on the draft bill noting piece by piece the lacunae's in the proposed DNA bill in India. The reports notes that,

> Overall the current version of the Bill is littered with significant and striking human rights and privacy concerns and, if passed in its current form, would place India far outside the mainstream of both law and policy in this area. Beyond the privacy and human rights concerns that are addressed in this analysis of the Bill, the breadth of the structural and financial costs of enacting the Bill in its current form should also be seriously considered as they would most certainly be staggeringly high.(Gruber 2012,1)

A report released in 2010 by British MP's under the Home Affairs Select Committee is reportedto have noted that only 0.3% of the crimes solved are due to DNA database. Further Roewer writes, "it has been pointed out that most of the matches refer to minor offences; according to *GeneWatch* in Germany 63% of the database matches provided are related to theft while <3% related to rape and murder" (2013,7). The intention of creating a database is clarified by the *The Daily mail* when it reports, "The MPs say the whole point of the DNA database - which contains samples taken from up to one million innocent people - was supposed to be that those who gave samples could be convicted of crimes they commit later."[112] However, the use of biometric information by the police and its unregulated use has been a much problematized issue in the UK currently, with the Science and Technology Committee of the UK Parliament noting that "'the Governance gap' in the use of biometric data must be fixed."[113]

However, the present government led by Narendra Modi has shown a deep inclination to pass this bill and create a national database. This is done with the reasoning of creating a national databank for missing persons and to enable identification of dead bodies. The government is also underselling this idea of a genetic database by stating that by using DNA profiling techniques, many convicts might be spared jail terms. This is using the language of the Innocence Project in the West to sell the package of DNA surveillance to

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[112] *"How just 0.3% of solved crimes are due to DNA database" Dailymail.co.uk.See http://www.dailymail.co.uk/news/article-1256404/How-just-0-3-cent-solved-crimes-DNA-database.html [Accessed July 13, 2015]*

[113] *"'Governance gap' in use of biometric data must be fixed" Commons Select Committee. See http://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/news/biometrics-report/ [Accessed July 13, 2015]*

the Indian masses.[114] The unease in the selling of DNA evidence as 'foolproof' by the Innocence Project has been highlighted by Sheila Jasanoff, she notes that, "legal facts, whether based on science or not, seldom have a life outside the class of cases for which they were produced. Their function is not to serve as facts pure and simple, but rather as *evidence"* (Jasanoff 2006,333; *emphasis in original*). Caudill points out that, "indeed, the founders of the Innocence Project, Barry Scheck and Peter Neufeld, both of whom had been active in challenging the validity and reliability of DNA typing in *Castro* and *Yee*, are nowadays busy "instilling a kind of mythic power to DNA evidence" (Caudill 2008,690). Further as Michael Lynch notes,

> The higher-than-moral certainty associated with 'science' (with 'DNA' as its avatar) has pro-vided strong leverage for the Innocence Project's efforts to reopen closed cases, but a reciprocal possibility has not been lost on proponents of the death penalty in the USA. In 2003, Mitt Romney, who at the time was Governor of Massachusetts, one of the relatively few U.S. states that had not legalised the death penalty, was quoted as saying, '[j]ust as science can be used to free the innocent, it can also be used to identify the guilty'. Romney envisioned what might be called the 'Guilty Project': an expert panel that would review evidence from certain heinous crimes, to decide on 'scientific' grounds if the evidence of guilt was 'incontrovertible'. (Lynch 2013,68)

News fresh off the press report that the government has ignored the 'dissent note' which was provided by the legal expert Usha Ramanathan to the expert committee formed to prepare the draft of the *Human DNA profiling bill* which includes personalities mainly from the scientific community including the Centre for DNA Fingerprinting and Diagnostics (CDFD) and bureaucrats. On the one hand we find that the government is ignoring the opinion from its own legal expert in their own committee set up to overlook the creation of the bill and on the other hand, we find Dr. J. Gowrishankar, Director of CDFD, actively pushing for the creation of the database. He claims that DNA is a gold standard, that it is an effective tool in fighting crime and that the cost of creating a database can be controlled; all of which are open to contestation. Usha Ramanathan is reported to have written to the committee that,

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[114]*Interestingly, a PIL was filed by Lokniti Foundation to create a missing persons databank to which the government responded positively. Many emails to Lokniti by me to get a copy of the PIL remained unanswered. "Human DNA Profiling Bill likely in Budget session: Centre to SC" The Economic Times.See http://articles.economictimes.indiatimes.com/2015-01-21/news/58306163_1_budget-session-biological-samples-dna-database. Also, "Centre to create DNA bank of unidentified bodies" Times of India. http://timesofindia.indiatimes.com/india/Centre-to-create-DNA-bank-of-unidentified-bodies/articleshow/45948126.cms [Accessed July 12, 2015]*

> In my piece written for the committee, I have set out the concerns about the databasing of DNA, questions of consent, the myth of the infallibility of DNA (that it is based on probability and is a better metric than others that we now know and use, but that is still probabilistic – this is important to emphasise when we consider the consequences of a presumption that it cannot be wrong), the problems with an agency like the CDFD being given the role of creating regulations and being the regulator when it is itself an institution that will have to be regulated – especially when we see the role of the CDFD in setting the DNA agenda in the study papers that were given by the DBT to feed into the 11th and the 12th Plans. There is much more, as you would have seen in the piece I prepared for the committee, which I attach to this mail, along with the comments on the Bill.

Further she writes,

> I do not see a reflection of the concerns that I have raised in my piece to the committee, or when I raised them during our meetings. Minutes are no substitute for a report. Consider, for instance, what is recorded as minutes when I had given in my piece to the committee: nothing of the concerns raised have been recorded there. Nothing from it was discussed either.
>
> I would reiterate that Minutes do not constitute a report. The revised Draft was not shown to me nor did I approve of it, and I have only seen it after I read in the papers that the report had been finalised and I wrote asking to see it; after which you sent me the minutes and the mildly revised draft as the report. I do not agree that the revisions reflect the concerns that have been raised by me time and again, including in my three contributions to the committee dated 9 November, 2014, 2 September 2013 and 18 November 2014 (clause-by-clause comments). [115]

This is not surprising since the fact remains that Modi has overlooked the creation of the Gujarat Forensic Sciences University when he was the Chief Minister of the state, and seems to be fascinated by the use of technology for fighting crime and of course, making women and cows[116] secure. Tamil Nadu is trying to amend the *Identification of Prisoners Act 1920* to be able to take blood samples from prisoners without their permission being required to create a statewide DNA database.[117] However, civil society actors point to the

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[115] *See, "Modi wants the DNA profiling bill passed right away. Here's why it shouldn't be. http://thewire.in/2015/07/24/modi-wants-the-dna-profiling-bill-passed-right-away-heres-why-it-shouldnt-be-6922/. "The Government's response to the DNA profiling bill in full" http://thewire.in/2015/07/25/the-governments-response-to-criticism-of-the-dna-profiling-bill-in-full-7241/. "The Wire replies to the government's concern with our criticism of the DNA profiling bill" http://thewire.in/2015/07/25/the-wire-replies-to-the-governments-concerns-with-our-criticism-of-the-dna-profiling-bill-7243/. "How the committee that drafted the DNA bill ignored a note of dissent" http://thewire.in/2015/07/26/how-the-committed-that-drafted-the-dna-bill-ignored-a-note-of-dissent-7280/. The Wire. [Accessed July 27, 2015]*

[116] *GFSU has, as one of the services it can provide, a 'mobile Cow meat detection unit.'*

[117] *"A prisoner DNA database: Tamil Nadu shows the way". The Times of India.See http://timesofindia.indiatimes.com/india/A-prisoner-DNA-database-Tamil-Nadu-shows-the-way/articleshow/5938522.cms [Accessed July 12, 2015]*

fact that there are deep issues of privacy and information security that cannot be overlooked. It is due to this pressure partly, but primarily because of the Nadia rape case phone tapping fiasco, that the government framed a draft National *Privacy Bill* that is also under review and evaluation. In my reading both the *Human DNA Profiling Bill* and the *Privacy Bill* are part of a continuum in which the architecture for creating and installing a governmental surveillance program on its citizens is under formation as is so magnificently done in the US, UK and other countries, in one way this trend cannot be escaped because the whole world is using DNA for creating national databases with the largest populated country on Earth, China also having a program for databases. In fact, China's totalitarian regime is perfect soil for the neo-eugenics program to flourish. The Beijing Genomics Institute (BCI) is the new Eugenics Office of Cold Spring Harbor with its Chairman Huanming Yang stating in 2011 that, "We are going to sequence every Chinese…I have a dream to sequence everything on earth…We are going to sequence everybody in the world…Genomics is an opportunity for all of us". That ever elusive Philosopher's Stone called 'intelligence', exemplified by Herrnstein and Murray's book *Bell Curve: Intelligence and Class Structure in American Life* (2010) is again resurrected from its deep slumber like a demon being awakened when BCI partners with Western institutions and scientists to find the genetic basis of cognition and IQ with a view to producing 'smarter' people. Not to be outdone, Narendra Modi seems to be also in the competition to grab a piece of the genetic pie. *The New Indian Express* reports, "When Prime Minister Modi visits China later this month, he could well initiate a dialogue with President Xi Jinping for a collaboration with Beijing Genomics Institute (BGI) for furthering the agenda of the Indian human DNA profiling initiative."[118] In worlds of flux and migration, which Hardt and Negri define as the 'immaterial labour' (2000) or in Marx's terms, when 'the solid melts into the air' of 'liquid modernity' (Bauman 2000), it is an imperative of governmentality to point and know exactly where the solid particles are floating in the air, for this each and every particle needs to be geo-tagged. In Foucault's words,

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[118] *"With the Use of DNA Profiling Technique, Many May be Spared Jail Terms" The New Indian Express. See http://www.newindianexpress.com/columns/With-the-Use-of-DNA-Profiling-Technique-Many-May-be-Spared-Jail-Terms/2015/05/09/article2804364.ece [Accessed July 13, 2015]*

> It was a question of organizing the multiple, of providing oneself with an instrument to cover it and to master it; it was a question of imposing upon it an 'order'…It allows both the characterization of the individual as individual and the ordering of a given multiplicity. It is the first condition for the control and use of an ensemble of distinct elements: the base for the micro-physics of what might be called a 'cellular' power.(Foucault 1977,148-49)

It will not be surprising or altogether difficult, to imagine that the DNA information of its citizens might be made a part of the national AADHAR repository so that the biometrics that is the base of this identification program is further validated and made much more powerful. All this will be done in the language of the welfare state trying to make sure that the poorest of the poor receive the welfare that is legitimately theirs. As Jacobsen notes,

> On the one hand, the discourses and programmes implemented by the state speak universalizing languages of development, financial inclusion or technology as solutions to sociopolitical problems; on the other, multiple sites of implementation suppress, make irrelevant or reorganize these logics and practices. The application of biometric technologies for identification purposes in India is equally a heterogeneous and hybrid process driven by different merging and contesting discourses. (2012,460)

But, the same poorest of the poor are also the criminal underclass of society. Thereby, the whip and the carrot go hand in hand. This is presented in its full view when we look at the question of the immigration of Bangladeshi Muslims in India with the *Citizenship Act 1955* amended to specify that 'illegal migrant' cannot apply for citizenship by naturalization.[119] Biometric information and national registries have been created with the explicit mandate to identify the 'Muslim' in particular. This paranoia of the Indian state finds expression in the creation of a DNA database in which some of these 'illegal immigrants' will also find themselves added (see Sathe 2014). A 2009 study called *Diverse genetic origin of Indian Muslims: evidence from autosomal STR loci* can give us insight on how 'Muslims' is becoming a 'genetic' category and the socio-political understandings that it might create (Eaaswarkhanth et al. 2009). There is a lot of money to be made from the National DNA Database as it will of course be a Private-Public Partnership (PPP) wherein leaders in forensic sciences in India will create the infrastructure to hold this together. The Department of Biotechnology is already giving

[119] *See Citizenship Act 1955, Sec 6A: "Citizenship by Naturalization" http://mha1.nic.in/pdfs/ic_act55.pdf [Accssed July 14, 2015]*

grants and hand-holding Small and Medium Biotech companies to take off.[120] The government might create another autonomous body like AADHAR to manage it and keep it away from 'bureaucratic hurdles' or, it might be merged with the AADHAR/National Population Registry (NPR) project. This is not a far-fetched idea because the *India Express* reports that the government has sanctioned 921 crore rupees to match the AADHAR data with the NPR data to "identify foreigners by March 2016." The news report quotes Minister of State (Home) Haribhai Parthibhai Chaudhary saying, "Once that is done, we expect to determine the nationality of each individual in the country, thereby identifying illegal immigrants." Moving on, "we will also register prisoners across the country under NPR. It will help us keep track of the person wherever he goes. At one click, we will get all the details of the person. We are also planning to link NPR with registration of birth and death certificates."[121] This is in parallel with the news of officials issuing AADHAR to their pet dog and a person applying for a card on behalf of the Hindu monkey god Hanuman and receiving it.[122] So, we can imagine a time coming when state employees will go to the most remote parts of India DNA hunting in the name of welfare and security. In a country where people are afraid to even provide their biometrics to the state, one can only imagine the level of paranoia it will create when the state mandates DNA for welfare. For example, there is a recent news story of how people in Mizoram have run away to Myanmar as they think the state is the devil incarnate coming to get their biometrics and thus, the sign of the beast. We do not yet know the specific cultural anxieties that these efforts of the government will unleash.[123] At the same time, there is an enormous investment made by the state in creating a program for identification of the people of India.

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[120] *See http://www.birac.nic.in/desc.php?id=21*

[121] *"Government out to match Aadhar, NPR data" The Indian Express.See http://indianexpress.com/article/india/india-others/government-out-to-match-aadhaar-npr-data/ [Accessed July 14, 2015]*

[122] *"This Dog in Madhya Pradesh Has an Aadhar Card. Owner is Now Arrested" NDTV.com. See http://www.ndtv.com/offbeat/this-dog-in-madhya-pradesh-has-an-aadhar-card-owner-is-now-arrested-777810. "OH MY GOD! Lord Hanuman gets his Aadhar card, but no delivery address!" Daily Bhaskar.See http://daily.bhaskar.com/news/RAJ-JPR-shocking-lord-hanumanji-can-boast-of-aadhaar-card-but-where-to-deliver-it-4741028-PHO.html [Accessed July 14, 2015]*

[Accessed July 14, 2015]

[123] *"Big Picture: What a strange journey"The Indian Express.See http://indianexpress.com/article/india/india-others/big-picture-what-a-strange-journey/99/ [Accessed July 13, 2015]*

> Both the Home Ministry and various police and intelligence actors are promoting a National Population Registration (NPR) database that is currently enrolling individuals biometrically, a National Intelligence database (NATGRID), and a Criminal Tracking System that will identify 'outsiders' and monitor the movements of 'irregulars'. The value of the homeland security market in India is expected to more than double in the next six years, from the current figure of $8 billion to $18 billion (ASSOCHAM, 2011). At the same time, the Unique Identification Authority of India (UIDAI) has been mandated by the Planning Commission6 to provide unique biometric identifiers to 600 million Indian residents, operating with a four-year budget of $2.17 billion.7 The process of creating the UID is entrenched within this larger ensemble of experts, institutions, techniques and machineries.(Jacobsen 2012,460-61)

Since India does not make any New Generation Sequencing (NGS) machines nor the re-agents used in sequencing, it will have to purchase it from multinational vendors who have proprietary rights over it. In a world where India has sold away its right to create generics and indigenize technology for its national use to the WTO (see Prasad 2009,9-16), it is no longer possible for India to create any of the technology for next generation sequencing or even the peripherals associated with it.

> TRIPs treats the genetic components of organisms, as well as genetically altered varieties of living organisms, as ordinary commodities subject to private ownership and standardized rules of transnational commerce. In its present form, TRIPs would make it illegal under most circumstances for citizens, businesses, or government agencies to commercialize or distribute brand-name plant varieties and privatized gene sequences, proprietary medicines, research technologies, and databases. Resistance by developing countries to this version of TRIPs has been growing and continues in the WTO TRIPs Council. (McAfee 2003,210)

This essentially means buying the instruments and paraphernalia at huge costs which the government will of course, 'subsidize'. In all of this commodification and corporatization, there will be an army of low-end bio-infotech workers who are paid a pittance for their skills in order to keep the bio-tech revolution in India burning bright. Now let us imagine a world where a criminal (who is also a poor dalit) has gone to prison for a crime, there he spends his time in the prison and comes out to be assimilated back into society (if that ever was possible). Now imagine that his DNA is a part of the national database, he looks for a job where his prospective employer checks with the police and finds that he is a convicted criminal. He gets declined. Insurance companies are unwilling to service him, he does not have health insurance. What Foucault calls "the

conduct of conduct."[124] There he finds that there is a program started by the best medical institute in India where they are looking to do research on criminality. He goes and gets paid some money, and as usual signs away (or more aptly fingerprints away) his genetic rights. The result of the research conclusively proves that certain castes of people coming from certain regions are more prone to behavioral 'defects'. This emergent trend finds indication in an expert article written to push biotechnology forward in India; here is their recommendation to "Western/Japanese firms" it states,

> Besides the usual reasons given for India to be a good outsourcing hub to reduce costs, basically it makes sense to additionally cooperate in innovation generation because in Phase IV clinical trials market tests are required and Indian firms have the necessary access to provide in-situ clinical tests of this nature. Indian markets are growing and so there is ample opportunity for exploiting new and emerging consumer needs/products. Partnerships may be more fruitful if opportunities for learning are offered to Indian firms. (Reid and Ramani 2012,662)

And this reality is being overlooked by the people in power in their quest to create a well-oiled machinery of the state's power to catch criminals and control crime. As Roewer notes, "It should not be assumed that the benefits of forensic DNA fingerprinting will necessarily override the social and ethical costs" (2013,8). For example, Dorothy Roberts informs us,

> In 2009, the ACLU of Northern California filed a class-action lawsuit charging that Proposition 69 is unconstitutional because it subjects innocent Californians to "a lifetime of genetic surveillance" that constitutes an unreasonable search under Fourth Amendment. The named plaintiff, Lily Haskell, was arrested at a peace rally in San Francisco and forced to provide a DNA sample even though she was quickly released without being charged with a crime. "When your DNA is taken after an arrest at a political demonstration, it can have a silencing effect on political action," Haskell says. "Now my genetic information is stored indefinitely in a government database, simply because I was exercising my right to speak out." But the ACLU lost its case. A California federal judge rules that the ACLU failed to show that individual privacy rights outweigh the government's compelling interest in DNA profiling that works to "swiftly and accurately" solve past and present crimes.(2013)

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[124] *According to Foucault power relation can be characterized as conduct, or rather as "conduct of conducts" and it is exactly this moment of relationality and reflexivity that distinguishes a power relation from consent and force: "Perhaps the equivocal nature of the term ‚conduct' is one of the best aids for coming to terms with the specificity of power relations. To 'conduct' is at the same time to 'lead' [conduire] others (according to mechanisms of coercion that are to carrying degrees, strict) and a way of behaving [se conduire] within a more or less open field of possibilities. The exercise of power is a 'conduct of conducts' and a management of possibilities. Basically, power is less a confrontation between two adversaries or their mutual engagement than a question of 'government'. (Lemke 2010; emphasis mine)*

However, in spite of the judgment given in Haskell v. Harris in 2009, the ACLU reports that, "on December 3, 2014 the California Court of Appeal ruled in the Case People v. Buza that mandatory DNA collection of arrestees violates the California Constitution. The district court ordered a stay pending final resolution of state law."[125] But, we should note the insight of Katie Worth when she writes,

> Technology may soon increase the danger of implicating innocent people. Today, most DNA analytical machines are optimized to parse the DNA of about 100 human cells. Future generations of forensic robots may extract a profile from just one. The DNA of a person who drives by a crime scene with an open window could wind up somewhere suspicious; shake someone's hand before he commits a crime, and you may be implicated. (2015)

One interesting thing about researching the DNA databasing in India is the total lack of transparency on the partof the government in telling its citizens what exactly it is that they are trying to do with it. The program is spearheaded by the Ministry of Home Affairs, and senior officers in the Central Bureau of Investigation (CBI), who say that it is a crime fighting tool and is required for maintenance of law and order. So this is somehow supposed to be top secret and confidential. They even want a blanket exemption from the *Privacy Bill,* they already have exemption under the Right to Information Act. In a revealing report, the *Indian Express* highlights how, "CBI sought part RTI exemption, Govt gave it full", strongly backed by the Prime Minister's Office.[126] There is thus a firewall being created from being accountable to the people of India by the law enforcement authorities, this despite that fact that the CBI has been repeatedly rocked by accusations of abuse of power and tweaking crucial evidence.[127] For example, Prashant Bhushan, an eminent lawyer filed a case of corruption against CBI chief Ranjit Sinha in the 2G scam investigation case alleging that he was shielding those

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[125] *"Haskell v. Harris" ACLU. See https://aclunc.org/our-work/legal-docket/haskell-v-harris [Accessed July 14, 2015]*

[126] *"CBI sought part RTI exemption, Govt gave it full" The Indian Express. See http://indianexpress.com/article/india/india-others/cbi-sought-part-rti-exemption-govt-gave-it-full/ [Accessed July 13, 2015]*

[127] *"CBI official connived with Bansal's nephew to destroy evidence in bribery case" Northgazette.com. See http://northgazette.com/news/2013/05/19/cbi-official-connived-with-bansals-nephew-to-destroy-evidence-in-bribery-case/page/64/ and "Sex scandal hits CBI, were the officials bribed to hush up evidence?" India Samvad.See http://indiasamvad.co.in/sex-scandal-hits-cbi-were-the-officials-bribed-to-hush-up-evidence/*
[Accessed July 13, 2015]

accused in the scam case.[128] While this is being said, the government is busy building the surveillance infrastructure in the form of the Central Monitoring System. Saikat Datta, a senior fellow at the National Law University, New Delhi writes that, "a Central Monitoring System will only empower such elements who can then use secret but legal interception to manipulate individuals and organisations and put our democratic rights in severe jeopardy. Unless citizens speak up now, their power over the state will be lost forever."[129] This fact has been highlighted by none other than the minister who spearheaded this initiative of the CMS, former Minister of Parliament Milind Deora, who has warned against its misuse.[130] Given such a scenario how can the public be convinced that the information that is uploaded in the DNA database is confidential, secure and will not be (mis)used for harassment and persecution? And what are the mechanisms available to the citizen by which such abuses, if they do occur, can be penalized? (See Gruber 2012,6-7) Further, to top it all, there is a provision the draft bill which allows the use of the genetic information in the database for 'research' purposes. Also, there is no mention of 'familial' tracking that can be carried out by law enforcement agencies using Y-STR and mt DNA lineage markers (see Roewer 2013,4-7). Also, the issue of DNA being changed by stem cell therapy and bone marrow transplantation has been mentioned by Verma and Goswami (2014,187).

There is no involvement of the larger public in this debate but what the government does is that it gets a few legal and human rights experts in the expert committee majorly made up of the technocrats and get them to comment on the legal and ethical aspect of the act. This is noted in the draft *Human DNA Profiling Bill* where the actors themselves are not involved, so much for democracy. This is noted in the report by the Council for Responsible Genetics,

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[128] *"CBI Chief RanjitSinha Accused of Corruption in Complaint Filed by PrashantBhushan" NDTV.com.See http://www.ndtv.com/india-news/cbi-chief-ranjit-sinha-accused-of-corruption-in-complaint-filed-by-prashant-bhushan-703829 [Accessed July 13, 2015]*

[129] *"Why Indians must resist the Modi government's planned surveillance system" Scroll.in. See http://scroll.in/article/729809/why-indians-must-resist-the-modi-governments-planned-surveillance-system [Accessed July 13, 2015]*

[130] *"Congress minister who put surveillance system in place warns against its 'lawful but malicious' use" Scroll.in. See http://scroll.in/article/729701/upa-minister-who-put-in-place-spying-system-warns-against-its-lawful-but-malicious-use [Accessed July 13, 2015]*

> The Bill lays out a number of fields from which the members are to be chosen inc. molecular biology, population biology, criminal justice and bioethics. There is no representation from civil society human rights organizations or the criminal defense bar to ensure that privacy, human rights and the general public interest are ensured. Furthermore the Chief Executive Office of the Board is to be a scientist and therefore unlikely to be familiar with criminal justice matters and evaluations of their efficacy. (Chapter III, Section 10) (Gruber 2012,3)

This is very undemocratic and dangerous. It reeks of totalitarianism. However in a country where the state is still considered the *"mai-baap"* and the citizens as its subjects[131], it is not at all hard to imagine that their voice do not count in this issue, although ultimately they will pay the heaviest price for it. It will not be surprising that in a scenario where most of the criminal population are Muslims and lower caste or tribals[132], how the DNA database for criminals, as and when it is created, will shape up and what kind of justice it will deliver. Let us not forget that the DNA database is only a database that will assist in catching the criminal who might have escaped the 'clutches' of law, it does not make a statement about why/how that crime happened. As Roewer notes, "Genetic fingerprinting *per se* could of course not reduce the criminal rate in any of the many countries in the world, which employ this method. But DNA profiling adds hard scientific value to the evidence and strengthens thus (principally) the credibility of the legal system" (2013,2). The underlying causes as to why there are so much more underclass who are in prison will never be debated. This will lead to a bludgeoning of the prison population in India, as is the case in the United States because they are too busy catching people and putting them in prison in the name of justice. As Cole notes, "We need no longer search for difficult social cures for the conditions that breed crime. Instead, we can attack crime at its supposed root cause: the criminals themselves."(2009,303) In India with the number of draconian and outdated laws (see U. K. Singh 2007), one might only imagine what will happen in the prisons if the courts of law are able to convict criminals in a quicker time frame. Filling it up with the poor. The DNA database act can be read as an exercise in social control and surveillance so that the

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[131] *See "Citizenship and its Discontents: An Indian History" (Jayal 2013)*

[132] *"Prison Statistics 2013: Muslims continue to overpopulate jails in India" Indiatomorrow.net. See http://www.indiatomorrow.net/eng/prison-statistics-2013-muslims-continue-to-overpopulate-jails-in-india [Accessed July 12, 2015] Also, see "Over-representation of Muslims: The Prisons of Maharashtra" (Raghavan and Nair 2013)*

long arm of the law can always catch the most weak in society and put him into prison while the rich and powerful can afford the lawyers to contest the evidence in court. This aspect has been highlighted by David Lyon in his book *Surveillance as Social Sorting: Privacy, Risk, and Digital Discrimination,* he writes, "whereas the very concept of state welfare involves a social sharing of risks, the converse occurs when the state welfare goes into decline. What are the results of this? For those still in dire need, because of unemployment, illness, single parenthood, or poverty otherwise generated, surveillance is tightened as a means of discipline"(2003,21). The 'effectiveness' of the law will enable the creation of a whole population of criminals (genetic suspects) (Hindmarsh and Prainsack 2010) who do not have right to exist except inside the prison. Four forensic researchers from King Georges Medical University, Lucknow present us with a compelling scenario that splits wide open the real zeal of law enforcement authorities in creating a DNA databank. They write,

> For example, in a state where freedom of speech or political rights are restricted, the police or secret services could attempt to take DNA samples from the scene of a political meeting to establish whether or not particular individuals had been present. DNA databases link searchable computer records of personal demographic information, such as name and ethnic appearance, with the ability to biologically tag an individual and track their whereabouts using their DNA profile. An individual's relatives may also be identified through partial matching with their DNA. Thus, DNA databases significantly shift the balance of power from the individual to the state.(Kumar et al. 2015,4)

Taking past instances into consideration, it is almost a certainty that the state will use this technology to stifle dissent. This is the biopolitics of DNA in which the population is the loci and the security of the population is the greatest logic, what is termed as *governmentality* and *the art of government*. This is required because the territory of the country is supposed to be guarded from others, what Roberto Esposito terms "immunitary logic" (Barkan 2012). Here, when the whole population DNA is databased in an identification program then the definition of his citizenship is based on whether the persons DNA is in the database, a truly 'genetic citizenship.' It will not allow others to come in and pretend to be Indian. There will be a very simple definition of who an Indian is: the person's whose biometric information is there in the database, this is the reason why the state is gathering the DNA information from new-borns in the world now (see Lemke 2006). It is connected to health; it will be linked to the whole infrastructure of the

medical profession. The whole file of disease and thus my claim, that it's a part of one paradigm, the fight for criminality and the quest for a health populace. Knowledge of the population via statistics is one of the main tools of government as per Foucault, and this elucidates the point that it is a biopolitical technology through and through.

Behavioral genetics is obsessed with finding genes for all sorts of behaviors. Who is to say that the state or its researchers will not use this database to do research and connect certain people with certain crimes? In her book *Race Decoded: The genomic fight for social justice*, Catherine Bliss (2012) shows us how race as a category came to be constructed by the whites in their colonizing conquest throughout the world, and how later on criminal anthropology evolved via the use of bodily characteristics to connect propensity for crime and deviancy with our somatic profiles. If we look at the way in which certain communities were constructed as 'criminal' tribes and castes in India by the British through processes of enumeration and census (Dirks 2001; Cohn 1996) linked to identification of bodily differences, we can have reasons to believe that DNA might take a similar path. This is not a past that has been closed, but impacts our everyday lived realities; for example, the lynching of ten members of a de-notified tribe called *Kureris* in Bihar,

> The National Commission for Denotified, Nomadic and Semi-Nomadic Tribes sent a team to investigate the incident. The team found that there was no evidence to suggest that the people lynched had committed a robbery or were thieves. The commission was not surprised to find that the local police had extorted a 'confession' from the traumatised lone survivor of the lynching, to quickly 'solve' the case. It said in its report: "In the commission's view this is a very common occurrence among nomadic communities. Whenever a burglary or a murder takes place, the police raids the habitations of nomadic (and denotified) communities and their members are arbitrarily picked up by the police to show immediate 'results'." The commission, however, found it shocking that not just the police but the media too initially reported that the victims of the lynching were thieves. (Kasturi 2007)

This genetic basis of crime can then be used in various contexts, to point to an example, the racial hygiene program of the German people. If genes determine behavior then what are the consequences, this is not too far-fetched as there have been cases where the argument of genetic determinism in criminal cases have been presented and there is a whole body of researchers doing research of genetic basis of voting behaviors, political persuasions etc. To give just one example, *A genome-wide analysis of liberal and*

conservative political attitudes (Hatemi et al. 2011). Further, India has many exceptional laws like *Armed Forces (Special Powers) Act 1958, The Unlawful Activities (Prevention) Act 1967* that are outside the gambit in the name of national security, DNA profiling will take its citizens out of *bios* and expose them to *bare life* (C. Mills, n.d.; Agamben 1998). Furthermore, since the international trend is to move towards population DNA databases, the government and police authorities in India will be under duress from international agencies like Interpol and FBI to create a database also which can be cross checked for serious crimes like terrorism or organized crime and immigration purposes. The draft *Human DNA Profiling Bill 2012* already has provisions incorporated for sharing with foreign institutions or law enforcement agencies. The brave new world that we inhabit needs to take its security seriously in this neoliberal period.

3.3. Genetics and Health: India's tryst with the neoliberal persona

Personalized medicine as a paradigm shift in healthcare

'Personalized medicine' or 'precision medicine' have become the new buzzwords in the medi-care business these days. There is a huge deluge of news reports in the media these days about its advantages; how each individual treatment will be personalized for the patient. In this domain, genes play an important part. Gene based diagnostic and therapeutic plans are increasingly coming into prominence in healthcare regimens. Researchers from St. George's, University of London, describe personalized medicine as,

> …tailoring disease prediction, prevention and treatment to each patient's unique genome, including the makeup of one's tumor or infectious microbes. For example, genomic data may enable the assessment of a person's risk of cancer and recommend preventative measures, or allow the prescribing of a narrow-spectrum antibiotic to target their particular infection.[133]

What does this shift in the positioning of medicare imply? Personalized medicine is a paradigm shift in healthcare as it is essentially a biotech approach to life, i.e. looking at life as a machine, and fixing and manipulating the underlying causes of diseases with the help of technology. I would like to point out here, that personalized medicine has

[133] *"What is personalized medicine?" The Genomic Era. MOOC by St. George's, University of London. https://www.futurelearn.com/courses/the-genomics-era/details*
[Accessed July]

many strands in it. The U.S. Food and Drug Administration (FDA) defines it as: "*the right patient with the right drug at the right dose at the right time.*"[134] Essentially, it appears to be medicine at the molecular level, also called medical genetics[135], or gene therapy[136]. For this project to becomes successful and be an effective force in improving the lives of patients, the detailed genealogical and medical history of the patient becomes of paramount value, because the information that is received from this exercise can provide a clue as to which diseases the individual is likely to suffer from. Also, it gives tremendous power to the individual to choose the path of healing that he/she is willing to accept, by being provided with various treatment options based on their individual genetic profiles.

Personalized medicine and the commodification of life – bench to bedside

India too is pursuing the path of personalized medicine because it is a part of the global capital chain, and the capitalization of life is directly linked with this paradigm of medicine.[137] This paradigm, for want of a better word, is an 'invention' wherein the commodification of life is taken to the next level with genetic risks involved in it; what Margaret Curnutte has called "consuming genomes" (Curnutte and Testa 2012). It will involve the discovery of many unique 'genes' that are linked to diseases and their patenting. This is linked to the insurance companies and employment (increasingly in the private companies) and all the social accouterments that come along with it.

This geneticization of disease is well on its way, with Indian researchers focusing on many genes that can provides clinical outcomes, the centers for translational medicines are created with this outcome in mind; to literally translate specific 'genes' into treatment solutions, to be able to marketize it for the consumer; what is called 'from

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[134] *See http://www.fda.gov/scienceresearch/specialtopics/personalizedmedicine/default.htm [Accessed June 27, 2015]*

[135] *"Medical Genetics." http://www.mayoclinic.org/departments-centers/medical-genetics/overview [Accessed June 27, 2015]*

[136] *"Gene therapy replaces a faulty gene or adds a new gene in an attempt to cure disease or improve your body's ability to fight disease. Gene therapy holds promise for treating a wide range of diseases, including cancer, cystic fibrosis, heart disease, diabetes, hemophilia and AIDS." See http://www.mayoclinic.org/tests-procedures/gene-therapy/basics/definition/prc-20014778 [Accessed June 27, 2015]*

[137] *"The harnessing of biotechnology in India: Which roads to travel?." (Reid and Ramani 2012)*

bench to the bedside' (See Martin, Brown, and Kraft 2008). For this kind of medicare to work, it is crucial to gather patient data and analyze it. The medical data of the population can then be researched and made into a commodity by the Indian state or the private companies in India. This is what is termed as 'biovalue' (Mitchell and Waldby 2015).

India – the most diverse gene pool – population genetics

Eric Lander gave an interview to *The Hindu* when he came to India, where he talked about searching and sequencing genes and finding genes common to India's problems. He is quoted in the interview to have said that,

> India is perhaps the single most interesting country to study. There is tremendous diversity across India. You have a country of over a billion people with so many different ethnic groups; endogamous groups with people tending to marry within particular groups; and parts of India with consanguinity marriages with relatives. You have amazing genetic variation — more than any other country perhaps in the world. And there is so much that can be learnt from that.
>
> The excellent science that is going on is only a fraction of what could go on. India should be one of the models in studying genetic variation and how it relates to disease. So, I would be in favour of seeing much greater activity in genomic medicine in India. That has been limited by budgets. It is also limited by regulations over sharing DNA out of the country. It is certainly a very big obstacle for international collaboration.[138]

India has already started a great exercise of sequencing the flora and fauna of the country, but here I am only going to focus on the human population. Population genetics is the term used to describe the collection and genome sequencing of the genetic information of the people. It is found useful by the scientists because they can find specific groups of people with disease propensities and then find the genetic or epigenetic factor that is relevant to their diseases. Thus it is the case, that now there is a 'gene hunt' for various 'genes' that correlate to specific peoples, so that a disease profile can be created for them. This is the reason that India set up the Indian Genome Variation initiative (http://www.igvdb.res.in) in 2003 to take advantage of possessing the largest and most diverse population in the world. This was again conceptualized by Dr. Lalji

[138] *"India should be a model for genetic research." The Hindu.*
See http://www.thehindu.com/opinion/interview/india-should-be-a-model-for-genetic-research-says-eric-s-lander/article6929818.ece [Accessed June 27, 2015]

Singh and Samir K. Bhahmachari at the Institute of Genomics and Integrative Biology, Delhi.[139] The website of the Indian Genome Variation initiative informs us that,

> The Indian Genome Variation initiative is a network program initiated in 2003 and tenured for 5 years, by six constituent laboratories of the Council of Scientific and Industrial Research (**CSIR**), with funding from Government of India. The laboratories include Institute of Genomics and Integrative Biology (**IGIB**), Delhi, Centre for Cellular and Molecular Biology (**CCMB**), Hyderabad, Indian Institute of Chemical Biology (**IICB**), Kolkata, Central Drug Research Institute (**CDRI**), Lucknow, Industrial Toxicological Research Centre (**ITRC**), Lucknow and Institute of Microbial technology (**IMTECH**), Chandigarh. These laboratories are involved in studies related to asthma, diabetes, neuropsychiatric disorders, cancer, coronary artery disease, clot disorders, high altitude disorders, retinitis pigmentosa, predisposition to malaria as well as other infectious diseases and drug metabolism. Apart from the CSIR laboratories, a key participant in the project is the Indian Statistical Institute (**ISI**), Kolkata. The project also involves active participation of the Anthropological Survey of India that has helped in the identification of the various Indian subpopulations. In addition to the institutional facilities, the project also has collaborations with The Centre for Genomic Application (**TCGA**), established through support of Department of Science and Technology (**DST**), CSIR with The Chatterjee Group (**TCG**) for high throughput sequencing and genotyping and **SilicoGene** Informatics Private Limited along with **LabVantage**, India for development of a comprehensive platform for IGV database management, analysis and portal development.[140]

As Lander has noted, India possesses one of the largest and most diverse 'gene pools' in the world, and hence is of greatest value to researchers and exploiters. Further, the genetic vision of life is highly appealing for the Indian state, as it would enable it to project the image of being a scientific powerhouse to the world. Thus, it would not be too difficult for the state to turn a blind eye to ethics and exploitation if it is sufficiently garbed, in order to pursue its own ambition.

Racism, caste-ism and classism perpetuated through 'scientific research'

Drugs that are targeted for specific populations and ethnicities only, for example the African-American population in America, based on their genetic propensities, are being increasingly promoted. Dorothy Roberts (2013) points out that this has led to a racialization of medicine with 'racial diseases' warranting research into pharmaco-ethnicity, leading to the creation of 'racial markets' for specific targeted drugs like BiDil

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[139] *See http://www.igvdb.res.in/participate.php [Accessed June 27, 2015]*
[140] *http://www.igvdb.res.in/ [Accessed June 27, 2015]*

(a vasodilator). This trend has been termed by Nadia Abu El-Haj as the 'genetic re-inscription of race' (2007).

Genes are also used as tools for the study of evolutionary history; there is now an effort to create bio-banks in India so that they can serve as a research tool. This is exemplified by an article written by a combined pool of researchers from Indian Statistical Institute, Indian Institute of Chemical Biology and the Saha Institute of Nuclear Physics, all in Calcutta titled *Ethnic India: A genomic view, with special reference to peopling and structure* (Basu et al. 2003). Without going into a detailed critique of this article, I would like to highlight three claims they make based on their research: i) "the tribal and caste populations are highly differentiated" ii) "the Dravidian *tribals* were *possibly* widespread throughout India before the arrival of the *Indo-European*-speaking nomads, but retreated to southern India to *avoid dominance*" and iii) "the upper castes show closer *genetic affinities* with Central Asian populations, although those of southern India are more distant than those of northern India." The article also mentions that, "*historical gene flow* into India has contributed to a considerable obliteration of genetic histories of contemporary populations so that there is at *present no clear congruence of genetic and geographical or sociocultural affinities*" (2277; *emphasis mine*). The researchers were upper caste Bengalis and this journal is a publication of Cold Spring Harbor, so here we have people from the upper caste doing research on the lower caste to prove some scientific connection and getting published with a journal that has an eugenics lineage. To give a more recent example, three researchers from the Department of Genetics, University of Madras have published a paper, *Genetic study of scheduled caste populations of Tamil Nadu* (Vijaya, Kanthimathi, and Ramesh 2008). These are by no means the exceptions as a quick Google search will attest. This is in alignment with the fact that disease is also a commodity now that can be made profitable. This is enabled by the creation of 'bio-banks' that can 'harvest' the unique genetic resource of the nation's population. However, as Reanne Frank writes,

> While it is clear that there is human genetic and phenotypic variation across population groups that is geographically correlated, it is also true that this variation is not categorically distributed at the population level and as a result does not match up in any uniform way to known racial categories. Accordingly, attempts to characterize human genetic variation have involved creating a set of arbitrary cut points that are dependent on

> decisions made by individual researchers. These decisions involve issues of sample size, number of loci, number of clusters, assumptions about correlation in allele frequencies across populations, and the geographic dispersion of the sample, all of which have been shown to affect how populations are sorted by genetic information and whether or not they ultimately match up to known racial/ethnic groupings. (2007,1978)

"The enrolled population and its collective history of disease form a resource that can be data mined, in the same way that database marketing businesses mine the everyday world of consumption patterns – of, for example, book or grocery purchases – for information that can then be sold to other companies" (Mitchell and Waldby 2015,340). We need to examine, "how structures of power and inequality in the global distribution of scientific, technological, and economic resources impact the institutionalization of new genomic knowledge practices and policy framings" (Benjamin 2009,342). Issues of bio-colonialism and genetic sovereignty arise here because of the colonial legacy of exploitation. It seems however, as Michael Fortun points out that the Indian state itself acts like a colonial overlord in the enterprise on bio-resources. Noting this point Eugene Thacker writes,

> If this is biocolonialism, it is arguably a very different sort of exploitation: government sanctioned, driven by national industry, and completely voluntary. As Michael Fortun notes, the study of such projects must therefore "trace how these rhetorics of exoticism and national difference are deployed not only by 'foreign' commentators and media outlets, but also have more 'domestic' origins."What is produced insuch projects is not only a database, but, in a sense, a new concept of what population may come to mean in the context of a genetics-based medicine and health-care paradigm. Fortun adds that such population databases "are like value-added export products designed to circulate in a global rhetorical economy." (cited in Thacker 2006,140)

Biotech companies and money matters

MedGadget.com reports that the global DNA sequencing market was approximately $4.6 billion in 2013 and was projected to cross $10 billion by 2017. The market for genetic technologies in India is also becoming larger and larger because of the focus on biotech by the government. There are entrepreneurs who are now creating companies for genetic testing, gene sequencing and various disease profiles; this is besides the fact that most of the world's biggest New Generation Sequencing (NHS) companies have set up shop to sell their products in India. A representative from one of

the multinational NHS companies, told me that the main handicap to genetic medicare taking off in India is that genetic diagnostics is still not covered by insurance companies.[141] Further, if and when insurance gets linked with genetic profiles; for example, in the corporate job market of India where the bargaining power of a worker (e.g. call center) is practically zero, it is important to seriously ponder over the question of how the enmeshment of genes and insurance will play out. I wonder whether work related diseases due to severe stress and unhealthy work conditions will be 'geneticized'. With the excess amount of computer engineers being produced in India, biotech seems to be the next haven for these people to go, to make a living by being bioinformaticians. Tata Consultancy Services (TCS) initiated a bioinformatics node in 2001 and is offering a plethora of services currently[142] (Banerjee 2012). It is in alliance with University of California, Berkeley to develop a "Genome Commons Navigator."

> The objective of this project is to develop an open source and open access platform for the analysis of genomic variation data in collaboration with UCB. Extensive genomic variation knowledge is a prerequisite for the development of personalized medicine and as a result, better healthcare. A single platform that provides public sharing of such data is expected to accelerate the understanding and development of treatments with genetic data as the basis. TCS' scientists and developers working alongside scientists and researchers from UCB will implement the Genome Commons platform.[143]

There is an all India exam now for bioinformatics that is open to biology students as well as computer science students called the Bioinformatics National Certification (BINC) Examination'. The website informs us that,

> In the first year 2006, not a single student could get in the first paper more than 50% marks and thus no one qualified out of 314. However, the examinations conducted in the next year 2007, 8 students were qualified and in 2008, 12 candidates have been qualified. The trend shows BINC pass percentage increases year wise and with this progress we can achieve generation of enough number of Bioinformatics qualified personal in the country to minimize the present gap of skilled human resource to work on hard core Bioinformatics problems. To popularize this scheme the DBT is also offering cash prizes for the toppers of BINC and fellowships similar to NET and GATE for the all BINC qualified candidates to facilitate pursuing PhD in this field.[144]

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[141] *Person and company name, including conversation details withheld from this dissertation because of privacy protocols and associated risks to the person.*

[142] *See http://www.tcs.com/about/research/research_areas/applications/Pages/Computational-Life-Sciences.aspx [Accessed June 30, 2015]*

[143] *http://www.tcs.com/research/Pages/academic-alliances.aspx [Accessed June 30, 2015]*

[144] *http://www.btisnet.nic.in/binc.asp [Accessed June 30, 2015]*

This is reflected in the plans of Vijay Raghavan as reported in *Nature*,

> In the short term, he wants to play India's strengths. Getting India's thriving community of mathematicians and computer scientists to work on problems of biology, for example, could help the country to gain an edge in bioinformatics and quantitative biology – fields that do not typically require as much funding as bench biology.
>
> This is all easier said than done, Vijay Raghavan admits, but he intends to use financial incentives and disincentives – what he calls "fire in the belly" and "fire in the rear" – to make it happen. (Mandavilli 2015)

The fact however remains, that none of these technologies are manufactured in India and it does not produce any reagents. Further, in comparison to China it is way behind in coming up with any novel technology. As in Mexico, in India too, the equipment used in biotech labs is created by biotech firms in the US like Applied Biosystems, Affymetrix and Illumina who have all set up their offices in India. Thus, in the words of Benjamin (2009), "the material and symbolic infrastructure of postcolonial genomics is comprised of a mixed genealogy that confounds the rhetoric of nationalist empowerment". The location of India in the global finance market and the software industry, however, will be an enabler in making bio-infotech a mass employment generator based on the speculative character of finance capital. Like the housing crisis that set forth the financial crisis, the world of speculation is embedded in creating value out of thin air.

> The correction in the global stock market bubble from 2000 to 2002 proved to be a blessing in disguise for Indian bioinformatics. The global stock market pullback from "irrational exuberance" (as Federal Reserve Chairman Alan Greenspan called it) also marked a burst in the "genomics bubble" as the hype and lofty valuations of cutting-edge genomics companies disappeared virtually overnight. With this decline, yet faced with growing pipeline productivity pressures, several global pharmaceutical companies (most notably Novartis, Pfizer, Aventis and GlaxoSmithKline) turned to India for its low cost and highly skilled scientific and computational work force. This was the selection event to turn the tides. In 2003, for example, Pfizer and Novartis each opened $100 million genomics and proteomics research facilities in India, and forged relationships with TCS and local IT services companies for bioinformatics research. Only a few years into existence, TCS' bioinformatics service business had found the committed corporate and financial sponsors needed to build and sustain a global competitive advantage in bioinformatics. TCS incorporated the new knowledge that was needed for an IT company to successfully internally renew its IT technological capability into an exaptive technological capability in bioinformatics. (Banerjee 2012,672)

Like the digital divide, now there will be a ***biotech divide***, in which rich people who can afford to get expensive personalized treatments will get greater care while the more traditional sorts of treatments will be left for the poor. This is done by segmentation of the medical healthcare set-up where the elite wealthy go to the private hospitals and the government hospitals are left for the poor masses. This is already happening in India, where hospitals like Max and Apollo are offering genetic diagnostics to their customers, while government hospitals use it only for the most deserving of cases. In a recent public conference, medical officers from Delhi government hospitals noted that in a context where basic healthcare provisions are so inadequate, genetic diagnostic tests really are a waste of public money.[145] The massive costs of sequencers (one machine costing around 70 lakh rupees and more), even when the costs are coming down, is a great revenue generator for the NGS companies. Further, the sequencing companies are not only providing machines but also helping with analytics in cloud platforms (for a fee, of course). For example, Apollo created Sapien Biosciences to provide 'personalized medicine'. It is important to note the way in which biotech and medi-care are coming together. As their webpage informs us,

> Sapien Biosciences is a joint venture between Apollo Hospitals & Saarum Innovations to create a world-class bio-bank and personalized medicine company that leverages Apollo's leadership position in healthcare and Saarum's cutting-edge life sciences research expertise for novel clinical and R&D applications. Sapien's primary objective is to build a high-quality bio-repository that integrates ethically consented human samples with associated medical, pathological & diagnostic data and leverage this resource to develop & deliver high-end diagnostic applications. Further Sapien has entered into an alliance with Apollo Hospitals that allows Sapien to front-end Apollo's personalized medicine initiatives. This allows Sapien to bring novel cutting-edge diagnostics to Apollo, either on its own or in collaboration with best-of-breed institutions world-wide thereby enabling world-class healthcare and improving patient outcomes. Sapien has fully functional labs located within the Apollo Health City Campus in Hyderabad.[146]

The Hindu reports that Sapien Biosciences has tied up with the US company Strand Centre for Genomics and Personalized Medicine to provide genetic testing to its patients. Sangita Reddy, joint MD of Apollo Hopitals is quoted saying, "A typical chemotherapy cycle usually costs anywhere between Rs. 2-3 lakh. So spending another

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[145] *Name and details withheld for protecting privacy.*

[146] *"Apollo Hospitals set to integrate clinical genomics as part of its personalized medicine initiatives." See http://sapienbio.com/apollo-hospitals-set-to-integrate-clinical-genomics-as-part-of-its-personalized-medicine-initiatives/ [Accessed July 11, 2015]*

Rs.20000 for a test that can detect the efficacy of the chemotherapy drug would be worth it. Moreover, as the volumes grow, we are sure the costs will come down too."[147] Similarly, Max Healthcare has also tied up with Strand to offer genetic medicare services to its customers, this news report from *IBNLive* is illuminating,

> "In our first phase, we went global and then served the local market. But now we'll first go local and then move to the global market," says Vijay Chandru, chairman and chief executive of Strand. He believes the Indian healthcare market is ready for it. So does Ajay Bakshi, chief executive of Max. "I have followed this space for a while and I can say it is ready for consumption, both for patients and healthy people," says Bakshi. "The beauty of this technology is that the benefits keep accruing as science advances, and your genetic counselors keep updating your profile."
>
> Globally, the genomics-based diagnostics market is projected to be worth $30 billion by 2015. In India, there are no estimates. But there's potential. "I am excited because India can show the way... We have no privacy or insurance issues like the developed markets... Why should we always follow the West," says Bakshi.[148]

NutraGene is offering a genetic test for Type 2 Diabetes priced at Rs 8000 along with "genetic counseling and wellness consultations with every test." Its Managing Director is reported to have said that the, "company was dedicated to promoting genomics in India from the perspective of both commercial genetic tests and India-specific genomics research. Retail genomics is poised to be the next major contributor to growth within the Indian clinical diagnostics industry, which is expected to reach INR 10,000 crores this year."[149] Similarly, *mapmygenome.in* has product offerings of SlimGene, myfitgene, sugargene and brainmap.[150] What they do not advertise is that there is no proper study of Indian population cohorts in the results that they provide to their clients, and further, the clients have signed away their own genetic information for the companies to research on and make profit. The main revenue is not in companies providing genetic diagnostic tests but in the way in which each customer's genetic

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[147] *"Apollo Hospital offers genetic tests." The Hindu. See http://www.thehindu.com/news/cities/Hyderabad/apollo-hospital-offers-genetic-tests/article6245838.ece [Accessed July 11, 2015]*

[148] *"Why Strand Life Sciences wants doctors to genetically profile patients". IBNLive.com. See http://www.ibnlive.com/news/india/why-strand-life-sciences-wants-doctors-to-genetically-profile-patients-595094.html [Accessed July 12, 2015]*

[149] *"NutraGene Launches India's First Commercial Genetic Test for Type 2 Diabetes" prnewswire.com. See http://www.prnewswire.co.in/news-releases/nutragene-launches-indias-first-commercial-genetic-test-for-type-2-diabetes-145884085.html [Accessed July 12, 2015]*

[150] *http://www.mapmygenome.in/ [Accessed July 15, 2015]*

information is profiled to study disease patterns and increase the 'value offering' and 'portfolio' of the company. For example, mapmygenome, says, "With your consent, the delinked data including results from the questionnaire and genetic information generated from sample processing will be part of our research database. This will help you serve the Indian community better and contribute to health science."[151]

Lack of regulation

The government bodies using biotech who sell treatment programs to its population will definitely have to create laws to regulate the market. There is no particular consensus on how to regulate the biotech genetic industry in the world (Gottweis and Petersen 2008; Gottweis and Lauss 2012). However, it is also true that there are a lot of companies that have come up in this regulatory vacuum and no one knows who gave them permission. There are now several personal diagnostic companies like Mapmygenome (mapmygenome.in), DNAlabsindia (www.dnalabsindia.com), easyDNA (www.easydna.in), DNAcenterindia (www.dnacenterindia.com), paternitytestingindia (www.paternitytestindia.com). Bio-Axis India (www.bioaxis.in) claims to be able to provide even a 'DNA ID card'.[152] Unlike the FDA in the US, the DBT is supposed to be the nodal agency but there is no regulator body for such matter, ICMR is also silent on this. The World Health Organization reports that,

> Accreditation of clinical laboratories is not mandatory in India, however the central government has recently implemented a voluntary accreditation program. The **National Accreditation Board for Testing and Calibration Laboratories (NABL)** is an autonomous body under the Department of Science and Technology, Government of India and is the sole government-authorized accreditation body for laboratories.
>
> It appears that the majority of clinical laboratories in India have yet to obtain accreditation. The first accreditation certificate for a clinical laboratory was issued in 1999 and as of June 2005, there were 47 clinical labs accredited by NABL out of an estimated 20,000 clinical laboratories in the country. Accreditation offers incentives of increased customer confidence, better control of laboratory operations, and greater access for their services. However, due to cost and potentially other burdens, relatively few laboratories have stepped forward for accreditation, and those that have are

[151] *http://mapmygenome.in/main/about-us-1/data-confidentiality/ [Accessed July 17, 2015]*

[152] *"DNA ID card: DNA Identity card is unique DNA Profile card of identification as any other govt identity proofs. DNA ID Card is useful for Identification of child swapping, wrong inclusion among suspects, Legal identification purposes, property cases, Immigration purposes etc." http://www.dnares.in/dna-id-cards-in-india.php [Accessed July 15, 2015]*

> predominantly private laboratories that can afford the expense. NABL continues to conduct awareness programs and panel discussions in order to promote wider participation in clinical laboratory accreditation. (World Health Organization 2015)

The Pre-Natal Diagnostic Techniques (Regulation and Prevention of Misuse) Rules 1996 explicitly states in section 14: *Conditions for analysis or test and pre-natal diagnostic procedures,*

> (1) No Genetic Laboratory shall accept for analysis or test any sample, unless referred to it by a Genetic Clinic. (2) Every pre-natal diagnostic procedure shall invariably be immediately preceded by locating the foetus and placenta through ultrasonography, and the pre-natal diagnostic procedure shall be done under direct ultrasonographic monitoring so as to prevent any damage to the foetus and placenta. (*The Pre-Natal Diagnostic Techniques (Regulation and Prevention of Misuse) Rules* 1996)

Many genetic analysis companies on the web advertise that they will do 'paternity' testing and also 'genetic diagnostics.' For example, mapmygenome.in, by far the most well funded company in the personalized genomic diagnostic market in India, with investors that, "include names like Aarti Grover MD – CMS Computers, Rajan Anandan MD- Google India, Arihant Patni –Managing Director at Hive Technologies and Satveer Singh Thakral – CEO of Singapore Angel Network among others." It has even tied up with e-commerce sites like Snapdeal and Amazon to provide its products. Satveer Singh Thakral, CEO Singapore Angel Network illuminates for us the individualized risk of the neoliberal genome when he says, "as *India's economy develops*, we strongly believe that *preventive healthcare* will form a rising share of the *household budget*. *Genome mapping* is at the frontier of technological innovation in this context, and we are backing this experienced team to *scale* and make this technology *commercially* available to people from *all walks of life* who are *pro-active about their health*" (*emphasis added*).[153] As Lemke notes,

> Predictive genetic tests will show us that, although we are ostensibly healthy now, we probably will become ill in the future and are therefore already ill. Unlike the 'invincible' social and economic risks, genetic risks can be verified by testing devices. However, genetic diagnostics contributes to ensuring the social and economic risks remain 'in the dark', by re-coding these as biological risks and presenting them as a matter for the individual. *Thus, the recourse to the molecular text blots out the social context.* (Lemke 2004,556; *emphasis added*)

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[153] *"Hyderabad-based Mapmygenome raises $1.1 million funding in pre-series A round" Yourstory.com. See http://yourstory.com/2015/03/mapmygenome-funding/ [Accessed July 15, 2015]*

However, their website informs us that, "we use the services of Ocimum Biosolutions that holds several patents in this space. We are also undergoing certifications like the NABL and CE mark. The lab is already ISO certified."[154] It is important at this point to wonder, who has given them permission to share the biological samples/genetic information of their clients with a third party (Ocimum Biosolutions)? Further, how are they functioning without even a certification from the National Accreditation Board for Testing and Calibration Laboratories (NABL)? Who allowed them to sell their products in online retail portals like SnapDeal and Amazon? And finally, why are they giving half-information to clients, ISO? which number?

In what I read to be coterminous with the evolution of neoliberal governmentality in India, there is the draft *Drugs and Cosmetics (Amendment) Bill 2015* that is pending approval in the legislature. *PharmaBiz.com* reports: "The Bill proposes to expand the scope of the Act to cover new areas and will "regulate the import, manufacture, distribution and sale of drugs, cosmetics, *medical devices and conduct of clinical trials* and for matters connected there with or incidental thereto"[155](*emphasis mine*). If we read medical devices to be 'New Generation Sequencing' machines and 'genetic diagnostics' as also applicable in this new amendment, then we can see the implications of this bill with greater clarity. This, along with many such 'draft bills' provides a glimpse of the functioning of India's governmental regime.

On the whole, private companies are providing a range of services, including, disease testing, paternity, etc. It is also possible for one to know the sex of the child now, by sending a DNA sample to the companies which will mail you the results, thereby easily bypassing all regulations for this. Also, a *Times of India* report points to the fact that men are increasingly opting for genetic testing to prove the suspicion that the child is not his biological progeny. In the case of Gujarat, the news item reports that there are increasing requests for such paternity testing to the courts and government laboratories. The government laboratories do not entertain private requests, however, the private labs do

[154] *http://mapmygenome.in/main/faq-full-width/ [Accessed July 17, 2015]*

[155] *"Health ministry releases draft Drugs and Cosmetics (Amendment) Bill, 2015 to amend D&C Act, 1940". Pharmabiz.com. See http://www.pharmabiz.com/NewsDetails.aspx?aid=86007&sid=1 [Accessed July 12, 2015]*

not have any such constraints.[156] This can propagate a way of 'conducting' and 'disciplining' women's sexuality. In a country where men are roaming free having affairs without a question being asked and it being taken as a 'public secret' with polite approval in most cases, it is the women who will have to answer for their 'promiscuity'. The *Times of India* headlined a news item *Paternity Suits: DNA order shot in the arm for men.* This is a judgment of the Supreme Court as reported:

> In our view, but for the DNA test, it would be impossible for the respondent-husband to establish and confirm the assertions made in the pleadings," the court said. The SC had, however, said that if the wife declines to still do the DNA test the allegations made by the husband about her infidelity would have to be determined based on presumptions contemplated in Section 114 (h) of the Indian Evidence Act. The court can draw an adverse inference when a person refuses to give an answer, which law does not compel a person to give.[157]

Further, in a regulatory vacuum, there is a SlimGene weightloss test offered by Mapmygenome that is supposed to assist in losing weight. In the words of its CEO, "Your genes need not define your jeans. When you know what the genes say, you can easily take charge of other controlling factors to achieve your ideal weight."[158] As Lemke notes,

> In the framework of this 'government of risks' genetic diagnosis might be important both in political and economic respect. Prediction and prevention together with individual self-management could replace the dangers of explicit state prescriptions and proscriptions. Genetic diagnosis presumably avoids general and anonymous control mechanisms and creates the possibility of compiling individual risk profiles with a concrete list of susceptibilities and dispositions to disease. (2004,555)

Secondary research and impact on oppressed human subjects

Besides the fact that these genome tests are pre-disposed towards women's concerns primarily, it is also interesting to note how it both gives a statement that the girl is fat because of her genes (so nothing can be done about it) and at the same time,

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[156] *"Forensic lab finds love cheats in 98% cases" The Times of India. See http://timesofindia.indiatimes.com/india/Forensic-lab-finds-love-cheats-in-98-cases/articleshow/45390899.cms [Accessed July 12, 2015]*

[157] *"Paternity suits: DNA order shot in the arm for men" The Times of India.See http://timesofindia.indiatimes.com/city/mumbai/Paternity-suits-DNA-order-shot-in-the-arm-for-men/articleshow/44842530.cms [Accessed July 17, 2015]*

[158] *Mapmygenome India launches SlimGene for weight loss. Financial Express.See http://www.financialexpress.com/article/healthcare/happening-now/mapmygenome-india-launches-slimgene-for-weight-loss/83784/ [Accessed July 12, 2015]*

because it is in her genes, she can tweak her lifestyle to become slimmer. The business of life is indeed profitable in India because the companies do not have any transparency on what happens to the DNA samples once you send it to them to get your tests done. Most probably they are not discarded, but kept for research purposes, because the main money to be made is on ***secondary research*** which can be sold to another bigger company or a pharmacogenomics company.

In addition, although genetic personalized medicine seems 'non-intrusive', it cannot be completed without researching on human beings. As Amit Prasad notes, reading into both Foucault's 'governmentality' (1991) and Agamben's bare life (1998),

> …people are being 'harnessed' as human capital, which leads to the politicization of 'bare life' through 'inclusive-exclusion'. This inclusive-exclusion occurs through two intertwined processes/rationalities: 'capitalization of vitality' potentially includes these people, yet they largely remain as 'guinea pigs' in this process because most of the drugs that are being tested are not for them. Moreover, since government-provided healthcare is so poorly funded and mismanaged in India, they have little access even to the medications that are available. 'Capitalization of humans' also potentially includes these people, but their 'value' (as human capital) is limited because they largely constitute a 'non-productive asset' except in the field of drug testing. Capitalization of disease in drug trials outsourcing operates through these governmentalities and exemplifies this double inclusive-exclusion.(2009,4)

India has a large population of poor and desperate people, who are available to be guinea pigs for the corporate and Indian drug manufacturers. Thus, although DNA technology looks clean it is based in experimentation with humans on a molecular level. It would not be too far-fetched to expect to see are lot more mutants in the future who have become collateral damage in the coming of the age of molecular medicine.

Further, "rich and poor, black and white, young and old – all subjected to the dictate of the genes. In this view, our social position has less to do with power strategies or exploitation structures and more with biological differences" (Lemke 2004,557). This is reflective of the condition of people described by Petrynain Chernobyl who continue to work in hazardous conditions that will ultimately kill them because they have no other option to find work and to feed themselves because of the retrenchment of socialism and the fragmentation of the welfare state in Ukraine. "There are a lot of people out of work," he said. "People don't have enough money to eat. The state doesn't give medicines for

free anymore. Drug stores are commercialized." He likened his work to that of a bank. "The diagnosis we write is money."(2004,263) It is safe to say that the people who undergo clinical trials in India live in a condition of 'bare life' outside of their claims to citizenship.

> The state (as well as its allied agencies), which has been aggressive in enacting laws to protect the benefits and risks of drug companies and CROs, seems to have a different approach when it comes to protection of benefits and risks of the people on whom drugs are being tested. This imbalance makes sense, however, if we realize that the market within neoliberal governmentality has usurped the role of public authorities and is expected to regulate not only exchange but also utility. (Prasad 2009,15)

The ethics of human germline editing

From a study of the current developments, it appears that the DBT and the Health Ministry are not serious in protecting the interests of the people of India from being exploited. For example, there is no specific course on bioethics being taught anywhere in India currently, not even in the medical colleges (although it may be a tiny part of their course). There is no onus on the part of any institution to take it forward in India. In spite of the great eugenic background of biotechnology, the government's DNA research institutions pretend as if it is a harmless exercise. There are hardly any ethics committees, and in the few that are there, there are no trained bioethicists in them; India does not have any bioethicist. Each research institution is supposed to set-up a bioethics committee but this task is left primarily to the institution. The US government did set up a bioethics educational portal and program with the National Institute of Epidemiology, however it seems to be quite inactive. The website is outdated and the program does not exist; if one sends an email, there is no reply.[159] There is a course on 'bioethics' that Indira Gandhi National Open University (IGNOU) provides in partnership with the India Council of Medical Research (ICMR) which is currently non-functional and also has no mention of the eugenic history of medicine in the course outline.[160] The *Ethical Guidelines for Biomedical Research on Human Participants* (2006) is the only ineffective embankment and it seems to present itself as benign neglect rather than a regulatory intervention.

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[159] *See http://www.nie.gov.in/leftcontent.php?lmid=MQ==&lcont_id=MTAz [Accessed July 17, 2015]*

[160] *See http://www.ignouonline.ac.in/icmrproject/ProgrammeGuide.aspx [Accessed July 17, 2015]*

Back to commodification of life and money matters – gene-commerce

This is important because the imagination of health in the notion of govenmentality, the health of the population is of primary importance, now it is a source of a big resource of the nations. Benjamin (2009) notes that the, "biology of the population becomes a 'natural resource' and genomics serves as a nation-building project maximizing the potential of this resource. Unlike other nationalisms, the point of postcolonial genomics is not to posit the nation as 'pure', but as a unique genetic mixture (i.e. 'admixed') when compared to other nations" (2009,344). The use of the genetic technology is geared towards not only curing disease, but also making money. Again, this highlights the imagination of life as a commodity and the politics associated with it. The increasing use of biotech in medicine in India will have its links with the market as I have shown. The poor who provide their genes for research will not benefit from it because research is married into industry in India. The ethics of consent is one of the main issues when we look at clinical trials in India, and in the case of genetic research it seems this will be repeated again. Rouvroy (2008) questions this as, "Which rights for which subjects?"

Perhaps, it is more in line with the dystopian conception of 'biological citizenship' provided by Adriana Petryna (2004) in the conditionality of 'postsocialism' (and postcolonialism) rather than the empowering picture painted by Rose and Novas' (2004) collective strokes in the case of the US,

> Biology becomes a resource in a multidimensional sense - versatile material through which the state and new populations can be made to appear. This postsocialist field of power has specific physical, experiential, political, economic, and spatial aspects. It is about knowledge and constructed ignorance, visibility and invisibility, inclusion and exclusion, probabilities and facts, and the parceling out of protection and welfare that do not fit predictive models. It is also about how individuals and populations become part of new cooperative regimes in scientific research and in local state-sponsored forms of human subjects protection. In this context, suffering is wholly appropriated and objectified in its legal, economic, and political dimensions. At the same time, these objectifications constitute a common sense that is enacted by sufferers themselves in ways that can promote protection as well as intensify new kinds of vulnerability in domestic, scientific, and bureaucratic spheres. (Petryna 2004,265)

More examples to highlight how this can perpetuate all kinds discriminations – marriage market

The creation of a PR industry to support this effort is yet to be seen in India however some markings are under way; for example, mapmygenome markets a 'complete genomic package' *genepatri* which enmeshes both gene and *patras* to create a universal Indian idiom of a global network of market-directed bio-marketization. This is distressing to say the least, because the use of the word *patri* is co-terminous with *janampatri*[161], which aligns *genepatri* as cunning commodification of the notion of genetic determinism as part of their product offering. Further, the link of *janampatri* with the marriage market in India and the commodification of women's bodies provides a great cause for concern for those invested in the project of gender equality. The desire for children with certain physical characteristics like preference for male child, height, skin color, and intelligence causes a lot of trauma and distress to women and they are constantly pressurized mentally, physically, socially, emotionally, culturally and economically. It is reported that people look for particular ethnicity, caste or religion in India when it comes to choosing the sperm of donors for artificial insemination. *The Times of India* reports that *Brahmin sperm in high demand among childless couples*, the news report states: "Dilip Patil, founding president of Trivector, an infertility solutions firm, says there is a definite preference for Brahim donors in Mumbai." Even among Muslims, couples want to know whether the donor is Sunni or Shiite," he says. "However, going by Indian Council of Medical Research guidelines, *we reveal only the religion of the donor, not the caste*" (*emphasis added).*[162] Another incident reports that couples are looking for sperms from students from the Indian Institute of Technology (IIT)'s in the hope of making progenies that are more intelligent and hence more successful.[163] The mobilization of gene to consolidate social structures especially caste,

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[161] *Hindu 'birth-chart' based on astrological calculations used for deciding important decisions in India, especially, in match-making for marriage alliances between partners. See http://mykundali.com/hindu-kundali.asp [Accessed July 17, 2015]*

[162] *"Brahmin sperm in high demand among childless couples" The Times of India. See http://timesofindia.indiatimes.com/PDATOI/articleshow/13114610.cms?from=mdr [Accessed July 15, 2015]*

[163] *"Wanted: An IITian sperm!" Firstpost. See http://www.firstpost.com/fwire/fwire-india/wanted-an-iitian-sperm-182313.html [Accessed July 15, 2015]*

class, race and gender is evident in these two sites. The use of 'genetic profiles' in the marriage market in India therefore are likely to be analogous with the emergence of genealogical diagnostics, a racial marketization or what Foucault calls the race question elsewhere (see Macey 2009; Stoler 1995). The arrangement of heteronormative marriage through matching "stars and genes" portend newer ways of governmentalizing sexuality and marriage.

Ridhi Tariyal, making a case for genetic diagnostics in India in her Master's thesis in the MIT writes that,

> I conclude that arranged marriage practices are still a vibrant norm in India and hypothesize that they can provide an interesting point of intervention for fatal genetic disorders. Part of Dor Yeshorim's success can be attributed to its ability to inform prospective couples of carrier status prior to marriage.
>
> At that stage, a prospective couple has multiple options. They can choose to not pursue a relationship, proceed with the marriage but be vigilant in the use of genetic testing on a fetus, choose to adopt a child or take no action. Whichever route the couple selects, they are at least informed and aware. (2010,12)

Tariyal's analogy with the Committee for Prevention of Jewish Genetic Diseases[164] is misleading for three reasons. First, it ignores the specificities of the response to Tay-Sachs disease within the Jewish community and the specific protocols of confidentiality that were built into the match making organization. Second, she ignores the critique of this kind of medicalized intervention that brings together match making with medical diagnostics. Finally, the margin of error in diagnosing whether or not a genetic disorder will manifest to the degree of fatality in a child in the future is also ignored here. Further, when women have limited agency in relation to sexual and reproductive choices, genetic technologies act to entrench the patriarchal family further.

For instance, talking about genetic diagnostic going mainstream in India, Jyotsna Agnihotri Gupta explicitly notes the eugenic use of genetic testing and screening in India. She notes that both positive and negative eugenics are practiced in India as part of population policies or practices of prenatal diagnosis by the women themselves. For example, in the case of thalassemia, which is a genetic disorder with a big population in

[164] *See https://www.jewishgenetics.org/overview-halakhic-issues [Accessed July 26, 2015]*

India, ("every year between 7,000 and 10,000 children are born with thalassemia major in India" (2007,219)), there is tremendous bias in blaming women for the children born with these conditions. This is a statement from Dr. V.K. Khanna, founder of the thalassemia unit at Sir Ganga Ram Hospital, Delhi and Vice President of Thalassemics India,

> I do not counsel pre-marital thalassemia. If they come to know that the prospective bride or groom is a carrier, no one will marry a person with thalassemia minor. There is so much interference from parents and grandparents. They must be told that individuals with thalassemia minor are normal. (2007,219)

Bio-citizenship

The use of genetic testing in surrogacy is another example of how India is placed in the global power hierarchy in the genomic age. Let us see how Indian citizens are treated by Western nations to understand this issue. Heinemann and Lemke (2014) argue that the biological notion of the family is still the rubric through which immigration proofs for family members are judged in Germany inspite of being a society which is increasingly accepting heterogeneous notions of family, so there is a double standard here in the sense that there is a separate yardstick for German nationals, (which could be based on a social understanding of family) *vis a vis* a more biological understanding for people seeking immigration into Germany to get citizenship for family reunification. They show that there is selective targeting of specific immigrants, especially from sub-Saharan Africa and Central and South-East Asia by mobilizing biological knowledge through the use of DNA testing for immigration (491). They note that German immigration authorities prefer DNA kinship reports as proof of evidence in contrast to other forms of identification inorder to decrease cases of forged documents proving relation. This is relevant in the case of India too, because of the way in which immigration authorities treat children born out of surrogacy in India. It is standard practice to ask for proof of DNA match report to confirm biological parentage from the biological parents in order for the child to be allowed to go back to the parent's country. Thus, the Indian woman is excluded from claiming any rights because she did not provide the chromosomes to the child who came out of her own womb. The United States' embassy in India provide the following information in its website

> If the Consular Officer finds that there is insufficient evidence of a genetic relationship between the parent(s) and the child(ren), a DNA test may be recommended at the time of interview**. If the interviewing officer makes this recommendation, then parents can expect a processing delay of approximately two weeks to allow for the receipt of the DNA test kit at the Embassy, sample collection, the mailing of the sample, and the receipt of results from the lab. Parents should factor this possible delay into their plans. If a DNA test is recommended, you will be provided with all details related to this testing at the time of your interview.** All costs and expenses associated with DNA testing must be borne entirely by the passport applicant and his/her family. (Note: The genetically related parent must be a U.S. citizen at the time of the baby's birth to be eligible to transmit citizenship.)[165]

Similarly, for example, the embassies of U.K and Australia also ask for proof of DNA match of the child and the parents.[166] *The Times of India* reports the case of a Norwegian woman who birthed twins that were later found to be not genetically linked to her.

> Norwegian woman Andras Bell approaches a fertility clinic at Bandra and commissions surrogacy with the help of the clinic, she meticulously chooses an unrelated Scandinavian sperm donor from Cyros Sperm Bank in Denmark. She then chooses an Indian egg donor. Within 48 hours, the tailor-made embryo is created in the IVF clinic. It is later implanted in the surrogate's womb. The surrogate carries pregnancy to term and Bell's twin boys are delivered. The matter came to light when Bell tried to return to Norway with her twins. DNA tests could find no genetic link between Bell and the babies. Norwegian delegates from the embassy in Delhi come to Mumbai to look for a solution. An investigation into the matter is still going on.[167]

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[165] *See http://newdelhi.usembassy.gov/service/reporting-births-and-citizenship-questions/surrogacy-a.r.t.-and-dna-testing [Accessed June 27, 2015]. The U.S. Embassy has detailed guidelines on "Information for Parents on U.S. Citizenship and DNA Testing." See http://travel.state.gov/content/travel/english/legal-considerations/us-citizenship-laws-policies/citizenship-and-dna-testing.html*

[166] *For UK see: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/324487/Surrogacy_overseas__updated_June_14_.pdf*
For Australia see: http://india.embassy.gov.au/ndli/vm_surrogacy.html[Accessed June 27, 2015]

[167] *See http://epaper.timesofindia.com/Default/Layout/Includes/TOINEW/ArtWin.asp?From=Archive&Source=Page&Skin=TOINEW&BaseHref=TOIM%2F2010%2F07%2F21&GZ=T&ViewMode=HTML&EntityId=Ar00103&AppName=1 [Accessed June 27, 2015]*

Thus, it seems that there is a sense of precariousness in the lives of Indians when it comes to dealing with genetic technologies that move away from the vitalist position of Nikolas Rose and Carlos Novacs (2004). Bio-citizenship is also embedded in the same unequal power relations that are in existence across social spaces, and are informed by the meanings embedded in each person's specific location. Further, it is pertinent to note that in today's day and age there is no biological citizen without at the same time a 'homo informaticus'. Genes are no longer physical objects in the strict sense but codes that carry and store information. Thus, now there are DNA chips being used as information storing devices and at the same time, genetic information being uploaded into cloud storage. How big data complicates this linkage is not an issue I will go into here, but, it is sufficient to note that massive storage space is needed for the concept of 'personalized medicine' to take off.

Conclusion

Genes and genetic information are a commodity just like any other commodity, and are meaty prey for market exploitation. The risk of markets and other parties getting access to one's biological information (in the garb of decreasing one's risk for getting certain diseases), and using it for their ends, is immense. Right now, companies are simply asking one to test for the SlimGene. It is important to ask whether the motive for this test is good health, or good business? Soon, they will be in the business selling lifestyle items *because they know* that you have SlimGene, or an OncoGene. This, in turn, will have huge implications for welfare, employment and insurance. From being a *partly risky individual,* one becomes a *permanently risky profile*. As Ekberg writes,

> A common error in the new genetics is over-estimating the predictive value of genetic tests and misunderstanding the difference between presymptomatic and susceptibility tests. This is the error that may result in new forms of social inequality and genetic discrimination. Employers, insurance assessors, educators, marriage registries, adoption agencies or immigration officials may interpret susceptibility as inevitability and may discriminate against people based on an uncertain probability of developing a future genetic disease. (2007,591)

Citizenship is dependent on the *worth* of each life, and life does not have the same worth for all, some are more equal than others. Foucault describes in *The Birth of the Clinic* (1973) how guilds are formed for the creation of a system of medicine in France in

which the modality of health is intimately associated with being a political tool. He traces the evolution of knowledge in the 18th century and the way that it gave birth to the 'medical gaze'. Something akin to this seems to be happening with the gene as it enters the domain of medicare, where the whole appendage of knowledge in the 21st century constitutive of a 'molecular gaze' seems to be in the making (Braun 2007). The epistemic grounding of medicine has changed from the 18th century to the current 'molecular' understanding of life (Kay 1993; N. Rose 2013; N. Rose 2009). Thus this new way of knowing will also bring with it a new medical regime which in my opinion, will turn the gaze *within*.

I have shown how the gene is a great tool of control. In this chapter, I have demonstrated how India is also imbricated in the knowledge/power nexus and is making its claim in the global arena. How it finally plays out within India remains to be seen, however based on a study of the current motivations and patterns of the Indian machinery, one can claim that it is not working on behalf of the Indian citizens. The lack of regulations and the prevailing levels of corruption will definitely play a huge role in shaping the future movement and direction of this technology.

Gene-cognition

> The growth of a capitalist economy gave rise to the specific modality of disciplinary power, whose general formulas, techniques of submitting forces and bodies, in short, 'political anatomy', could be operated in the most diverse political régime, apparatuses or institutions. (Foucault, 1977,221)

No idea goes uncontested in science. By now, philosophers have generally concluded that science is not really a linear progression with uncontested ideas bursting forth. In a way this dissertation maps the politics of this contestation. It is about the many ways in which knowledge, politics and power interact; and how science is implicated in the logic of globalization. Not only is science shaped by and embedded in power as a study of the history of science would reveal, but it also is a significant force which shapes societies, and has ramifications at the social, cultural, political and juridical levels. In this inter-disciplinary dissertation, at a broader level, I have attempted to study the current social impact, implications for the future as well as the social embedded-ness of scientific ideas and their application for technology. Specifically, I have looked at the scientific object of the 'gene', its philosophical underpinnings and its 'usage' through genetic technologies. In this study of the 'social life of the gene' I have focused on implications for law, society and governance of what is being advocated as not simply enhancing, but potentially revolutionizing life as we know it. There are many scientific issues related to the argumentation of why 'genetics' as a science is flawed and how 'genetic science' rests on shaky ground (Rosenberg, 2008, for debate), however this debate is beyond the scope of this dissertation. I have focused on the philosophy of the gene that is embedded in an economy of power, and its usage at the level of micro-physics and at the level of govermentality.

Gene and the Economy of Calculation

It will not be incorrect to state that we are global beings floating in the ether of finance capital. Karl Marx in his *Fragment on Machines* recognized the way in which humans would be networked in a circulation of capital. In this instance, he recognized the

capacity of the human body itself to be made a site of capital production, what he deemed as *fixed capital.* He wrote, "when we consider bourgeois society in the long view and as a whole, then the final result of the process of social production always appears as the society itself, i.e. the human being itself in its social relations."[168] Similarly, Foucault talks about the way in which humans have been neo-liberalized because of the incorporation of the population in the government of life. This, as Ulrich Bröckling points out, leads to a condition where the human being is looked at as capital itself, not only his/her labour. He writes,

> The individual appears here as an economic institution whose continued existence, like that of a company, depends on his or her choices. Whatever someone does could have been decided against or replaced by something else done at the same time. For that reason it makes sense to presume that individuals take up the options assumed to correspond most closely to their preferences. The human being of human-capital theory is above all someone who unswervingly decides. (2010,257)

The capitalization of life is a historical process, previously labour was the domain of capitalization. The 'gene' now has entered the domain of this economy of calculation in multiple forms.

I have pointed out the relation of genetic material with the connective of life. I am referring to life as it is understood in this age; as Foucault shows us, life has meant different things to different people in different times (Foucault 1978). The life I talk about here is the life of the individual as embedded in neoliberal times. For me, the trope of the 'gene' becomes an important marker, which is symbolic of this very kind of life.

In this dissertation, I took two points of entry; two ways to look at the way in which genes enter the world and interact with it. The domain of criminality shows us how genetic technologies have enabled the life of society to be controlled in a much more 'efficient and *productive'* way than would otherwise have been possible. Similarly, the entry of the gene in the realm of healthcare has enabled the realization of many significant improvements that *enable* patients to live longer and get better quality

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[168] *See "Fragment on Machines" Karl Marx. http://thenewobjectivity.com/pdf/marx.pdf [Accessed July 24, 2015]*

healthcare. These are without a doubt very important developments in the social life of human beings.

I have pointed out, with a sense of foreboding, the closure of democratic spaces in public life that a citizen is entitled to in a vibrant democracy (see chapter 3). I have also noted the ways in which the modality of the gene might be constitutive of the ways in which human beings form social relationships. The ethics of editing of human beings at the genetic level is a topic I have only briefly touched upon in this dissertation, and remains and area for future research. What I have primarily focused on, is how the gene as a scientific and social object carries within it a whole philosophy and political meaning (see chapters 2 and 3). A self-entrepreneurship is enabled by genetic technology that was not possible in the past. What this will do for the future is an open question. I would like to posit here my point of view, which may be correct or incorrect or in between both these claims.

'Gene-opticon'

I draw on Foucault's notion of, the *panopticon* as an apparatus of the technology of power. He describes the architecture of the panopticon as something that conducts the moral economy of the convict. The panopticon is not only for the prison, it could be for the hospital, the military barrack and the school. It is in the end a tool to discipline the individual. I posit that the current technology of the gene is also a mechanism, a complex through which discipline is exercised on the bodies of individuals. If we take the architecture of the panopticon away, and look at the specific way in which power is enabled in the creation of surveillance, we can talk of a '***gene-opticon'*** which accomplishes this task by the mechanics of power. The disciplined subject that is the whole *effect* of the creation of the panopticon, lies within an optics of seeing, without being seen; a constant supervision; a play with visibility and invisibility. What the gene does is that it manufactures a similar power; the disciplined subject is constantly *aware* of the threat of supervision and surveillance. The prison as a place has now been *located* outside of the brick walls to the body of the individual, where the person is always *accessible* to the regime of discipline and punishment. The purpose of the prison has been

transposed to the biology of the subject. In this way, genetic *information* potentially has the power to function as a panoptic gaze, with the ability of finding the perpetrator of a crime. In a recent news item it was reported that an American company did a DNA test to find out which disgruntled employees defecated on the company supervisor's door.[169] Similarly, the ability to constantly supervise the conduct of the persons under authority gives it the power that the panopticon was originally designed for.

Power flows via regimes of 'truth'; it finds a way of inscribing itself on the bodies of people. Foucault placed institutions as the creation of a specific way by which human bodies are *moulded* to behave in a desired manner. Every item is intended to create an effect that produces as its objective a human invested with power; that is why power is productive. It is a way, a mode of producing, the subject. The 'gene' is also a technology of this power that works at not only the anatomical, but at the molecular level by *inscription;* a '*gene-scription'* one could say. In a nutshell, genetic information creates the subject as a particular object of power. The gene is invested with the power to provide information, a specific form of information which is a blueprint of the individual. It plays on individuality by negating it from the multitude, at the same time it forms the multitude. This information can be used in various ways, the police officer uses it to check a DNA profile in the database, the judge uses it to make a *judgement* about a crime, a researcher uses it to study unique information and compare it with millions of others, the potential husband uses it to evaluate whether his wife will be able to produce healthy babies, the market insurance analyst uses it to make predictions on life, the employer uses it to make sure that his employee is capable of a return on investment, and, finally, due to all of these '*genescriptions',* the individual him/herself uses it to evaluate his/her life chances and make decisions based on his/her 'profile'. It is no longer clear whether the gene produces the individual or the individual is the possessor of the genes. What appears to be the individual's ownership of genetic material, and hence greater freedom in choosing one's destiny if we look from afar, actually seems to become subtle and covert forms of imprisonment and a control, if one looks more closely. It is a prison

[169] *See http://www.psmag.com/politics-and-law/devious-defecator-privacy-gina. [Accessed July 25, 2015]*

without a jailor, without policemen, without other prisoners, without the walls of the panopticon. But the individual is monitored and tutored constantly. He is automata.

The Politics of the Inscription of Life

However it is not enough to say that a particular personhood is produced. The next question to ask is what is this production for? What is the role of such a person? As Foucault shows in *Discipline and Punish* we have come a long way from the power of the sovereign being written directly on the bodies of the people, although he never said that it has disappeared. The technology of power has conformed to a new way in which individuals are *formed* by the micro-physics of power on individual bodies that make up the docile bodies. But are the bodies really docile? Foucault says not. In fact, they are the most productive bodies because they have been *conditioned* to produce their truth effects. Power is *inscribed* on the bodies of the school boy, the prisoner, the patient, the armyman. How genes accomplish this task is a modality that needs detailed interrogation, however, the way in which DNA data provides information does away with the need for the person to confess his own incapacities because the gene confesses everything for him; his age, sex, origin, propensities, his biological relations, and of course, locates his person constantly in a particular geography. But that is not to say that she is not his own governor, she is given full freedom to govern herself as per the knowledge that she has gained for herself through her genes. He will decide whether he will be able to do certain work by the age of fifty, whether he should make that graffiti, eat that apple or be an illegal migrant and take the risk to live in another country. He alone chooses. But s/he is also *the governed.*

Many people have taken great pains to show that the gene is not scientifically valid, and the dangers associated with giving it too much importance in our lives. It is absolutely important to show that the gene is not based on rigorous science, but then, we do not contest the scientificity of the panopticon, but the truth effects it produces. For this, it does not need to be scientifically grounded but what is needed is that it be *productive.* Having said that, let me comment briefly on the science of the gene. We have seen how the genetic technologies are also conditioned by the social environment and

institutions that they come up with in the chapter on genealogy, as the panopticon would have come up in a certain *historical* time. In chapter two, I elaborated on how the modality of the gene gets located in the body politic of the United States, the United Kingdom and to a lesser extent, the European Union by way of how it is used to *control* criminals and how also, it is used to '*enhance'* the life chances of the patients. In the third chapter on India, I located the gene in the Indian terroir and *problematized* it.

In the backdrop of all the three chapters was the gene of science, and the gene of social science, which at times have gone in diverse directions. On the one hand, the gene as has been defined with its properties has been constantly refuted in the sciences by scientists themselves; while on the other hand, the social life of the gene has taken off at a different velocity, building global networks. It is increasingly used all over the world in forensics, in data basing, in healthcare, in consumables. The steam engine has morphed into the bio-technology of the twenty-first century. This technological progress is marked by firstly, the configurations of power in the global arena, and secondly, by the economization of life leading to capitalization of genetic information.

Power flows in different ways and it arranges things in order to *govern* the bodies of individuals and thereby, of populations (see chapters 2 and 3). The gene is a unique configuration in this complex of things and how it is arranged, what economy it functions in (as a social device) that gives it the power to become a magnificent tool of accessing the lives of individuals (see chapter 1). This is a complex that has been created by the interaction of academic knowledge production with already pre-defined notions of the world; it is also, importantly a *technology* that is engineered by finance capital (see chapter 3). There can be no bio-tech, as we imagine it today without the involvement of the ability to *capitalize* the potential and real benefits of this social, scientific and political contraption.

From a molecule, the *gene* has become the *definition* of our lives in ways that have been shown in this dissertation. At the same time, as noted, the *gene* is an embodiment of the ideas of rationality, scientific knowledge, social processes and political realizations. If this pre-cognition of the genetic story sounds too pessimistic,

then there is the speech given by Charlie Chaplin in the age of exactly such a 'revolution' given in the *Great Dictator* (1940), where he stresses with great elucidation how men who created the machines have themselves become its slave mirroring Marx's statement in the *Fragment*:

> The conditions and objectifications of the process are themselves equally moments of it, and its only subjects are the individuals, but individuals in mutual relationships, which they equally reproduce and produce anew. The constant process of their own movement, in which they renew themselves even as they renew the world of wealth they create. (Marx, [1859]1973)

Once again, we are back in the future. And the future is always premised on the spirit of finding a new time and space; a new scape that seems to be opening up is the *mindscape* (see Rose & Abi-Rached, 2013); where the black box of mental processes will be split open like the atom leading to the bomb, or the gene leading to human engineering. As scientific objects, both the gene and the atom do not exist in their normative framing, but the social lives of both are anything but non-existent.

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