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TAILORED GENES: IVF, GENETIC ENGINEERING, AND EUGENICS

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Synopsis – Developments in *in vitro* fertilization techniques and recombinant DNA technology are improving the technical feasibility of genetically manipulating human embryos. The combination of these technologies allows a new form of eugenic selection to be practiced and some IVF practitioners and researchers are advocating that genetic disorders can be eradicated from future generations in the human population. Prevention of the inheritance of "defective" genes by embryo manipulation or screening can be likened to the passing of laws in previous times, disallowing marriages that would produce "genetically diseased" offspring. The increasing number of genetic probes being developed to predict genetic disorders in embryos (e.g., Huntington's disease) means that IVF preimplantation embryos can be genetically screened. With this knowledge, so-called "defective" embryos would not be reimplanted. The recent development of a DNA probe that can be used to sex human embryos will potentially allow sex predetermination of IVF or naturally conceived embryos. The increased emphasis on locating genetic markers for an increasing number of diseases (including psychological conditions such as manic depression) means that the number of diagnostic screening tests will also expand. Ultimately, it is researchers who are deciding which tests will be developed, and it seems that the technical feasibility will provide the justification for genetic manipulation and screening in human embryos. The eugenic nature of such research and its subsequent application to humans only serves to reinforce prejudices against those with disabilities (genetically caused or not). Looking to the future, the technologies will undoubtedly be used in sexist and racist fashions as well.

In the past fifteen years, massive scientific developments have taken place in the fields of recombinant DNA technology and genetic engineering. The year 1978 saw the birth of the world's first "test tube" baby, and the technique of in vitro fertilization is now being applied to the "curing" of infertility in Europe, America, Australia, Asia, and countries of the Third World. Even though these two areas of science *may* have seemed unrelated in their beginnings, the two have now converged. In vitro fertilization, the fertilization of egg with sperm in an external environment, provides embryos that may be reimplanted into a woman. It is still largely an experimental technique with a low success rate. Most women who go on IVF programs will not give birth to a live baby.[1] These embryos are also the raw material which allows genetic experimentation to be possible. They are in an external laboratory environment, which means they are accessible for manipulation. The simultaneous development of DNA . technology and IVF techniques has brought science and society to a unique point – the possibility of gene manipulation, to "correct" genetic disorders. Such manipulation, if carried out on embryos, will affect future generations irreversibly, and its application to humans inherently reinforces a discrimination against those who are differently abled in our

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society. It seeks to eradicate “defective” genes from future human populations.

In this article, I argue that we are witnessing the theory and practice of eugenics resurrected, with the desire of scientists to genetically manipulate the human genetic makeup. Also, the increased emphasis on isolating the causes of diseases as genetic ones and neglecting environmental factors, can be likened to the theories of sociobiology and biological determinism Both eugenics and sociobiology have been used in sexist, racist, and ablist fashions to reinforce prejudices and to oppress certain social and ethnic groups. Evidence for the eugenic and determinist nature of genetic manipulation can be found in the basic scientific literature itself. Indeed, scientists have taken a great degree of licence in their writings to justify the possibility of gene manipulation in humans as a form of “therapy” to eradicate genetic disorders. I believe that the *development of techniques* in molecular biology and IVF will provide the justification for gene manipulation of human embryos, long before the ethics are decided. The history of science shows that: “If it can be done, it will be done.”

Eugenics is a term first made popular by Francis Galtoh (a cousin of Charles Darwin) in 1883 in England, with the publication of “Inquiries Into Human Faculty and Its Development” (Galton, 1883). He took it from the Greek “eugenes,” which means “of good birth.” Eugenics claims to apply genetic principles to the improvement of “mankind,” and there are two general subdivisions: positive eugenics, the increasing of the reproduction of fit individuals, and negative eugenics, reducing the breeding of unfit individuals (e.g., social degenerates). Galton thought that an individual’s abilities and behavioral traits were genetically determined, and he was looking for the source of his own family’s genius (Allen, 1984).

In the beginning of this century, the eugenics movement gathered momentum in the United States, in both academic and popular circles, and it was associated with a sense of white Anglo-Saxon superiority and racism. It resulted in the passing of sterilization laws in 24 states for various “social misfits,” for example, criminals, the mentally ill, sexual perverts, alcoholics, and others. In 1924, the Johnson Act was passed, which almost totally restricted immigration from Eastern European and Mediterranean countries into the United States (Allen, 1984). Eugenic writings and propaganda of the time, which influenced the passing of the act, argued that white races were superior, and that intelligence had a biological and genetic basis. Characteristics such as feeble mindedness and degeneracy were said to be inherited through single genes (Mendelian genetics). Later, many biologists withdrew their support for such arguments because of the scientific flaws and bias, but the immigration restrictions were not repealed until 1965 (Allen, 1984). This illustrates the power that such eugenic arguments carried but also the reluctance by the governments to denounce them and therefore repeal laws. Racism essentially remained as an acceptable sentiment.

At a similar time in Germany, eugenic ideas were popularized under the term “racial hygiene,” the first document appearing in 1895 written by a physician, Alfred Ploetz (Proctor, 1984). Documents published by the Society for Racial Hygiene in the early 1920s stated that racial mixing was a dangerous practice, and that the white Nordic races were superior. The idea of racial hygiene had become popular amongst the German medical profession, and the rise of Nazism and Hitler saw the further embracing of purely biological values.

> No more than Nature desires the mating of weaker with stronger individuals, even less does she desire the blending of a higher with a lower race. . . . (Hitler, 1925: 286)

These values were institutionalized with the passing of laws. In 1933, the Law for the Prevention of Genetically Diseased Offspring was passed, and it meant that individuals with schizophrenia, feeble mindedness, manic depressive insanity, genetic epilepsy, Huntington's chorea, blindness, deafness, physical deformity, or alcoholism would be sterilized against their will. In 1935, the Law for the Genetic Protection of the German People disallowed marriage between individuals if one partner was genetically defective, Jewish, or from any race deemed inferior. Doctors were also empowered to carry out euthanasia of people with "incurable illnesses" (Proctor, 1984). It is important to note that doctors and medical scientists were the chief exponents of racial hygiene in Germany. Of the 1300 members of the Society for Racial Hygiene up to 1930, most were physicians. The National Socialist Doctors Association, which represented the main medical wing of the Nazi Party, had more than 30,000 members in 1938, representing 60 percent of all physicians practicing in Germany at that time (Proctor, 1984).

Eugenic ideas and practices did not only "belong to Nazi Germany, although this represented an extreme of how eugenic and racist philosophies could be institutionalized. In Australia, there were proponents of eugenics, and eugenic societies existed early this century. Eugenists in Australia seemed to belong to the more humane wing of the eugenics movement. Environment was considered to play a stronger role in the development of human characteristics than purely hereditarian values. Physicians and politicians who supported eugenic ideas however, campaigned for eugenic marriage laws, and in 1912, the editor of the Australian Medical Gazette commented favourably on the need to segregate mental defectives and welcomed the formation of eugenic societies (Bacchi, 1980). The passing of the Mental Deficiency Act in Britain in 1913 gave the government there compulsory powers to segregate those , with mental deficiencies (feeble mindedness), and this British ruling increased fears in Australia about the menace of feeble mindedness. There was a shift in emphasis therefore to a more hereditarian deterministic one, which was also influenced by changing social conditions such as the spread of venereal disease. In the 1930's eugenic societies flourished (Bacchi, 1980).

In 1975, E. O. Wilson sought to establish sociobiology as a new field of study in his book, *Sociobiology: The New Synthesis* (Wilson, 1975). The theory of sociobiology asserts that all human behaviors, social relationships, and organization are biologically, genetically, and evolutionary determined. It says that human characteristics are explicitly programmed in our genes because they were adapted for survival, and the very existence of these characteristics proves it to be so, otherwise they would not have evolved. Sociobiologists claim to establish the innateness of wars, racism, competition, sex differences, and differences in social roles and positions. These theories have been used to justify, for example, the physical and social oppression of women by men. Sociobiolo-gists can even explain the naturalness of rape (Barash, 1979)! Indeed, they can explain patriarchy as a naturally evolved order of society. Even though sociobiology has had several exponents in recent years, there are also critics who point out the deceptive and faulty methodology that is used–a kind-of-circular-logic. Moreover, no evidence is provided for the existence of behavior-causing genes (Bleier, 1984). In the context of human development, it seems impossible to tease apart genetic factors from environmental ones, but this is what sociobiology seeks to do–it ignores the complexities in human development. As will be discussed later, there is an increasing trend in medical research to isolate *genetic* causes and separate them from environmental ones in

human disease states, including those of a psychological or behavioral nature.

The simultaneous developments in IVF technology and molecular biology have made gene "therapy" (the correction of "defective" or missing genes to cure or ameliorate diseases) a forthcoming possibility in medicine, depending on whether or not the techniques of gene manipulation can be perfected. But first, what are genes, how do they act in living organisms, and how can they be manipulated?

Deoxyribonucleic acid (DNA) is the molecule of heredity in most living organisms. Most of the DNA is organized inside cells into structures called chromosomes. The normal complement of chromosomes in human cells is 23 pairs (state of diploidy), and gametes (ova and sperm) have half this number (haploidy). On fusion of an ovum and sperm during fertilization, the full complement of chromosomes is achieved. The discovery of the three dimensional structure of the DNA molecule in 1953 by Watson and Crick lead to the understanding of the mechanism of how DNA is able to replicate itself during the division of cells.[2] This was the discovery that preceded modern molecular biology and genetic engineering - the overall physical structure was known, and thus such a molecule could be dissected into smaller parts.

DNA is a long macromolecule, consisting of two strands that intertwine to form a dou ble helix. Each strand is made up of smaller molecules called *nucleotides* (or bases), which occur in a defined sequence. There are four chemically different bases in DNA, and a set way in which the bases of one strand of the helix match up and bond to bases in the other strand, thereby holding the two strands together as a helix. This is called *base pairing*.

A gene can be thought of as a piece of DNA within the chromosome that has a particular function. Genes act by determining the kinds of proteins (e.g., enzymes, hormones, antibodies) that are made by cells for the maintenance of individual cells and the whole organism. The flow of genetic information in cells is as follows (although the process is sometimes reversed, for example, retroviruses can synthesize DNA from RNA:

$$\text{DNA} \xrightarrow[\text{transcription}]{} \text{RNA} \xrightarrow[\text{translation}]{} \text{protein}$$

Another type of nucleic acid, ribosenucleic acid (RNA) is made in the cell, using DNA as a *template*. The sequence of nucleotides in DNA is used to make a strand of RNA. The sequence of nucleotides, or message, in RNA is then used to make proteins, which are made up of individual amino acids, also occurring in a defined sequence. The relationship between the sequence of bases in DNA and the sequence of amino acids in the corresponding protein is called *the genetic* code, and it is exactly the same in all living organisms.

Some twenty years after the structure of DNA was postulated, the discovery of *restriction enzymes*, which can chemically cut DNA molecules at specific places, opened up the fields of recombinant DNA technology, gene "cloning," and genetic engineering (Emtage. 1985). DNA can be cut into smaller pieces using these enzymes and rejoined using other enzymes. It can therefore be manipulated and rearranged. Using such enzymes, particular genes can be isolated from, say, a human chromosome, and then transferred to a bacterial cell. The new gene will be expressed and the corresponding protein is manufactured by the bacterium, along with its other proteins. These techniques are known as *gene cloning*, since a particular gene can be amplified many times in this way if it is expressed in a microorganism. This is how human insulin was first manufactured in the bacterium *E. coli*. Isolated genes have also been transferred to mammalian cells grown in tissue culture. More recently, isolated genes from human or other species have been transferred to fertilized mouse eggs (or other

animals). These introduced genes may be integrated into the chromosome of the embryo and expressed in their new environment.

These types of gene transfer experiments have provided the technical basis for the development of gene manipulation in humans, as well as the basis for a multimillion dollar, worldwide biotechnology industry.[3] So-called gene "therapy" aims to treat genetic disorders and diseases by replacing a defective or missing gene with a functional one. Some inherited diseases can clearly be traced to a mutation in a single gene, and scientists and clinicians see these types of conditions as the most likely candidates for attempted gene manipulation. At present, there are two types of potential gene manipulation for the purposes of altering the genetic make-up. *Somatic cell* manipulation would involve the replacement of defective or missing genes in the cells of one particular tissue of the body. For example, B-thalassemia is an inherited condition, caused by a defect in a gene for one part of the hemoglobin molecule (hemoglobin is found inside red blood cells and is responsible for carrying oxygen and removing carbon dioxide from the body's tissues). Red blood cells originate in the bone marrow, and thus a functional B-globin gene could be transferred to bone marrow cells to correct B-thalassemia.[4] The second type of potential gene manipulation is *germ line* manipulation, where new genes would be put into the early embryo, obtained through an IVF procedure, either by direct microinjection of the new DNA or by linking the DNA to a retrovirus. All the body cells of this new individual, including its gametes, would theoretically carry the new gene. The gene would therefore be passed onto future offspring.

Recent developments in basic genetic research are improving the technical feasibility of gene manipulation in human embryos. The techniques may be used for or lead to eugenic outcomes, but it is clear from the scientific literature, that the very rationale of some of these experiments has a eugenic nature–the aim is not only to "cure" disease – it is also to alter the genetic makeups of animals and humans, to get rid of "bad" genes from the population. In the language of eugenics, it is to increase the reproduction of fit individuals.

Transgenic animals, particularly mice, are increasingly being developed and used as an experimental system to study how genes are expressed and regulated. Transgenic mice have had foreign DNA integrated into their germ line cells (i.e., their gametes). The animals are produced by directly injecting an isolated piece of DNA into mouse eggs that have been fertilized in the laboratory. These fertilized eggs carrying the foreign DNA are then implanted back into pseudopregnant (superovulated) mice. This situation is exactly analogous to a human IVF experiment, excepting that human IVF embryos have not been genetically altered (yet). The resulting newborn mice carry the foreign DNA in all their body cells (but perhaps to a variable extent). These mice are then used for breeding, to transfer the foreign gene to subsequent generations (Palmiter and Brinster, 1985).

The earliest experiments of this kind were done more than ten years ago (Jaenisch and Mintz, 1974), but the most noted and cited example was that where the gene for rat growth hormone was microinjected into fertilized mouse eggs. Some of the mice that developed from these embryos expressed the new gene and developed to twice the size of litter mates that did not carry the gene. The transgenic mice also had abnormally high levels of growth hormone in their blood (Palmiter *et al*., 1982).

Putting new genes into embryos can also *cause mutations*. An experiment from Harvard Medical School reported the insertion of a mouse tumour virus joined to oncogene5 into mouse embryos, and the resulting off-spring showed deformities of their fore and hind

limbs. The mutation was apparently caused by the insertion of the foreign DNA. (Woychik *et al.*, 1984). In other experiments, the phenotype, or physical appearance of transgenic animals was not altered, but foreign genes had still been integrated into the, chromosome of the offspring – this can be monitored by analysing the DNA in cells of the offspring. It appears that injected genes are incorporated and expressed in a random way.

Some of the aims of this type of basic genetic research are to understand development processes in animals and how genes are expressed and regulated. For example, putting the genes that code for antibodies into mouse embryos and looking at how they are expressed has helped us to understand how immune systems in animals are regulated. Also, transgenic mice are being used to understand how tumours develop (Palmiter and Brinster. 1985). However, some scientists advocate the application of these gene manipulation techniques to eradicate human genetic disorders – the barrier at present is the uncertainty as to how these inserted genes may behave in their new environment and whether they can be located to their correct position in the chromosome.

Scientists are continuing to attempt to improve techniques to "target" genes to specific sites in chromosomes. One research team was able to selectively insert a B-globin gene into its correct position in the chromosomes of cells grown in culture. However, the context of the new gene was different from that of the normal situation because of the method used to introduce it, and therefore it was not expressed and regulated correctly (Maniatis, 1985; Smithies *et al*., 1985). The refinement of gene targeting techniques may allow more selective insertion of genes in the future, but how could all the possible random events that may occur with gene insertion be controlled? Clearly, there are dangers and hazards with germ line manipulation, such as mutations or inappropriate gene expression, that will be passed onto future generations. Germ line manipulation is not a reversible process.

"Paving the way" for embryo manipulation is clearly an incentive amongst some scientists for' the further refinement of techniques in genetic manipulation. The designers of "supermice" see greater possibilities:

> This approach has implications for studying the biological effects of growth hormone, as a way to accelerate animal growth, as a means of correcting genetic disease, and as a method of farming valuable gene products. (Palmiter *et al*, 1982: 611).
>
> Man has been interested in altering the genetic make-up of higher animals for thousands of years, dating back to the first animals. . . . The approach of directly injecting genes into eggs currently offers the most promising technique for selectively altering the genetic make-up of an animal. (Brinster and Palmiter, 1982: 438)

In a review article of current gene transfer methods (citing 206 references, which reflects the scientific activity in the field!), the authors state that further sophistication of gene manipulation techniques would "help pave the way for embryo manipulation" (Ku-cherlapati and Skoultchi, 1984).

These statements contain eugenic ideas – to selectively alter the genetic makeup of animals, to select for "good" genes, to eliminate "bad" genes, and to increase the reproduction of fit individuals. Although the experiments have been done thus far with animals, particularly mice, they have laid the groundwork, and the justification, for such experiments to be done with human embryos in the future. Are they already being done? In vitro fertilization is the vehicle for the externalization of embryos, which are then accessible for genetic manipulation or generic screening:

> So far, the experimental aims (of putting genes into early embryos) have been academic rather practical but there is no reason in principle that this approach to gene therapy would not work in conjunction with in vitro fertilization. (Williamson, 1982:417)

According to the same writer, the only reason that this principle is not yet a practice is a technical problem:

> It is *our inability* (emphasis mine) to obtain correct gene function when DNA is put into a cell, and the fact that few inherited disease affect only single tissues, such as bone marrow, makes gene therapy impracticable at this time. (Williamson, 1982: 416)

Once the techniques have been mastered, gene manipulation becomes practicable, and perhaps inevitable. Some IVF practitioners are advocating the desirability of gene manipulation to the point where IVF will become the best mode of childbirth, because they could ensure that no "defective" embryos would ever be reimplanted back into women. (Perhaps embryos which have already implanted through natural conception could be Hushed out of a woman's uterus and genetically characterized.) Dr. Helmut Zeilmaker of Rotterdam thinks that IVF will enable "us" to eliminate most genetic diseases within the next 25 years. He envisages a day when most people will reproduce using the egg and sperm from genetically screened individuals. The gametes themselves will be stored in freezers deep underground to protect them from nuclear disasters (Vines, 1986)!

Even though population control remains one of India's chief objectives, that country has also "embraced IVF technology." Dr. T. C. Amand Kumar of the Institute for Research in Reproduction sees that IVF technology will have beneficial effects in medicine as a whole, especially in the treatment of inherited diseases by gene manipulation of embryos (Jayaraman, 1986). Clearly, the emphasis in IVF research is being diverted from the "treatment" of infertility, and the genetic analysis of embryos to be reimplanted is taking on a major focus. Leading Australian IVF scientist, Dr. Alan Trounson, has maintained that although the primary focus of IVF techniques is the treatment of infertility, genetic manipulation of embryos to overcome genetic disease is still on the agenda:

> There are many more complex situations that *require* (emphasis mine) the development of sophisticated methods such as DNA insertion by techniques of genetic engineering to overcome genetic diseases, and' the sexing of human embryos for cases of sex-linked genetic disease. (Trounson, 1982: 62)

It is clear from these opinions that the intention exists to eugenically select out which embryos will be used in embryo transfer, and the technical feasibility seems near. In previous times, laws have been passed to prevent the inheritance of "undesirable" characteristics or diseases. IVF and genetic manipulation is the combination that allows a new form of eugenics to be practiced, and it is researchers who are at the forefront of deciding which genetic probes to develop for screening embryos. Therefore, they ultimately make judgments about which kinds of embryos should be reimplanted. The stage is now set for the use of sex predetermination in association with IVF. A British medical team has recently reported the development of a DNA probe that can determine the sex of human "preembryos," four to eight days old (West *et al.*, 1987). The University of Edinburgh's in vitro fertilization team has developed a test that uses a commercially available DNA probe to identify the male Y-chromosome in embryos four to eight days

old. Seven human embryos were investigated, and six of these were positive for Y-chromosome DNA. A member of the Edinburgh medical team involved in the development of the test, Dr. John West, says that the probe was developed for the prenatal diagnosis of sex-linked genetic disorders. He said that it wouldn't be ethical to use this test for sex predetermination of babies, but he admits, "we couldn't prevent the technique from being used in that way" (Johnston, 1987: 547). The development of this probe by scientists has made sex predetermination of embryos possible. Preimplantation IVF embryos could be screened, or, normally fertilized embryos collected by uterine flushing could also be tested. We already know that in some countries, fetuses of the female sex are aborted in the thousands.[6] Similarly, at Hammersmith Hospital in London, Professor Robert Winston and his team are almost ready to apply animal-tested gene probes to humans to detect hereditary diseases in embryos. A service to detect genetic disorders such as cystic fibrosis, hemophilia, muscular dystrophy, and Down's syndrome is expected to be offered by a new £250,000 IVF clinic due to open at Hammersmith Hospital in October (Johnston, 1987). In England at least, eugenic selection of embryos implanted after the IVF procedure is already occurring.

Feminists have recognized previously that IVF provides the embryos necessary for genetic manipulation (Bartels, 1983; Minden, 1985). Women are the experimental subjects on IVF programs, and are therefore the source of the eggs necessary to produce these embryos. Some mainstream scientists are now beginning to speak out against the excesses and eugenic possibilities of reproductive technology research. Jacques Testart, a leading French specialist in IVF, has denounced the continued development of IVF technology. He is worried about future perversions of this technique, such as the screening of embryos for genetic disease, or for the sex of a child.

> If we have such techniques we can use them for many things. Eugenics is not far away. I think it is better to abandon the technique than to take the risk. (Walgate, 1986: 385)

The sexing of embryos is no longer a "future perversion" – it is possible now with the available technology. Testart's fear that eugenics is not far away does not admit that the techniques are developed with a eugenic intention – they are *designed* for eugenic outcomes (i.e., only genetically "perfect" embryos will be reimplanted). A recent commentary in the international science journal *Nature*, by a professor of biochemistry, Erwin Chargaff, describes the "engineering of a molecular nightmare," in which the se-miindustrial production of babies has arisen not from the demands of society, but from the will of scientists. He describes the unleashing of "a molecular Auschwitz, where valuable enzymes, hormones and so on will be extracted instead of gold teeth . . . we can already see the beginning of human husbandry, of industrial breeding factories" (Chargaff, 1987: 200). These words paint vivid connections with the practice of eugenics and Nazism.[7]

The promise of financial gain is as prominent as the quest for knowledge of human reproduction. The development and promotion of research into genetic manipulation of animal embryos for "better" breeding qualities, and the development of human IVF research can often be linked to the same people with vested interests. For example, transgenic pigs with extra growth hormone gene were produced in Australia in 1986 at Adelaide University. The extra growth hormone gene effectively "turbo charges meat production, resulting in more meat with less fat, the kind that consumers prefer" (O'Neill,

1987). The research group was led by Dr. Bob Seamark, who is quoted elsewhere as being a leading IVF expert. According to Dr. Seamark, cooperation between clinicians and scientists is one of the major driving forces behind the tremendous surge of IVF research in Australia (Swinbanks, 1986). Similarly, the formation of companies like IVF Australia Ltd., originally set up through Monash University, is evidence that IVF technology is a salable commodity. Some IVF practitioners are critical of the potential abuses, but these criticisms are concerned with the exploitation of embryos and not women. There are some 10,000 frozen embryos stockpiled around the world. Dr. Michelle Plachot of the Marignan IVF clinic in Paris fears that an international trade in frozen embryos may be set up by "unscrupulous dealers."[8]

On other scientific fronts, there is a worldwide project to map the entire human genome. The original estimate of the cost of this project was $3 billion, but estimates now stand between $50 and $100 million (Lewin, 1987). This vast amount of money has been allocated to characterize every single gene in the human chromosome. Ironically, most of the DNA in the human chromosome does not code for proteins and may have no apparent function. What is the value, or indeed the dangers of characterizing every human gene? It seems to be a desire of modern molecular biology to understand human beings in terms of our "base sequences," and this mapping project interlinks with the increased emphasis to locate the causes of disease as genetic, without the consideration of the interplay of environmental factors. Scientists are looking for the genes that cause cystic fibrosis, muscular dystrophy, Alzheimers disease (senile dimentia), and have branched into the psychological disorders such as manic depression. Researchers are attempting to identify these "disease-causing genes" by a methodology known as *reverse genetics*. In some diseases, a genetic component is indicated through family studies of inheritance, but the responsible gene and its protein product are unknown (e.g., in cystic fibrosis, there are no visible changes in chromosome structure). Reverse genetics involves the creating of many fragments of the chromosomal DNA using restriction enzymes, and then looking for particular base sequences, or "markers" that may be inherited along with the "disease gene," which remains unknown.

The recent studies of the genetics of manic depression (bipolar disorder) are important to discuss, since they highlight a rationale that is linked with biological determinism (i.e., attempting to describe human behaviors or conditions as being genetically determined). A study reported earlier this year has suggested that the gene *causing* manic depression is located on chromosome 11, even though it was in fact a "marker" that had been located (Egeland et al., 1987). This particular study was carried out among the Old Order Amish population in the United States. The researchers say because the genealogy of its 12,000 members can be accurately traced, they do not use alcohol or drugs, and the death rate by suicide attributable to the disorder is "easier to ascertain" because there are virtually no crimes of violence among the Amish population.

However, even the initial diagnosis of manic depression suffers from a subjectiveness, because the symptoms are largely behavioral.9 There is an attempt to remove or disregard environmental factors that is similar to the methodology used in sociobiology:[10]

> Establishing the role of genetic factors in the aetiology of mental illness has represented a formidable challenge. The separation of environmental factors from intrinsic biological factors and the complexities of psychiatric diagnosis are major obstacles in this endeavour.

> Nevertheless, evidence of biological and genetic contributions to aetiology make the major affective disorders excellent candidates to address this issue. (Egeland *et al*., 1987: 783)

Clearly there are inheritable components in manic depression, but not everyone in "susceptible" families will develop the condition, and the existence of a responsible gene or genes cannot be proven. Other studies of manic depression in Icelandic and North American families have found *no* linkage to chromosome 11 (Detera-Wadleigh, *et al.*, 1987; Hodginskon *et al*., 1987), so even the genetics of this condition are multifactorial. More importantly, the likely interplay of environmental variables have attempted to be removed.

It is possible that an understanding of how manic depression is caused may lead to improved treatment of sufferers – it may also lead to a prenatal diagnostic test, as it has done with the identification of a marker in Huntington's disease (Hayden *et al*., 1987; Quarrell *et al*., 1987). Huntington's disease is a progressive dominantly inherited neurodegenerative disorder, and the symptoms usually begin between age 30 and 50. Researchers say that the stigma of manic depression will be removed if the cause .can be identified as genetic (Kolata, 1987). But the stigma of Trisomy 21 (Down's syndrome) or other disabilities have never been removed simply because the causes, genetic or otherwise, are known. Would lesbianism or homosexuality be more acceptable if a genetic cause could be found? Stigmas are about attitudes in our society towards those who are "different" – stigmas are not removed by finding genes to explain these differences. In fact, the stigma may increase and prejudices may be intensified.

The rapid technical developments in genetic and reproductive technology research may well provide the justification for gene manipulation of human embryos to eradicate genetic disorders. The nature of this research is eugenic, since the aim is to apply genetic screens to select which embryos are implanted, and therefore which babies are born. The notion of perfect babies has a negative impact on disabled people in general, and a preferable sex of a baby can only serve to intensify sexist attitudes and practices. Medical technologists taking part in this research may argue that prenatal screening tests are developed because society demands them. But initially, it is the scientists and practitioners who decide *which* genetic probes to develop. The demand can be created thereafter.

ENDNOTES

1. A "success rate" of 8.5 percent (live births per treatment cycle) for 1985 in Britain was cited in the Second Report of The Voluntary Licensing Authority for Human in vitro Fertilization and Embryology 1987. London: 15.

2. The discovery of the structure of DNA was attributed to James Watson and Francis Crick, who were given a Nobel prize. It is less well known, however, that the technical data of Rosalind Franklin were crucial to this discovery (Anne Sayre, 1975, *Rosalind Franklin and DNA*, W. W. Norton and Co., New York).

3. Gene cloning in bacteria is being used to produce a variety of proteins with biomedical and therapeutic applications (e.g., insulin, growth hormone, and blood clotting factor).

4. In 1980, Dr. Martin Kline, of the University of California, attempted to treat bone marrow from two patients, using normal B-globin genes, and then carried out a limited marrow self-transplant. There was no previous basis that this treatment would give any clinical benefit (Williamson, 1982).

5. Oncogenes are thought to be "switched on" in normal cells in the process of cancer formation.

6. Reported at Congress: Women Against Gene and Reproductive Technologies, Bonn, West Germany, 1985. See also Roggencamp, Viola, 1984. Abortion of a special kind: Male sex selection in India. In Arditti, Rita, Duelli-Klein. Renate, and Minden, Shelley (eds.), *Test-Tube Women: What Future For Motherhood?* Pandora Press, London: 266-277.

7. Professor Chargaff is an Austrian.who was forced to leave Europe by the rise of the Nazis.

8. Reported in *The Age*, Melbourne, October 6, 1987: 7 from the European Society of Human Reproduction and Embryology conference held in Toulouse, October 1987.

9. The clinical symptoms of mianic depression are mood swings. During the manic phase, patients are elated or irritable. They say that thoughts race through their minds. The patients exhibit increased activity and talkativeness. They have poor judgment and behavioral excesses. At other times, patients are clinically depressed, with feelings of hopelessness and changes in their sleep patterns and appetite. They may have suicidal thoughts and actions (Kolata, 1987).

10. The major affective disorders are a group of ill nesses manifested by disturbances in mood, and in physiological, cognitive, and endocrine functions.

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