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Eugenic Sterilization - A Scientific Analysis

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NOTE

EUGENIC STERILIZATION— A SCIENTIFIC ANALYSIS

INTRODUCTION

EUGENICS is a concept of improving human stock through the regulation of heredity. Positive eugenics would accomplish this by encouraging reproduction of those with favorable traits; negative eugenics, such as sterilization, would discourage or prohibit the reproduction of those with unfavorable traits.

Crude attempts to apply basic eugenic principles have been made since very early times. For example, the Spartans of ancient Greece permitted their sickly children to die, and they slaughtered their more intelligent slaves in order to insure control by the ruling elite.[1] Sir Francis Galton originated the modern concept of eugenics in the latter part of the 19th century as a result of a study of the pedigrees of various eminent persons of his time. His discovery that desirable mental traits and other qualities frequently were shared by persons of common lineage led him to conclude that human abilities were in large part determined by ancestry. Galton coined the word "eugenics" from the Greek word *eugenes* meaning "well born" and did much to publicize the possible advantages of applied eugenics during the latter decades of the 19th century.[2]

Other studies suggested, from a different point of view, that heredity appeared to be an important determinant of human development. Unlike the notables studied by Galton, later investigators traced the pedigrees of genetically inferior families, the legendary "Jukes" and the "Kallikaks," and found among them descendants with an extraordinary number of undesirable traits, suggesting mental or behavioral abnormalities or inadequacies, *e.g.*, feebleminded-ness, criminality, pauperism, and sexual immorality. These studies, even more than those of Galton, served to fuel the growing eugenics movement.[3]

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* A glossary of pertinent medical terms appends this note.

[1] Jennings, *Eugenics*, in ENCYCLOPEDIA OF THE SOCIAL SCIENCES vol. V, 617-18 (1931).

[2] T. DOBZHANSKY, HEREDITY AND THE NATURE OF MAN 60 (1964).

[3] *Id.* at 60-61.

Contemporaneous with Galton's original study were the investigations of Gregor Mendel, who demonstrated how simple hereditary characteristics were transmitted.[4] When his work came to the world's attention near the turn of the century, Mendel's scientific data was immediately hailed by the eugenicists as the explanation for the theories formulated by recent studies of human populations and as a scientific justification for a program of eugenic control.[5] The final development still needed to make it possible to legislate eugenics was the perfection of procedures for the regulation of procreation.[6] This was achieved with the development of simple and effective surgical techniques for the sterilization of human beings.[7]

With all the legal requirements thus apparently satisfied, the discovered "eugenic principles" were soon codified into laws to provide for sterilization of undesirable persons having defects such as mental retardation, mental disease, epilepsy, and a variety of other conditions — the assumption being made that all such defects had some genetic basis. The first sterilization law was successfully enacted in the State of Indiana in 1907.[8] In 1922, a *Model Eugenical Sterilization Law* was proposed that would have subjected the following classes of persons to sterilization:

> (1) Feeble-minded; (2) Insane (including the psychopothic); (3) Criminalistic (including the delinquent and wayward); (4) Epileptic; (5) Inebriate (including drug-habitues); (6) Diseased (including the tuberculous, the syphilitic, the leprous, and others with chronic infections and legally segregable disease); (7) Blind (including those with seriously impaired vision); (8) Deaf (including those with seriously impaired hearing); (9) Deformed (including the crippled); and (10) Dependent (including orphans, ne'er-do'wells, the homeless, tramps and paupers).[9]

In succeeding years laws were passed by many of our states which either incorporated provisions directly from, or were inspired by, this proposal. During the period from 1907 to the present, a majority of the states had at one time or another adopted sterilization

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[4] E. GARDNER, PRINCIPLES OF GENETICS ch. 1 (1964); W. JOHNSON *et al.*, BIOLOGY 598-99 (1966).

[5] AMERICAN MEDICAL ASSOCIATION, A REAPPRAISAL OF EUGENIC STERILIZATION LAWS (1960) [hereinafter cited as AMA STUDY].

[6] *Id.* at 1.

[7] In the human male, sterilization can be accomplished by a vasectomy and in the female, by a salpingectomy. The vasectomy involves a simple scrotal incision severing the *vas deferns* which conducts sperm from the testes to the urethra of the penis. In a salpingectomy, a considerably more complicated procedure, the operation requires an abdominal incision and the cutting and tying of the fallopian tubes. Neither of these procedures is hazardous under proper surgical conditions nor does either interfere with the desire for sexual intercourse or with its gratification. *See* F. LINDMAN & D. MCINTYRE, THE MENTALLY DISABLED AND THE LAW 183 (1961).

[8] Note *The Individual and the Involuntary Sterilization Laws, 1966,* 31 ALBANY L. REV. 97 (1967).

[9] H. LAUGHLIN, EUGENICAL STERILIZATION IN THE UNITED STATES 446-47 (1922).

laws. At present, 25 states still retain eugenic sterilization statutes; of these 22 are compulsory.[10] Recently some of the laws have been mitigated by the provision of consent requirements, but such requirements are frequently subject to administrative discretion tantamount to the rejection of consent.

It was not until the landmark case of *Buck v. Bell*[11] that federal authority and acquiescence was placed solidly behind the eugenic movement. In the *Buck* case, a Virginia court had held that the state's sterilization law was valid under both the *Virginia* and *United States Constitutions*. On appeal to the United States Supreme Court, the law in question was found to be a reasonable regulation under the police power of the state and not to be violative of either the due process or the equal protection clauses of the fourteenth amendment.[12] Justice Holmes' affirming comment in the *Buck* case, "Three generations of imbeciles are enough," has become legendary.[13]

The period of the 1920's, when the *Buck* case was decided and model sterilization laws were being proposed, represented a high water mark in the enthusiasm for eugenic sterilization as a proper expression of governmental authority. This optimism, however, soon subsided as legal and constitutional doubts began to appear and as new scientific evidence was marshalled to refute most of the eugenicists' basic scientific premises. Today, some of the original laws have been repealed, and others are infrequently enforced.[14] Yet, the fact that *some* sterilizations continue to be performed[15] and that, in any event, the threat remains of possible sterilization being imposed, even though there is questionable scientific value in such procedures, makes this a topic of continuing timeliness and interest. Numerous legal, medical, and sociological reviews have been published on the

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[10] ALA. CODE tit. 45 § 243 (1958); ARIZ. REV. STAT. ANN. §§ 36-531 to 36-540 (1956); CAL. CODE ANN. WELF. & INST'NS § 6624 (Supp. 1969); CONN. GEN. STAT. REV. § 17-19 (1969); DEL. CODE ANN. tit. 16 §§ 5701 to 5705 (Supp. 1968); GA. CODE ANN. §§ 99-1301 to 99-1319 (1967); IDAHO CODE ANN. §§ 66-801 to 66-812 (Supp. 1969); IND. STAT. ANN. §§ 22-1601 to 22-1618 (1964); IOWA CODE §§ 145.1 to 145.22 (Supp. 1969); ME. REV. STAT. ANN. tit. 34 §§ 2461 to 2468 (1964); MICH. STAT. ANN. §§ 14.381 to 14.390 (1969); MINN. STAT. §§ 256.07 to 256.10 (1959); MISS. CODE ANN. §§ 6957 to 6964 (1952); NEB. REV. STAT. §§ 83-501 to 83-508 (1966); N.H. REV. STAT. ANN. §§ 174:1 to 174:14 (1964); N.C. GEN. STAT. §§ 35-36 to 35-57 (1966); OKLA. STAT. ANN. tit. 43A §§ 341 to 346 (1951); ORE. REV. STAT. §§ 436-010 to 436-150 (1967); S.C. CODE ANN. §§ 32-671 to 32-680 (1962); S.D. CODE §§ 27-11-1 to 27-11-6 (mentally ill), §§ 27-17-1 to 27-17-34 (retarded) (Supp. 1967); UTAH CODE ANN. §§ 64-10.1 to 64-10.14 (1968); VT. STAT. ANN. §§ 18-8701 to 18-8704 (1968); VA. CODE ANN. §§ 37.1-156 to 37.1-171 (Supp. 1968); W. VA. CODE ANN. §§ 16-10-1 to 16-10-7 (1969); WIS. STAT. ANN. § 46.12 (1957). The Connecticut, Minnesota and Vermont laws are voluntary in nature.

[11] 274 U.S. 200 (1927).

[12] *Id.* at 207-08.

[13] *Id.* at 207.

[14] Ferster, *Elimination the Unfit—Is Sterilization the Answer?*, 27 OHIO ST. L.J. 591, 613 (1966).

[15] *Id.* at 600-01, 613.

subject, most of them unfavorable in their appraisal.[16] The basic criticisms have been that eugenic sterilization does not accomplish its stated objective of "human betterment," and, at the same time, it interferes with important freedoms either expressly guaranteed by the *United States Constitution* or brought within its ambit by judicial construction.[17]

I. SCIENTIFIC BACKGROUND

The essence of the argument against the sterilization laws is that they are of little value in achieving their specific goal of overall eugenic improvement. The main thrust of this argument rests on the following considerations: (1) genetic etiologies for many of the mental defects and deficiencies to which the laws apply have not been established; (2) the procedures now used reach only a small fraction of those with defective hereditary factors; and (3) hereditary factors are not a static but a changing phenomenon.

Before proceeding to the elaboration of the scientific arguments that militate against the eugenic laws, a short excursion into the fields of genetics and biochemistry may be helpful to a general understanding of the problems involved.

A. *Classical Genetics*

Gregor Mendel's experiments demonstrated that the characteristics of organisms were transmitted to offspring by a random assortment and recombination of pairs of hereditary units.[18] These units remain intact and unchanged throughout the reproductive process, as demonstrated by the fact that a hereditary trait transmitted but completely hidden in one offspring can reappear in later generations in a completely undiluted and unchanged form.[19] The hereditary units, later designated as "genes," are found in the nuclei of all cells, aggregated into elongated, rod-like "chromosomes."[20]

The specific area of a chromosome that determines any specific trait can be termed a "gene." Each gene on the chromosome ultimately governs a specific biological function or characteristic. For

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[16] *See, e.g.,* AMA STUDY, *supra* note 5; LINDMAN & MCINTYRE, *supra* note 7; M. WOODSIDE, STERILIZATION IN NORTH CAROLINA (1950); Bligh, *Sterilization and Mental Retardation,* 51 A.B.A.J. 1059 (1965); Ferster, *supra* note 14; Kindregan, *Sixty Years of Compulsory Eugenic Sterilization: "Three Generations of Imbeciles" and the Constitution of the United States,* 43 CHI.-KENT L. REV. 123 (1966); Comment, *Compulsory Eugenic Sterilization: For Wom Does* Bell *Toll?* 6 DUQUESNE UNIV. L. REV. 145 (1967-68); Note, *Compulsary Sterlization of Criminals —Perversion in the Law; Perversion of the Law,* 15 SYRACUSE L. REV. 738 (1964).

[17] *See, e.g.,* AMA STUDY, *supra* note 5, at 9-11; LINDMAN & MCINTYRE, *supra* note 7, at 187-90, Comment, *supra* note 16 *passim.*

[18] GARDNER, *supra* note 4, at 15.

[19] *Id.*

[20] I. ASIMOV, THE GENETIC CODE 17-18 (1962); GARDNER, *supra* note 4 *passim.*

example, one aspect of blood-clotting in man is determined by a specific region (gene) in one of the chromosomes. Typically, the structure of this region will confer the property of normal blood-clotting. However, if an alternative structure for this same chromosomal region is present, most typically in a human male,[21] the person suffers from the disease known as hemophilia, in which blood-clotting occurs slowly if at all.[22]

Chromosomes normally occur in functional pairs which contain the same or similar genetic material. In the human body cell, 46 chromosomes occur in 23 pairs. The genes occupying the same locus or position on such pairs of chromosomes and controlling the heredity of a particular characteristic are termed "alleles," which is simply the designation of alternative forms of the same gene. When both genes of the pair are alike, the gentic complement (*i.e.*, the genotype) is described as "homozygous" and when unlike, as "heterozygous."[23] If the two alleles would tend to yield different expressions of a genetic characteristic, one of them is frequently *dominant* over the other and the dominant gene determines the entire external expression of that characteristic (*i.e.*, the phenotype). The *recessive* gene remains unexpressed but can reappear in later offspring if paired with another recessive allele.[24]

In the total reproductive process, the paired choromosomes and their allelic genes are separated during the complex sequence of events termed "meiosis." The net result of meiosis is that potential sex cells are produced which have just half the number of chromosomes as are present in the somatic cells. Each sex contributes one such sex cell or gamete during fertilization, a sperm cell from the father and an egg cell from the mother.[25] The result is the reattainment of the normal chromosome number and allelic complements in the new individual.

The favorite example of eye color, although a rank over-simplification, is illustrative of the operation of simple gene combinations. Let us assume that the observed characteristic of eye color is governed by a single pair of alleles, one of them controlling the characteristic for brown eyes and the other allele conferring blue eyes.

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[21] The example of a human *male* is used because the male happens to possess only a single gene site for the hemophilic defect. This accounts for the fact that men are more commonly affected by hemophilia than are women. In the female two gene sites are present and the occurrence of the phenotypic disease requires the occupation of *both* sites by defective genes. This is statistically less probable than the case for a single site. The occurrence of a single defective gene paired with a normal one results in a defect *carrier*, who, although outwardly normal, can transmit the hemophilic disease to her male children. *See* GARDNER, *supra* note 4, at 107-08.

[22] D. BONNER, HEREDITY 15 (1961).

[23] GARDNER, *supra* note 4 *passim*; H. KALMUS, GENETICS 244-58 (1964).

[24] GARDNER, *supra* note 4, at 15-17.

[25] *Id.*

Based on a consideration of population genetics, the brown-eyed phenotype is found to occur in a characteristic proportion which indicates the brown-eyed allele to be dominant over the blue.[26] It follows, therefore, that if an individual is to possess blue eyes, both genes must be of the blue-eyed allele, while an individual with a genotype consisting of either a combination of blue and brown or of paired brown alleles is phenotypically brown-eyed.

B. *Biochemical Genetics*

Until recently little was known of the precise chemical structure of the genetic apparatus or of the mechanisms by which genetic information is physiologically expressed. The elucidation by Watson and Crick of the structure of deoxyribonucleic acid (DNA), the presumptive major component of genes and chromosomes, provided a considerable impetus to genetic-biochemical understanding.[27] The Watson-Crick Model consists of two chains of complex molecules called "nucleotides" twisted about each other in a regular helix. The sequential arrangement of four different "nitrogen bases" which are a part of these nucleotides is the key to the genetic information contained in the chromosome (the "genetic code"). It is this genetic code which is translated into possible physiological characteristics, the phenotype of the individual.[28]

DNA molecules do not enter directly into the synthesis of materials which are necessary for cellular and bodily processes. The genetic information of the code is first transferred to molecules of ribonucleic acid (RNA). With a structure similar to that of a single strand of DNA, RNA is an intermediate in the conversion of the genetic information to biochemical products.[29] DNA is the *master code,* while RNA is the *working pattern* (template) from which materials necessary for cellular and bodily processes are synthesized.

The RNA working patterns, in turn, order the specific arrangement of amino acids in proteins. These protein substances are the enzymes which regulate the body's basic physiological processes.[30] Typically large and structurally complex, the protein-enzymes are

[26] A. MONTAGU, HUMAN HEREDITY 244-46 (1963).

[27] ASIMOV, *supra* note 20; GARDNER, *supra* note 4; H. VAN PEENEN, BIOCHEMICAL GENETICS (1966); J. WATSON, MOLECULAR BIOLOGY OF THE GENE (1965).

[28] WATSON, *supra* note 27.

[29] RNA is actually of several kinds: *Messenger* RNA carries the code from DNA to the ribosome where protein is synthesized. *Transfer* RNA brings up amino acids and matches them to the code on the messenger RNA. *Ribosomal* RNA functions as a "jig" which holds the messenger RNA while transfer RNA brings up amino acids to form the developing protein molecule. *See* P. HARTMAN & S. SUSKIND, GENE ACTION 30 (1965); Holley, *The Nucleotide Sequence of Nucleic Acid,* 214 SCIENTIFIC AM., Feb. 1966, at 30-39.

[30] WATSON, *supra* note 27, at 88, 172.

aggregations of amino acids,[31] each of which is represented by one or more code groups on the DNA and RNA chains.[32] The genetic endowment encoded in the DNA is translated into physiological manifestations through the agency of these protein-enzyme intermediates.[33]

The genetic code, although amazingly durable for its complexity, is nevertheless subject to change or "mutation."[34] Mutations can be produced by high energy radiations such as cosmic rays and ordinary medical X-rays,[35] or by milder agents such as ultraviolet radiation and certain reactive chemicals.[36] Increasing evidence has been found that many chemical substances taken into the body can be mutagenic, for example, the hallucinogenic drug LSD[37] and even substances found in ordinary foods, such as caffeine,[38] the artificial sweeteners cyclamate[39] or cyclohexylamine,[40] and a host of other commonly used foods and chemicals.[41]

Mutations may occur in body cells or in germ cells. In the latter case, a permanent change occurs in the hereditary endowment that is transmitted to potential offspring. In most cases, such changes are detrimental rather than beneficial, but it is the occasional beneficial mutation that is the raw material for nature's evolutionary process.[42]

II. Scientific Appraisal of Eugenic Sterilization

An analysis of the scientific value of legalized eugenic sterilization must consider and answer the following questions: (1) are the observed defects which sterilization aims to eliminate related to

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[31] Phillips, *The Three-dimensional Structure of an Enzyme Molecule,* Scientific Am., Nov. 1966, at 78-90.

[32] Each amino acid is represented by a particular triplet of nitrogen bases termed a "codon." With four nitrogen bases, 64 codons are possible, several of which may represent a single amino acid. Some codons have been found to perform the specific function of *chain termination,* that is, to indicate when the end of the protein molecule has been reached. *See* Holley, *supra* note 29; Yanofsky, *Gene Structure and Protein Structure,* Scientific Am., May 1967, at 80-94.

[33] *See* Johnson *et al., supra* note 4, at 652-55; Beckwith, *Regulation of the Lac Operon,* 156 Sci. 597-604 (1967).

[34] Watson, *supra* note 27, at 287.

[35] Kalmus, *supra* note 23, at 123-35; Pollard, *The Biological Action of Ionizing Radiation,* 57 Am. Scientist 206-36 (1969); Puck, *Radiation and the Human Cell,* Scientific Am., Apr. 1960, at 142-53.

[36] D. Cohen, The Biological Role of the Nucleic Acids (1965); Montagu, *supra* note 26, at 334.

[37] Sanders, *Chemical Mutagens,* Chem. & Eng. News, May 19, 1969 (part 1), at 50; June 2, 1969 (part 2), at 54, 57-59.

[38] Sanders, part 2, *supra* note 37, at 60-61.

[39] *Id.* at 61-62.

[40] *Id.* at 62.

[41] Sanders, parts 1 & 2, *supra* note 37.

[42] Gardner, *supra* note 4, at 174-80.

genetic causes?; (2) is the sterilization of individuals with abnormal phenotypes an efficient means of eliminating gene defects?; and (3) of what importance are mutations to the eugenic scheme? These are the topics to be considered in this section. In addition, to be treated separately, is the recent evidence indicating the relationship of the chromosome complement to antisocial behavior.

A. *Are the Observed Defects Related to Genetic Causes?*

1. General Survey of Mental Abnormalities

The defects to which sterilization laws have been addressed are *physical* as well as mental; however, we will concern ourselves here primarily with conditions which have some emotional, mental, or behavioral significance since these are typically the bases for legal sterilization at the present time.

The clear establishment of genetic etiologies for mental or physical defects is of paramount importance to a rational eugenic program. Defects can be the result of heredity alone, but they can also be caused or aggravated by conditions existing during the prenatal period or by an accident at birth, as well as by disease organisms or stresses encountered during youth or adult life. For example, it is estimated that of birth defects, only about 20 percent can be blamed primarily on heredity, the rest being attributable to environmental factors or to a combination of environment and heredity.[43]

Two broad categories of mental abnormalities are recognized: mental deficiency (retardation) and mental defect or illness (psychoses and neuroses in their various forms). Mental retardation is frequently of a nonspecific type (the low IQ individual), generally recognized as being hereditary, but with little or no understanding of specific modes or patterns of transmission. Mental deficiencies traceable to a particular genetic or physiological factor, such as that accompanying uncontrolled phenylketonuria (PKU),[44] galactosemia,[45] or cretinism[46] are more fully understood, if only because there is knowledge that these have a specific organic cause. These diseases are probably the result of single gene defects, although cretinism is considered by many to be only a dietary disorder. The mental and physical deficiency of Down's Syndrome (mongolism)[47] is, in contrast, relatable to a chromosomal anomaly, *i.e.*, an extra chromosome, rather than a simple gene defect.

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[43] Apgar, *What Every Mother-to-Be Should Know*, TODAY'S HEALTH, May 1966, at 16.

[44] MONTAGU, *supra* note 26, at 174-76.

[45] H. SUTTON, GENES, ENZYMES AND INHERITED DISEASES 111-12 (1962).

[46] *Id.* at 105-06.

[47] MONTAGU, *supra* note 26, at 89-91.

So far as mental *defect* is concerned, certain types of mental disorders formerly characterized simply as "insanity" are known to be entirely environmental in origin. For example, in the tertiary stages of syphilis some of the tissue of the brain is destroyed by the invading spirochete organisms. This leads to mental deterioration and the characteritic mental condition known as paresis. Without question, heredity does not play any part in the etiology of this disease; it is a condition attributable to microbial pathogens.[48]

Although evidence has been adduced that certain of the psychoses may involve a "genetic factor" (which we shall discuss later), in general the psychotic and neurotic illnesses have been considered developmental or environmental in origin or are simply termed "functional," because no organic cause can be identified.[49] Moreover, sociopathy or psychopathy and, until recently, so-called "criminal behavior" could not be definitely related to genetic origins.[50] However, evidence has now been presented which associates certain types of antisocial or criminal behavior with the presence of supernumerary sex chromosomes in affected individuals. These developments will be discussed in a later subsection.

2. Genetic Evidence of Defect

Dramatic evidence of genogenic factors is provided by two rare forms of mental illness — amaurotic family idiocy and Huntington's chorea — which are important for our purpose in that they are rather clearly characterized as following a single gene, Mendelian mode of inheritance.[51] Single gene recessive traits were shown by Mendel to occur among offspring in a 3:1 ratio of the dominant (in this case, *normal*) phenotype and the expressed recessive trait. In studies of 59 families with a history of the recessive trait, amaurotic idiocy, 413 offspring were studied of whom 115 were idiots, yielding approximately the 3:1 ratio of unaffected individuals.[52] Huntington's chorea is governed by a *dominant* gene, frequently with delayed expression of the overt disorder.[53] The disease follows the expected Mendelian ratio for dominant traits.

Of greater practical significance is the possibility that a genetic cause might be found in the more common psychoses, particularly schizophrenia. Among such diseases, however, Mendelian inheritance

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[48] A. WINCHESTER, HEREDITY AND YOUR LIFE 281 (1960).

[49] Rubin, *Psychiatric Illness,* in READINGS IN LAW AND PSYCHIATRY 46-49 (R. Allen, E. Ferster, & J. Rubin eds. 1968).

[50] MONTAGU, *supra* note 26, at 156-63, 370.

[51] A. MASLOW & B. MITTELMANN, PRINCIPLES OF ABNORMAL PSYCHOLOGY 117 (1951).

[52] *Id.*

[53] *Id.*

has not been demonstrated, although there is evidence that a gene may confer a *predisposition* to the disease whose actual expression may then be governed by environmental factors (*i.e.*, stress) to which the susceptible individual is exposed.[54]

The major work on the genogenic origin of psychoses has been done with schizophrenia, which is characterized by disturbances in reality relationships and fragmentation of the ego. Kallman examined 691 pairs of identical (monozygotic) and fraternal (dizygotic) twins, one or both of whom were schizophrenic, and determined the concordance rate (*i.e.*, the percentage of similar development) in each case.[55] He compared these results and also the concordance rate in identical twins living in different environments. From these studies of twins and their relationships with other family members, Kallman was able to show that the incidence of schizophrenia was directly related to the closeness in family relationship.[56]

This data indicates the presence of a strong genetic factor in the development of schizophrenia. However, the effect of environment is not ruled out, as suggested by the small but definite concordance rate for marital partners and by data, not shown in the table, of a lower concordance among separated versus nonseparated monozygotic twins—77.6 percent against 91.5 percent.[57] The "genetic factor" implied by these studies, rather than signifying ordinary Mendelian inheritance, means that genetically *predisposed* individuals *can* develop schizophrenia under proper environmental conditions. That is, if exposed to the same environmental stresses as "normal" persons, predisposed individuals will tend to develop schizophrenia, where others would remain relatively unaffected.[58] It has also been noted that development of the schizophrenic state is influenced in many instances by the physical condition of the individual. For example, when one identical twin develops schizophrenia and the other

[54] *Id.* at 120-21.

[55] Kallman, *The Genetic Theory of Schizophrenia,* in READINGS IN LAW AND PSYCHIATRY 56-60 (R. Allen, E. Ferster, & J. Rubin, eds. 1968); MASLOW & MITTELMANN, *supra* note 51, at 119.

[56] Kallman, *supra* note 55, at 58.

Relationship to Schizophrenic Twin Index Cases
Incidence of Schizophrenia in Percentage

Husbands and Wives	Step-siblings	Half-siblings	Parents	Full siblings	Dizygotic cotwins	Monozygotic cotwins
2.1%	1.8%	7.0%	9.2%	14.3%	14.7%	85.8%

[57] MASLOW & MITTELMANN, *supra* note 51, at 120.

[58] It should be noted that one of the assumptions made in the twin studies—that identical and fraternal twin pairs each enjoy a common environment—is questioned by some pspchologists. For example, a recent study by Smith of dietary habits supports the notion that there *is* a difference in the overall environment of the two types of twins, which will, in turn, influence intra-pair differences. Smith, *A Comparison of Socio-environmental Factors in Monozygotic and Dizygotic Twins, Testing an Assumption,* in METHODS AND GOALS IN HUMAN BEHAVIOR GENETICS 45-61 (S. Vandenberg ed. 1965).

does not, the affected twin is usually weaker physically and of lower weight. Furthermore, when the general health of the weaker twin improves, the schizophrenic symptoms frequently disappear, and the individual may resume a normal life.[59]

In their attempts to discover a physiological basis for schizophrenia, some workers in the field have attributed the disorder to an adrenal gland functional disturbance, in which an insufficient amount of corticoid hormone is secreted to cope with conditions of stress.[60] Others have noted the ability to produce a schizophrenic-like symptomatology with drugs such as mescaline and lysergic acid and have suggested that the disease may be due to the presence of abnormal substances with properties similar to these drugs.[61] Perhaps the most impressive physiological results, however, are those obtained by Heath, who, by injecting volunteers with the substance taraxein (obtained from the blood of schizophrenic patients), was able to induce a variety of schizophrenic-like symptoms — catatonic reactions, paranoia, disorganization, and depersonalization.[62] The onset of symptoms was described as gradual, reaching a peak between 15 and 40 minutes following the injection and then subsiding. Heath considers the symptoms resulting from the taraxein injection to be more specifically schizophrenic in nature than those resulting from mescaline or lysergic acid, which he considers more characteristic of toxic psychoses.

The significance to a genogenic argument of these possible physiological etiologies may seem obscure, but it should be recognized that, except for toxic, pathologic, or traumatic conditions, physiology is fundamentally a reflection of genetic endowment. That is, genes and chromosomes are the essential synthetic sources of those biochemical substances (enzymes) that regulate all physiological processes. Thus, genetic and physiological evidence are presumptively related and usually converge on a single organic cause.

The twin study technique has also been applied to manic-depressive psychosis, a disease characterized by marked emotional oscillation from manic to depressive states. Studies of twins concerning manic-depressive psychotics, although less extensive and convincing than those with schizophrenics, indicate a probable genetic predisposition for manic-depressive psychosis.[63] Concordance among monozygotic twins may run as high as 90 percent or more.[64]

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[59] MONTAGU, *supra* note 26, at 154.

[60] J. COLEMAN, ABNORMAL PSYCHOLOGY AND MODERN LIFE 275 (1956).

[61] *Id.*

[62] *Id.* at 276.

[63] *Id.* at 121.

[64] MONTAGU, *supra* note 26, at 154.

Involutional psychosis is the remaining important mental illness with which twin study research has been conducted. This disorder is characterized chiefly by depression, often in association with symptoms of insomnia, guilt, anxiety, and delusions. Concordance in identical twins has been found to be about 61 percent, but the genetic mechanism is obscure.[65]

Epilepsy is a neurologic disorder the variation of which suggest a variety of causes; however, gene deficiencies are undoubtedly involved in many cases. Some authorities, although insisting that the overt disease is *not* inheritable, feel that a predisposition to the disorder may be inherited.[66] Reasonably convincing evidence for genetic predisposition is provided, again by twin studies, which shows concordance among identical twins at a rate of 66 percent.[67] It appears that a number of recessive genes are involved in epileptic vulnerability.

We may summarize this section by noting that a genetic causation can be demonstrated for certain mental abnormalities but, by far, not for all. Those conditions that exhibit Mendelian inheritance, such as amaurotic idiocy and Huntington's chorea, have an evident genetic origin. On the other hand, a genogensis of the classical, *functional* psychoses — schizophrenia and manic-depressive psychosis — is more speculative and such a concept has not yet replaced the still vital developmental and environmental theories on which these diseases are postulated.

B. *Is the Sterilization of those with Abnormal Phenotypes an Efficient Means of Eliminating Gene Defects?*

If we were to go so far as to assume a genetic cause for all abnormalities to which sterilization laws are directed, we are still faced with the crucial question: Can sterilization of the affected persons wipe out the defect or deficiency? To answer this question we must examine more closely the implications of phenotypic expression of defects versus genotypic incidence of gene errors.

Typically, abnormal and especially lethal characteristics are genetically recessive in nature (or dominant with so called "reduced penetrance").[68] This is to be expected simply from considerations of selection and survivability; dominant defects are rapidly extinguished, but recessive defects can persist in unexpressed genotypes. Because they are recessive, therefore, a considerable number of defective genes may be and *are* secreted among the many genes — the

[65] *Id.*

[66] R. BARROW & H. FABING, EPILEPSY AND THE LAW 7 (1956).

[67] MONTAGU, *supra* note 26, at 155; WINCHESTER, *supra* note 48, at 289.

[68] MONTAGU, *supra* note 26, at 199.

gene pool — carried by the population. Thus, it has been estimated that an average person will carry some eight defective recessive genes.[69] The net result is that almost everyone is a carrier of one or more defects. The probability of a random mating involving two particular defective alleles is usually quite low and, even then, the probability is only one-in-four of begetting a homozygous offspring. Moreover, the probability of an *expressed* defect should be even smaller if the homozygous state confers only a predisposition to a disease that requires an adverse environment for overt expression.

For these reasons, defects are maintained in the heterozygous state for generation after generation in a relatively stable ratio of defect carriers to those who physically manifest the defect. Of greatest significance is the fact that carriers of defects are much more numerous than those who happen to express those defects. As an example, the carrier of albinism is almost 300 times more frequent than the albino himself.[71] Moreover, the rarer the disease, the greater the disproportion between the frequency of carriers and of affected persons.[72] Again, this data applies to *fully expressed* traits, and when there is only a predisposition to expression which requires environmental elaboration, the ratios between carries and expressed defectives would be greater than for simple Mendelian inheritance.

Since the number of those who are affected is always quite small in relation to those who are carriers, one is led inescapably to the conclusion that sterilization of expressed defectives reaches only a minute fraction of the defects circulating in the gene pool. Because of this, homozygous sterilization to eliminate hereditary defects

[69] *Id.* at 316-17.

[70] S. REED, PARENTHOOD AND HEREDITY 29-30 (1963).

[71] Population genetics (for a single gene site with two "alleles") are based on a deceptively simple expression, $(p+q)^2 = p^2+2pq+q^2$, attributable to G. Hardy and W. Weinberg. In the expression, p and q are probabilities of occurrence of particular genes ("alleles") and p^2, 2pq and q^2 are probabilities of occurrence of individuals carrying different gene *combinations* (*i.e.,* genotypes). The equation is based on the concept that the proportion of two allelic genes remains constant in a breeding population. The formula may be applied to compute the probability of the occurrence of genotypes of those alleles if the frequency of one member of the allelic pair is known. *See* GARDNER, *supra* note 4, at 307-12.

[72] REED, *supra* note 70, at 31.

The Ratio of Carrier to Affected Individual for Cases of Simple Single Factor Recessive Inheritance

Frequency of Affected Persons in the Population	Frequency of Carriers in the Population	Ratio of Carriers to Affected Persons
1 in 10	1 in 2.3	4.3:1
1 in 100	1 in 5.6	18:1
1 in 1,000	1 in 16	61:1
1 in 10,000	1 in 51	198:1
1 in 100,000	1 in 159	630:1
1 in 1,000,000	1 in 501	1,998:1

appears, quite frankly, to be a totally vain exercise. For example, if 1 percent of the general population were affected by a simple recessive abnormal condition and these people were all sterilized, it would require four generations or a span of about one hundred years to reduce their number to 0.5 percent, and seven generations or 175-200 years to reduce their number to 0.25 percent.[73]

C. *Of What Importance are Mutations to the Genetic Scheme?*

The immediate answer to this question is that mutations reinforce the case against eugenic sterilization. Abnormal genes are constantly being generated as a result of gene mutations. These may be caused by such mutagenic agents as radiation, chemicals, and food substances, as noted earlier. Because of mutations, therefore, it will never be possible to achieve a gene pool free of defective genes except by some as yet unknown process of eliminating defective genes at a faster pace than the mutation rate.

D. *Chromosome Number versus Criminality*

Until very recently, the association of criminality or "antisocial behavior" with genetic makeup was highly questionable.[74] However, evidence as now been adduced implicating an abnormal condition of the sex chromosomes — the XYY syndrome — with antisocial behavior.[75] The normal male possesses an XY complement of sex chromosomes and the normal female, an XX complement.[76] The XYY individual thus possesses an *extra* male-determining chromosome, hence the designation "supermales."

The link between XYY and antisocial behavior was first indicated about four years ago in Scotland, when researchers discovered a remarkably high incidence — about 3 percent — of this rare condition among patients of a maximum security hospital for the mentally ill and retarded.[77] Further surveys in English and American institutions have corroborated the high incidence of patients possessing this chromosome abnormality.[78]

The results of the various XYY surveys indicate a strong positive correlation between antisocial behavior and XYY incidence, the correlation increasing significantly with increased stature of individuals sampled.[79] The XYY's identified in these surveys evidence

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[73] MONTAGU, *supra* note 26, at 302-03.

[74] *Id.* at 156-63.

[75] *See* Burke, *The "XYY Syndrome": Genetics, Behavior and the Law,* 46 DENVER L.J. 261 (1969).

[76] GARDNER, *supra* note 4, ch. 8.

[77] *Crime Chromosome; genetic abnormality explains criminal behavior,* 91 SCI. NEWS 258 (1967).

[78] Burke, *supra* note 75.

[79] *Id.*

varying degrees of antisocial and disorganized behavior. The affected individuals typically suffer from personality disorders and are extremely immature, unstable, impulsive, and overly aggressive, and many are also mentally retarded.[80] Objective findings among at least some of the XYY's include significant differences in parts of the electrocardiogram,[81] abnormal electroencephalograms,[82] and, in a few cases, high hormone levels.[83]

Recently, pleas have been entered by a number of accused criminals alleging their XYY condition as grounds of insanity. In Australia and in France such a plea has met with some success in gaining acquittal or more lenient sentencing in murder cases.[84] On the other hand, in a California kidnapping and rape case, a trial court ruled that the XYY syndrome was not sufficient to establish that the defendant was legally insane.[85] A similar plea made on appeal in the Richard Speck murder case is yet to be decided.[86]

Whether XYY males are really psychiatrically different from other men remains to be shown. Some of the institutionalized XYY's have come from broken homes and poor environments, and those experiences could account for their criminal records and antisocial behavior.[87] Nevertheless, very few XYY's are found to have relatives with actual psychological or criminal records.[88] The fact that many XYY's are unusually tall could also account for their adjustment problems.[89] At present, medical opinion is divided on the significance of the XYY relationship to criminality.[90] However, at least one prominent medical worker in the field, D. S. Borgaonkar of Johns Hopkins University, feels there is a valid association of the XYY syndrome with behavioral, though not necessarily *criminal,* problems.[91]

Notwithstanding the apparent relationship of the XYY syndrome to antisocial behavior or criminality, the crucial issue relating to the instant sterilization controversy is whether a condition such

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[80] SCI. NEWS, *supra* note 77.

[81] *Borgaonkar et al., The YY Syndrome,* LANCET, Aug. 24, 1968, at 461; Price, *The Electrocardiogram in Males with Extra Y Chromosomes,* LANCET, May 25, 1968, at 1106 (letter to the editor).

[82] Cowie & Kahn, *XYY Constitution in Pre-Pubertal Child,* BRIT. MED. J., Mar. 23, 1968, at 748 (1968); Mintzer *et al., The XYY Syndrome,* J. PEDIATRICS, Apr., 1968, at 572; Welch *et al., Psychopathy, Mental Deficiency, Aggressiveness and the XYY Syndrome,* 214 NATURE 500 (1967).

[83] *Extra chromosome in court,* 94 SCI. NEWS 410 (1968).

[84] *Criminal Law: Question of Y,* TIME, Oct. 25, 1968, at 76.

[85] 19 CITATION 132 (1969).

[86] TIME, *supra* note 84.

[87] SCI. NEWS, *supra* note 83.

[88] *Id.* SCI. NEWS, *supra* note 77.

[89] SCI. NEWS, *supra* note 83.

[90] SCI. NEWS, *supra* note 77.

[91] SCI. NEWS, *supra* note 83.

as this is predictably transmissible. Thus, although a genetic etiology has been suggested by the statistical data, the eugenic value of sterilization depends, in the ultimate, on whether the *incidence* of the abnormality can be altered by a eugenic program.

There appears to be some evidence of a familial tendency to nondisjunction of chromosomes, that is, a predisposition to form the anomalous gametes which appear to be the necessary intermediates of XYY generation.[92] Yet, in a least one reported case, the abnormality was definitely *not* transmitted. Thus, an Oregon XYY individual fathered six sons, *all* of whom had the normal XY pattern.[93] We must conclude then that the evidence as of the moment is not yet conclusive of transmissibility, and this would indicate that a rational basis for effective eugenic sterilization has not been established.

The behavioral patterns of the so-called sociopaths or psychopaths bear at least some similarities to the behavior observed among XYY's. Cleckley, in a lengthy list of the characteristics of the sociopath, indicates such traits as: untruthfulness and insincerity, lack of remorse or shame, inadequately motivated antisocial behavior, and unresponsiveness in general interpersonal relations.[94] These behavioral traits appear to bear some resemblance to those exhibited by the XYY, though, on the other hand, the sociopath may be a more "normal" individual in his ability to display a superficial charm, possession of at least adequate intelligence, and absence of delusions and other irrational thinking. Nevertheless, since classification and analysis of the sociopath remains somewhat of a mystery, it would be of interest to pursue a chromosomal analysis to determine whether this baffling symptomatology may not spring from such an organic cause.

E. *Summary of the Scientific Appraisal*

The specific scientific conclusions regarding eugenic sterlization may be summarized as follows: (1) sterilization of persons with nonheritable conditions does not achieve a eugenic purpose; (2) a sterilization program is of limited value if it fails to recognize the significance of defect carriers; and (3) allowance must be made for the impact of natural and induced mutations in creating genetic defects.

Based on these conclusions, the present laws for eugenic sterilization of the mentally defective or deficient (or of physical defec-

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[92] Hauschka, Hasson, Goldstein, Koepf & Sanberg, *An XYY Man with Progeny Indicating Familial Tendency to Non-Disjunction,* 14 AM. J. HUMAN GENETICS 22 (1962).

[93] *Genetics: Of Chromosomes and Crime,* TIME, May 3, 1968, at 41.

[94] H. CLECKLEY, THE MASK OF SANITY 362-64 (1964).

tives) are in most cases unsound. Genetic etiologies have usually not been established with reasonable medical certainty. Furthermore, the sterilization process, as applied only to individuals with expressed defects, is woefully inefficient in eliminating defective genes. Finally, the elimination of defective genes may, in fact, be a practical impossibility in view of the fact of genetic mutation.

It should be clear, then, that present sterilization practices are not a rational means of attaining the governmental purpose asserted as their justification,[95] and laws pertaining to sterilization should be struck down as an invalid exercise of the police power.[96] The policy implications of the scientific analysis should also be clear.[97] However, as already indicated, the objections that may be made to eugenic sterilization which embrace legal, moral, and sociological issues are adequately treated elsewhere.[98] The scientific analysis has clearly shown that sterilization of potential parents of socially inadequate offspring will not eliminate the problem — contrary to the assumptions upon which *Buck v. Bell*[99] was decided.

III. The Prospects for an Enlightened Eugenics Program

If sterilization is not a rational means for attaining an arguably legitimate state purpose, what alternative courses of action exist for a more enlightened brand of eugenics? First, it must be recognized that eugenics is not primarily a legal problem; rather, it is a medical and scientific problem. Thus, eugenic sterilization should be supplanted by the utilization of *treatment* and *prevention.*

Traditionally psychiatric treatment of the functional psychoses and neuroses[100] should, of course, continue. Moreover, efforts must be made to extend the coverage of psychiatric therapy, to make it more efficient in terms of increasing the number of patients who can be treated by each practitioner and to reduce the treatment period

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[95] The purpose of governmental regulation is typified by the *Model Eugenic Sterilization Law; see* note 9, *supra* and accompanying text.

[96] The "substantive due process" test alluded to was stated in *Bates v. Little Rock,* 361 U.S. 516, 525 (1960):

> Where there is a significant encroachment upon personal liberty, the State may prevail only upon showing a subordinating interest which is compelling. . . .
>
> . . . .
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> When it is shown that state action threatens significantly to impinge upon constitutionally protected freedom it becomes the duty of this Court to determine whether the action bears a reasonable relationship to the achievement of the governmental purpose asserted as its justification.

See also, Comment, 46 Denver L.J. 482 (1969).

[97] *See* authorities cited, note 16, *supra.*

[98] *Id.*

[99] 274 U.S. 200 (1927).

[100] A. Watson, Psychiatry for Lawyers, 29-49 (1968); W. Overholser, *An Historical Sketch of Psychiatry,* in Readings in Law and Psychiatry 3-12, 15 (R. Allen, E. Ferster, & J. Rubin eds. 1968).

for each patient. Increasing use of group therapy and supplementation of traditional psychoanalytic techniques with medical and physical treatments[101] are trends which should be encouraged. Where mental disorders are traceable directly to physiological causes, traditional medical and dietary treatment as a program of prevention will be of primary importance.

It is of interest to consider in more detail some of the specific problem areas and the types of solutions that may be sought in the attainment of a rational eugenic program. The following topical areas will be explored: (1) recent developments in medical treatment and prevention; (2) identification of defect carriers, therapeutic abortions, and genetic counseling; (3) genetic engineering; and (4) psychiatry and psychology — the continuing need for therapy.

A. *Recent Developments in Treatment and Prevention*

With the increased understanding of emotional and physical disease processes and origins, development has been away from generalized descriptions and treatments to ever more specific classifications and techniques. Thus, much of the melange of poorly characterized entities has gradually yielded to an isolation of specific causes and treatments. Such development has been especially rapid in the case of certain mental deficiencies which have been identified with metabolic disturbances arising either from genetic or dietary causes. Often treatment can be instituted which avoids entirely the mental and physical damage that formerly would have reduced the patient to a level of incompetance.

An example of recent development in circumventing the effects of hereditary deficiency is the prevention of mental retardation from phenylketonuria (PKU).[102] This condition is one in which the body lacks the enzyme required to effect a transformation between the two amino acids, phenylalanine and tyrosine. Both of these materials are essential ingredients in the synthesis of human protein. It is not the lack of tyrosine that is determining, however, since this can be obtained from other sources. Rather, it is the excess of phenylalanine and its toxic by-products that cause damage. The disease can be controlled by restricting the intake of phenylalanine to just that consumed in essential protein build-up. Therapy must begin as early as possible; if delayed until the patient is two or three years old, only slight benefits are derived from the therapy. Thus, delayed control may yield a final IQ of perhaps 40, only a modest increase over an IQ of 25 obtainable with no treatment.

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[101] Overholser, *supra* note 100, at 15.

[102] SUTTON, *supra* note 45, at 105-06.

Fortunately, it is possible to detect the metabolic disorder by relatively simple test procedures.

The importance of early PKU detection has been recognized by the enactment in a majority of the states, including Colorado, of laws pertaining to the screening of infants for this disease.[103] The Colorado statute requires that all newborn infants be tested by appropriate procedures for phenylketonuria and other metabolic defects in order to prevent mental retardation.[104]

Mongolism (Down's syndrome)[105] is a genetically related entity characterized by severe mental retardation and stunted physical appearance. Reduction in *incidence* of this condition may be controlled through family planning since the probability of occurrence of the disease among offspring increases markedly with age of the mother.[106] If mothers will complete child-bearing at a relatively early age, *i.e.*, at about age 40, it has been estimated that incidence of the disease could be reduced by about 30 percent.[107] Mongolism has recently been associated with the presence of an *extra* chromosome in the victim's somatic cells. Unlike the XYY condition, the disease involves one of the autosomes ("nonsex" chromosomes). The additional chromosome apparently results from nondisjunction during formation of the ovum in the female. The significance of the extra chromosome in the causation of Down's syndrome is not clear, but genetic factors which relate to inadequate secretions of endocrine hormones appear to be an important causal element.

Mongolism may also be caused by the transmission of specific chromosomal abnormalities known to be present in one of the parents, as when a chromosome pair is joined to form a unit which cannot undergo the normal disjunction that occurs during gamete formation.[108]

B. *Identification of Defect Carriers; Therapeutic Abortions; and Genetic Counseling*

The treatments for genetic defects so far described are advantageous to the individual in controlling his disease, but they provide

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[103] U.S. DEP'T. OF HEALTH, EDUC. AND WELFARE, WHAT DO YOU KNOW ABOUT PKU? 3 (1965).

[104] COLO. REV. STAT. ANN. §§ 66-27-1 to 66-27-4 (Supp. 1965).

[105] MONTAGU, *supra* note 26, at 89-91.

[106] REED, *supra* note 70, at 51:

Percentage Risk Figures for the Incidence of Affected Children Expected from Mothers of Different Ages

Age of Mother	15-20	20-24	25-29	30-34	35-39	40-44	45-49
% Risk of Mongoloid Birth	0.00-0.06	0.03-0.07	0.03-0.07	0.11-0.17	0.35-0.36	1.03-1.42	1.78-2.63

[107] *Id.* at 52.

[108] Brody, *Will Our Baby Be Normal?*, WOMAN'S DAY, Aug., 1969, at 47.

no *cure* for the underlying gene defect. Thus, the phenotype is changed but the genotype persists. Such procedures have a dysgenic effect in that they tend to preserve deleterious genes by permitting those who possess them to mature to such an age that they can marry and procreate. Medical questions are raised as to the wisdom of degrading the gene pool in this way. However, the trend appears to be strongly in the direction of saving the genetically defective, and at least one argument favoring the practice is that the means to provide supportive treatment will continue to improve.[109]

What measures can counter this trend? Some hope is offered by our growing ability to identify heterozygous carriers of defective genes. It is already possible to identify carriers of phenylketonuria[110] and those predisposed to epilepsy,[111] and, quite recently, a procedure has been developed to detect carriers of the cystic fibrosis defect.[112]

Another area of great promise is the development of the technique of intrauterine test of a fetus suspected of carrying a genetic defect. A sample of fluid drawn from the uterus may be tested for chromosome defects or the sex determined as part of an analysis in which a sex-linked defect is suspected. In the event a defective fetus is identified, a therapeutic abortion could be ordered, at least in those states whose laws permit abortions in such circumstances.[113]

The ability to identify genetic carriers should become increasingly more common, and the use of prenatal tests of the fetus may become relatively routine. With the availability of such techniques, a workable and efficient eugenic program becomes possible for the first time. Many of the objections to traditional negative eugenics would be mitigated, not only because rights and freedoms would not be arbitrarily limited, but because of the possibility of actual improvement in the human stock. Either through counseling or legal sanctions, a substantial reduction could be achieved in the frequency distribution of defective genes and in their expressed disorders.[114]

As an adjunct to the program of carrier identification, widespread public education in genetic matters will become a necessity. Public enlightenment may be all that is required for general acceptance of limited, voluntary reproductive control where the presence

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[109] MONTAGU, *supra* note 26, at 304-05.

[110] *Id.* at 175-76; REED, *supra* note 70, at 85.

[111] JOHNSON *et al.*, *supra* note 4, at 334.

[112] McCALL'S, Apr. 7, 1969, at 66.

[113] Brody, *supra* note 108, at 79.

[114] MONTAGU, *supra* note 26, at 308-09.

of deleterious genes can be clearly demonstrated and the risks of defective births reasonably well estimated.

A major vehicle for the dissemination of genetic information is the growing number of genetic counseling clinics that have been established, largely in association with universities and medical centers.[115] Such clinics provide genetic counseling services and information to parents of genetically defective children or to prospective parents fearful of harboring unexpressed genetic defects. Also, the concept of genetic counseling has received support from the National Foundation-March of Dimes, which publishes a directory of available services.[116]

C. *Genetic Engineering*

We have discussed how the body may be supplied with metabolic intermediates in cases where the genetic apparatus is incapable of effecting their synthesis. The speculations of some geneticists suggest that such procedures are likely, in the future, to be replaced by the more effective technique of correcting the deficiency at the genetic level and thereby restoring the body to full function. This possibility has been suggested recently by a well-known geneticist, R. L. Sinsheimer,[117] who proposes the use of selected viruses to introduce bits of DNA into the cells which they invade. This would permit supplementing damaged or blocked DNA structure; thus, insulin synthesis could be reactivated in a diabetic, making continuous insulin treatment unnecessary. When and if emotional illnesses are found to be gene-based, the possible extension of such theorizing to the correction of mental disorders must be considered.

D. *Psychiatry and Psychology — the Continuing Need for Therapy*

The emphasis which has been placed on the prevention of genetically defective births and on treatment at a physiological level of diseases which frequently have behavioral and emotional significance is not intended to disparage the continuing efforts of the psychiatrist, psychoanalyst, and clinical psychologist. The need for psychiatry and the allied fields will obviously continue.

The therapy provided by the psychiatrist for the largely functional disorders represents the major, and frequently the only, means of treating these conditions. Such treatment should be, if anything, expanded and made available to all those who can benefit from it. But in view of the limitations on the availability of psychiatric and

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[115] REED, *supra* note 70, at 1-5.

[116] H. LYNCH, INTERNATIONAL DIRECTORY OF GENETIC SERVICES (1969).

[117] Sinsheimer, *The Prospect for Designed Genetic Change*, 57 AM. SCIENTIST 134 (Spring 1969).

related care and the fact that treatment of the functional psychoses requires prolonged therapy, every effort which successfully identifies a mental or behavioral entity as genetic or physiological in origin and thereby eliminates it from the concern of the psychiatrist and frees him to concentrate more completely on those in need of his special training should be encouraged in every way possible. Those individuals who are genetic or physiological defectives can then be assisted by more conventional medical techniques.

An example of the benefits that are possible from psychological therapy applied to a pre-existing, apparently functional psychosis — that of infantile autism — was recently published.[118] Autistic children exhibit a pattern of complete withdrawal from their surroundings. Though the hope has been expressed that perhaps autism may turn out, like cretinism or PKU, to involve an easily remediable metabolic disturbance, in the meantime, the use of conditioning therapy has had at least some success in breaking the trance-like behavior pattern of the autistic child. The therapy abates the worst of the symptoms and permits the child to make use of the special schools available to other handicapped children.

CONCLUSION

On the basis of scientific evidence alone, if not for legal, moral, or sociological reasons, the concept of a legalized eugenic sterilization of the mentally defective or deficient (or of physical defectives) is in most cases unsound. Present scientific knowledge suggests a more effectual, rational, and humane policy by which the same end might be achieved.

The place of eugenic sterilization should properly be filled by an intensified program of *treatment* and *prevention.* Major advances have already been made in the understanding of physiological causes with consequent development of procedures for treatment and control of many abnormalities. Prevention has been aided by the growing availability of genetic counseling services, which have been a factor in promoting awareness of the genetic role in birth defects and in encouraging selective childbearing. Moreover, the increasing ability to identify carriers, and the development of the technique of prenatal testing provide means of reducing even further the fortuitous aspects of parenthood. Ultimately, there is the hope of prevention at the genetic level by repair of the genetic fabric itself.

William R. Matoush[119]

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[118] *Mental Illness: The Trance Children,* TIME, Aug. 1, 1969, at 56.

[119] Directorate of Analysis, North American Air Defense Command (USAF), Ent A.F.B., Colorado; B.A. *summa cum laude,* Coe College, 1950; Ph.D. (Chemistry), Northwestern University, 1956; J.D. University of Denver, 1969.

GLOSSARY[120]

Adrenal Gland. A body situated in the upper tissue of each kidney; it is a gland of internal secretion producing hormones essential to life.

Allele. One of two or more contrasting genes situated at the same position in homologous chromosomes which determine alternative characters in inheritance.

Amaurotic. Pertaining to one affected with amaurosis, a condition marked by complete loss of vision, especially that in which there is no evidence of pathologic condition in the eye. *Amaurotic Family*

Amino Acid. The building blocks of which proteins are made; a large group of organic compounds marked by the presence of both an amino (NH_2) and a carboxyl (COOH) group.

Autosome. Any of the chromosomes other than the sex (designated X for female and Y for male) chromosomes.

Biochemistry. The chemistry of living things and vital processes; the science of the chemical changes accompanying the vital functions of plants and animals.

Catatonic Reaction. The state of catatonia is characterized by immobility with muscular rigidity or inflexibility and at times by excitability; virtually always a symptom of schizophrenia.

Corticoid. Any one of a specific group of organic compounds termed steroids emanating from the outer layer or cortex of the adrenal gland.

Cretinism. A chronic condition attributable to a lack of thyroid secretion and characterized by impaired physical and mental development accompanied by degeneration of the bones and soft parts and by lowered basal metabolism.

Dizygotic. In reference to twins, those individuals originating from two discrete eggs individually fertilized.

Down's Syndrome. Mongolism; named after the English physician J. L. H. Down.

Electrocardiogram. A graphic tracing of the electric current produced by the contraction of the heart muscle; gives important information concerning the spread of excitation to the different chambers of the heart.

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[120] Sources used to compile glossary were:
DORLAND'S ILLUSTRATED MEDICAL DICTIONARY (24th ed. 1965).
E. J. GARDNER, PRINCIPLES OF GENETICS, glossary (1964).
READINGS IN LAW AND PSYCHIATRY, appendix, A Psychiatric Glossary (R. Allen, E. Ferster, & J. Rubin eds. 1968).
TABER'S CYCLOPEDIC MEDICAL DICTIONARY (10th ed. 1968).
J. WATSON, MOLECULAR BIOLOGY OF THE GENE, glossary (1965).

Electroencephalogram. A graphic tracing of the electric current developed in the brain.

Enzyme. An organic compound, frequently a protein, capable of accelerating or producing by catalytic action some chemical change for which it is often specific.

Epilepsy. An episodic disturbance of consciousness during which generalized convulsions may occur.

Etiology. The study or theory of the causation of any disease; the sum of knowledge regarding such causes.

Galactosemia. A hereditary disorder of carbohydrate metabolism, characterized by vomiting, diarrhea, jaundice, poor weight gain, and malnutrition in early infancy.

Gamete. A male or female reproductive cell, the sperm or egg cell.

Gene. A hypothetical biologic unit of heredity, self-reproducing and located in a definite position (locus) on a particular chromosome; there are specific points on the chromosomes for genes governing each characteristic.

Genetics. The study of heredity and its variation; the science that accounts for natural differences and resemblances among organisms related by descent.

Genogenic. Originating from genes, having a genetic cause.

Genotype. The fundamental hereditary constitution or gene assortment of an individual.

Germ Cell. A reproductive cell capable, when mature, of being fertilized and reproducing an entire organism.

Heredity. The innate capacity of an individual to develop traits and characteristics possessed by his ancestors; such is dependent upon the presence of genes in the chromosomes of the parents from which the individual develops.

Heterozygous. Possessing different alleles in regard to a given character.

Homozygous. Possessing an identical pair of alleles in regard to a given character or to all characters.

Hormone. A chemical substance produced in the body which is conveyed through the blood to a certain organ of the body upon which it has a specific effect, such as stimulating it to increased functional activity.

Huntington's Chorea. A chronic condition of ceaseless occurrence of a wide variety of rapid, jerky but well coordinated movements performed involuntarily.

Idiocy. The term for a group of related familial diseases marked by dementia (irrecoverable deteriorative mental state), impaired vision, and defect in fat metabolism.

Infantile Autism. A term used in child psychiatry referring to babies who remain aloof from relationships with others but usually without evidence of intellectual impairment; the child responds chiefly to inner thoughts, does not relate to his environment, is immature, and often appears retarded.

Meiosis. A special method of cell division occurring in maturation of the sex cells by means of which the nucleus of each sex cell receives half the number of chromosomes characteristic of the other cells of the body.

Microbe. A minute organism, especially protozoa, fungi, and bacteria.

Mongolism. Now called Down's syndrome or disease; a variety of congenital mental retardation characterized by severe intellectual defect, abnormal body development, and a fold of skin over the inner angles of the eyes giving a "mongoloid" appearance; the condition results from the presence in the individual's cells of an extra small chromosome.

Monozygotic. In reference to twins, those individuals originating from the cleavage of a single fertilized egg.

Mutation. A permanent, transmissible change in the characters of an offspring from those of its parents; a change in form, quality, or some other characteristic.

Mutagenic. Inducing genetic mutation.

Neurosis. Emotional maladaptations due to unresolved unconscious conflicts; one of the two major categories of emotional illness, the other being "psychosis"; usually less severe than psychosis with minimal loss of contact with reality; thinking and judgment may be impaired; such an illness represents the attempted resolution of unconscious emotional conflicts in a manner that handicaps the effectiveness of a person in living.

Nucleotide. A compound formed of phosphoric acid, a sugar, and a base (purine or pyrimidine), all of which constitute the structural unit of nucleic acid.

Paranoia. Rare psychotic disorder which develops slowly and becomes chronic; characterized by an intricate and internally logical system of persecutory and/or grandiose delusions; the system stands by itself and does not interfere with the remainder of the personality.

Paresis. Weakness of organic origin; incomplete paralysis; the term is frequently applied to the sequelae of syphilitic infection.

Pathogen. A microorganism or substance capable of producing disease.

Phenotype. The outward, visible expression of the hereditary constitution of an organism.

Phenylketonuria. A congenital faulty metabolism of the amino acid phenylalanine resulting in abnormal chemicals which interfere with brain development; often associated with mental defects (phenylpyruvic oligophrenia); transmitted genetically and treatable by diet when detected in infancy.

Physiology. The science of the functions of cells, tissues, and organs of the living organism.

Protein. A group of complex organic, nitrogenous compounds, essentially combinations of amino acids, which are essential constituents of all living cells.

Psychopathy. Any mental disease, especially one characterized by defective character or personality.

Psychosis. A major mental disorder of organic and/or emotional origin in which there is a departure from normal patterns of thinking, feeling, and acting; commonly characterized by loss of contact with reality, distortion of perception, regressive behavior and attitudes, diminished control of elementary impulses and desires, abnormal mental content including delusions and hallucinations; chronic and generalized personality deterioration may occur.

Schizophrenia. A severe emotional disorder of psychotic depth characteristically marked by a retreat from reality with delusion formation, hallucinations, emotional disharmony, and regressive behavior.

Sociopathy. Connoting a pathological attitude toward society.

Somatic. Pertaining to nonreproductive cells or tissues.

Spirochete. A spiral shaped bacterium.

Sterilization. The process of rendering barren.

Syphilis. An infectious venereal disease leading to many structural and cutaneous lesions, due to the bacterium *Treponema pallidum,* transmitted by direct contact.