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EUGENICS REVISITED: THE CASE FOR GERMINAL CHOICE

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DISCREDITATION OF EARLY EUGENICS

The application of genetics to man has had its chief success in medical genetics. The extensive analysis of blood group incompatibilities, the chromosomal basis for almost one dozen disorders, including Down's Syndrome, and the genetic basis of inborn errors of metabolism are universally recognized achievements in this field. To a lesser extent human biology and anthropology have benefited from the applications of population genetics, especially in the study of racial origins and the diversity of genotypes in populations. In both instances the additions to our knowledge of human evolution and of the genetic uniqueness of our existence have far exceeded the practical applications of this knowledge.

At first we may attribute this to a caution characteristic of the scientist, whose applications may lag by many years the immediate implications of his discoveries. This would hardly be the case, however, if we contrasted human applications of genetics with the industrial and agricultural applications of new knowledge generated from the genetic studies of plant, animal, and microbial organisms. In these applications there has been an extensive and intense use of genetic principles in bringing about hybrid seed production, disease resistance, increased productivity, artificial insemination, cross breeding, and the selection of new varieties.

The conservatism of applied genetics to man stems from the failures of the eugenics movements which flourished from the late 19th Century to the 1930's. In almost all instances these eugenic programs were developed without a knowledge of genetics or they were based on faulty or spurious interpretations of genetics. This raises three questions which have not usually been asked: first, why were geneticists virtually absent in developing these eugenic movements? Second, how can society develop a eugenics program without falling victim to the same errors and failures which plagued its predecessors?

Most important of all, however, is the third question: Is eugenics doomed to failure because its basic premises are based on fallacies?

The eugenics movement was first created by Francis Galton. It was Galton's research in anthropology and psychology which convinced him that individuals varied in talent, intelligence and behavior. His *Natural Inheritance* (1889) and *Hereditary Genius* (1892) claimed a genetic basis for human height and for "eminence," a hard to define quality compounded of ability, achievement, and fame through individual effort yet rare enough to be bestowed on only one among 4000 persons in England. Galton's finding that about 25 percent of the sons or fathers of eminent men were also eminent suggested that heredity played the major role in elevating this rare event to such a large proportion of family members. By contrast the non-related, or distantly related, children raised in nepotic tradition by Bishops and Cardinals did not show the environmental influence to play as significant a role in generating eminence. From these observations Galton developed a eugenics program. He advocated eugenics as a religious duty for human betterment. Inherent in his idealism was the wish for differential breeding, with the choice of mates motivated by the quality of the family stock. He stressed positive eugenics through the propagation of talent, genius, and good health.

By contrast, the American eugenics movement arose as a reaction to environmental idealism. The failure of communes such as New Harmony and the failures of prison reform, welfare and mass education to eliminate crime, insanity, ignorance, and poverty led to a pessimism about human nature. Man's troubles, in this view, stemmed not from the failures of his inadequate social reforms but from the corrupting influence of bad heredity. At first the spokesmen for this new viewpoint, like Richard Dugdale, illustrated their cases with supposedly degenerate American stock of Anglo-Saxon origin, such as the Jukes family in upstate New York (WINSHIP 1900). Similar contaminating families, like the Kallikaks in New Jersey and Oscar McCulloch's tribe of Ishmael in Indianapolis, created a belief that welfare fostered the maintenance and rampant reproduction of these families, whose miscegenations with their wholesome and trusting American neighbors led to their degeneration. In David Starr Jordan's view, these families constituted proven instances of human parasitism, as corrupting and loathsome to the nation's health as an infestation of sacculina feasting on crabs (JORDAN 1900).

Through the efforts of Jordan and the post-Mendelian wave of enthusiasts for eugenics, some 16 states, by 1917, had passed compulsory sterilization laws for feeblemindedness, insanity, rape, habitual criminality and other categories of the "hereditary unfit." About 30,000 sterilizations, mostly vasectomies, were carried out by 1935 in the United States, a third of them in California. Whether the "unfit" had become that way by a Lamarckian transformation, as Max Jukes was

thought to have done to his reproductive tissue through his "dissolute" life, or whether the hereditary blight arose through some permanent defect in the germ plasm, the outlook of the American eugenics movement was essentially a holding action, in which the philosophy of negative eugenics prevailed. If the defective germinal material was prevented from breeding then the rigor and excellence of the uncorrupted stock would be restored.

It was a stunning revelation for eugenicists when the U.S. Army administered Binet tests in World War I and reported 47% of white inductees to be feebleminded by the standards of eugenicists. It was even more demoralizing, a few years later, to learn that feeblemindedness was neither a single entity nor a simple Mendelian mutation (LUDMERER 1972). Most devastating of all were the analyses by Penrose, Haldane, and Fisher of the staggering amount of time required by negative selection for the elimination of a major portion of the population carrying a recessive harmful gene. The naive hope that rigorous sterilization in 2 or 3 generations would bring a return to normalcy was dashed by the reality that such zeal would only become effective after centuries or millenia of universally enforced sterilization for parents of defective children or the defective individuals themselves (HALDANE 1924).

As the Jukes and Kallikaks lost their propaganda effectiveness as the basis for the contaminating source for American degeneration, the immigrants replaced them as the scapegoats to be excised and quarantined. The polemical writings and lobbying of Madison Grant, Prescott Hall and Harry Laughlin, none of them geneticists, played a major role in convincing the public and Congress that the immigrant was suspect. Labor unrest, the glut of foreign cultures and languages, the perpetuation of ghettoes, and the identification of socialism and revolution as alien philosophies, all became stigmatic attributes of the Italian, Russian, Polish, Greek and Jewish immigrants. The Nordic and Anglo-Saxon origins of an earlier America were now threatened by the potential miscegenation of these outcasts, identified as an inferior breed of humanity through their high illiteracy rate, poverty, and broken health. By 1921 a temporary restrictive immigration act was passed and in 1924 the infamous Johnson Act virtually excluded immigration from Southern and Eastern Europe by using the ethnic census of 1890 as the standard for future admissions. The full weight of the eugenics movement was thrown into the passage of this act and it was justified on the grounds of conscious and unconscious racism and prejudice disguised as biological fact and genetic theory. In this, as in sterilization laws, genetics was misused and distorted to serve political and social goals. In both instances geneticists played little or no part, but through their silence the spurious rationalizations became accepted and disreputable eugenic measures were adopted (LUDMERER 1972).

The prevailing philosophy among geneticists, and most American scientists, in the first half of the 20th Century, was to maintain scientific objectivity by a strict separation

from politics and public affairs. Few geneticists wanted an endorsement from the Genetics Society of America or from more general organizations such as the AAAS; such an action would be interpreted as a group endorsement for public policy, whether as a criticism of the ineffectiveness of sterilization laws, a condemnation of the racism in the Johnson Act, criticism of the myth of Nordic superiority or, much later, criticism of Lysenko's successful destruction of formal genetics in the USSR. In all instances opponents of group endorsement, while personally loathing the mistaken doctrines assigned to genetics, believed that protest was an individual matter and that a group act would be detrimental to the free scientific activity of the society itself.

The depression years of the 1930's and the rise of racism on a devastating scale in Nazi Germany were the major events which diminished the already retreating American eugenics movement. With millions of Americans unemployed, the problems of poverty and crime could no longer be assigned to bad genes. The arrest and subsequent murder of six million Jews and the widescale sterilization (over 250,000) carried out under the Eugenic Sterilization Law decreed by Hitler in 1933, frightened the geneticist as well as the general public. The eugenicists were embarrassed by these developments because they had, at first, welcomed the German Sterilization Law as socially advanced and refused to believe that it was being applied politically to non-Nordic races as part of an official racist policy. By 1940, for all practical purposes, eugenics as a social program in the United States was dead (LUDMERER 1972).

The history of these eugenics movements clearly illustrates the reasons for the underlying suspicion, distrust and outright opposition to any of its postwar revivals. It is against this past history of failure that H. J. Muller renewed his efforts to promote eugenics as a biological necessity and as a social good.

MULLER'S EUGENIC THOUGHT

Muller's first interest in eugenics was aroused as a ten year old child listening in awe to his father explain the evolution of living things from a display of fossil horses' feet at the Museum of Natural History. If nature could develop such wonderous forms by unplanned accident, how much more marvelous, he thought, would man's creations be when he applied his biological knowledge to life. The thought haunted him and served as an underlying motivation throughout his life (MULLER 1936a).

As a 19 year old undergraduate student at Columbia University, MULLER presented his first eugenics paper to the Peithologian Society on March 24, 1910. He accepted the chromosome theory and the primary role of the gene as the basis for generating all cell metabolism, cell components, and multicellular organization. Evolution he interpreted as a

natural selection of minor variations arising by gene mutations. It should be noted that Morgan's white eye case was not yet worked out and that neither sex linkage nor crossing over had been conceived. If evolution depended on natural selection then in its absence, he claimed, degeneration must occur, because "detrimental mutations are more frequent than beneficial ones." His solution was eugenic and combined the idealism of Galton's positive eugenics and the idealism of the early proponents of negative eugenics: "there would have to be both a partial or complete elimination of the lower forms and an acceleration of the multiplication of the higher forms." Like Jordan he believed that "the way to eliminate the unfit is to keep them from being born," but he rejected the view that the unfit were to be identified with the poor, "for the obvious reason that the present economic system is a very poor device by which to sift the worthy from the less worthy members of society."

The rationale for negative eugenics rests on the assumption of degeneration in an assumed relaxation of natural selection under conditions of modern civilization. Muller's justification of positive eugenics was historical: "If we could have had our way about it, would we have let the cavemen all rear offspring equally and thus have retained the world in the pre-Stone Age or to degenerate even further from that, rather than have let Natural Selection act to bring the world to where it now is?" A dedication to this goal would make the perfection of life the motivating basis for applying genetics to man. The features and attributes of this "nobler race of beings" are not definitely specified in Muller's eugenic system of 1910 but higher intelligence is implied in his eugenic credo, "mind makes might and might makes mind." There is also an expressed wish for the selection of emotional qualities, especially sympathy and love. To bring this to pass he advocated committees of scientists to judge and set tests for the selection of superior candidates who would then be encouraged to reproduce at a faster rate than the normal population. He hoped that values would change, resulting in the licensing of reproduction as well as the presently accepted licensing of marriage. He did not look upon multiple insemination by superior males as promiscuity; rather he argued that their motivation for improving man by differential reproduction was the reverse of egotism. The glorification of "commonness and chance and the status quo is an expression that we like to deify ourselves."

From 1911 to 1915 Muller focused on his genetic theories and experiments with the Drosophila group, especially the conception of coincidence and interference in crossing over, the development of marker stocks, and the analysis of complex variable traits through the isolation and mapping of modifier genes. At Rice Institute, in 1916, his first teaching position, he was asked by Julian Huxley, his Department Chairman and President Lovett to present two public lectures on the new biology. These speeches, "The Recent Findings of Heredity" and "Applications and Prospects" provided a much more

convincing case for the neo-Darwinian mechanism of evolution by natural selection. Muller saw in genetics the same potential for revolutionizing civilization as physicists were already predicting from their studies of the atom. The recognition of this power to transform society stirred Muller's eugenic idealism. "The central problem of biological evolution is the nature of *mutation*, but hitherto the occurrence of this has been wholly refractory and impossible to influence by artificial means, though a control of it might obviously place the process of evolution in our hands. Likewise, in physics, one of the most important problems is that of the *transmutation* of the elements, as illustrated especially by radium, but as yet this transmutation goes on quite unalterably and of its own accord, though if a means were found of influencing it we might have inanimate matter practically at our disposal and would hold the key to unthinkable stores of concentrated energy that would render possible any achievement with inanimate things. Mutation and transmutations - the two keystones of our rainbow bridges to power!"

Muller did not look upon the deterioration of the genotype as an immediate problem requiring alarm and sudden remedy; he claimed "it probably would be many thousands of years before much damage was done." He accepted the prevailing view that "the more shiftless, less intelligent, and less progressive members of our communities are actually reproducing at a higher rate than those of a more desirable type." While he still favored positive and negative eugenic measures to counter the "crumbling process," he emphasized that "most important is need for knowledge of what <u>is</u> inherited in man."

Muller's public discussions of eugenics then ceased while he cultivated his interest in mutation, chromosome structure, gene size and number, and evolutionary mechanisms. In 1925 he completed work on his book, *Out of the Night*, and presented it orally as a series of public lectures at the University of Chicago as a summer visiting Professor. He did not publish the book until 1935 because its strongly critical attack on capitalism and its enthusiastic endorsement of socialism, especially in the USSR, would have jeopardized his career at Texas. After Muller's decisive proof of the artificial induction of mutation in 1926 and 1927, he returned to his applied genetics. In 1928 he presented a talk on radiation protection to a Medical Society at Baylor and was berated for his claims that the medical uses of x radiation required caution and reexamination of techniques so that germinal material in patients would not be damaged. A second talk, to radiologists, was cancelled. The Wall Street collapse and the ensuing depression accelerated Muller's enthusiasm for socialism and the Soviet experiment. In 1932 he made a break with his tradition of public silence on political matters. At the Third International Congress of Eugenics, held at the Museum of Natural History in New York, he denounced the American eugenics movement for its racist and spurious elitist views. The reason eugenics made no headway was not faced by society. The stumbling block had to be assigned to "fundamental economic

forces." In capitalist society, he claimed, children were an economic burden to all classes and no incentive for differential reproduction would overcome the economic advantages of small families in such a society. Only in a classless society with optimal opportunity for education, welfare, and health of children, could the underlying genetic variation be expressed clearly enough for a successful eugenic program. To equate success, wealth, or family privilege with innate intellectual superiority was a fallacy. "There is no scientific basis for the conclusion that socially lower classes, or technically less advanced races, really have a genetically inferior intellectual equipment, since the differences found between their averages are to be accounted for fully by known effects of environment." He condemned the perpetuation of an environment which kept the impoverished from escaping their low status and which maintained the rich and powerful through a prevailing principle of "to him that hath shall be given." The presentation of this talk "the Dominance of Economics over Eugenics" in 1932 was bitterly opposed by the organizers of the Eugenics Congress; the time allotted for it was reduced and the paper was threatened with cancellation as being "primarily sociological." (MULLER 1932a). Despite these measures the paper made front page news and reflected, in a less Marxist form, the disillusionment with eugenics among intellectuals.

Muller left on a Guggenheim Fellowship that year for Berlin and, after Hitler became Chancellor of Germany, he accepted an invitation from N. I. Vavilov to be a guest investigator in the Soviet Academy of Sciences. He was exhilarated, at first, by the facilities and financial backing provided for his research and he developed a flourishing school of radiation genetics at Leningrad and in Moscow (CARLSON 1967). In 1934 he sent his manuscript of *Out of the Night* for publication by Vanguard Press. He hoped that it would stimulate reinterest in eugenics as well as enthusiasm for social reform to bring about a classless society. He advocated freedom from the bondage of pregnancy, including legalized abortion, public endorsement of birth control, and public programs and facilities for child care, especially for women desiring work or higher education. He sought to separate sexual enjoyment from reproduction, hoping that with new values women would accept the eugenic inseminations donated by "the greatest living men of mind, body, or spirit" while maintaining their love for their legal husbands. Artificial insemination in man was rarely used then but this seemed to be the best way to accomplish the insemination of several women by each such eminent male if a substantial portion of the population were to harbor eugenic conceptions. He feared that in most countries the mantle of eminence would be assigned to popular personalities such as sport figures, evangelists, and movie stars. Only when "individualism, careerism, charlatanism, unscrupulous aggression, and shallow hypocrisy" were abandoned as national values and replaced by "comradeliness and intelligence" would his eugenic system work. In the meantime he hoped biologists would perfect the techniques of artificial insemination in man and of the tissue culture of germinal material so that

such material could be preserved and would not be used "until, say, twenty-five years after the death of the donor."

Coincidental to the publication of *Out of the Night* was an unforeseen development in the Soviet Union. The freedom of scientific inquiry was gradually being eroded by the rise of T. D. Lysenko and his school of Michurinism which attempted to discredit, with the support of the popular press, the research and practical applications of Vavilov and his colleagues. Partly to head off the influence of Lysenko, and partly to show how much more promising formal genetics could be, Muller, in 1935 followed the advice of his friend, S. Levit, to go "directly to the top" in advocating his eugenic views (MULLER 1936b). A translation of *Out of the Night* was prepared by one of Stalin's secretaries and it was presented to him along with a letter of Muller's appealing to Stalin to permit eugenics to be "put, in some measure at least, to a preliminary test of practice." Stalin was enraged by the proposal and the book and he ordered reviews of it in the Soviet press to be stopped (MULLER 1937). Fortunately, by then, Muller had already left as a volunteer in the Spanish Civil War, thoroughly disillusioned by the purges and disappearance of Agol, Levit, and other soviet geneticists. He was always embarrassed by this incident and later in his eugenic thinking sought ways to prevent the error of relying on political dictate as the basis for a eugenic program.

The crushing destruction of the socialist ideals which Muller witnessed between 1935 and 1937 brought to an abrupt end any hope to stimulate eugenic thought. The mounting acts of racial persecution in Germany and Italy overshadowed any claims on idealism or appeals to human betterment by eugenic means. At the International Congress of Genetics, held in Edinburgh in 1939, Muller responded to a question addressed to the Congress "How could the world's population be improved most effectively genetically?" He reaffirmed the need for social progress before eugenics could be widely applied and denounced the racial or class prejudice usually associated with eugenic movements. He emphasized health, intelligence, and "those temperamental qualities which favor fellow-feeling and social behavior" as the attributes most valued for eugenics. The prospects for bringing these about had to wait until "men's minds are turned from war and hate and the struggle for elementary means of subsistence to larger aims, pursued in common." (MULLER 1939).

The war years and immediate post-war period made the Nazi terror too vivid an image for any return to eugenic thought. But in 1946 Muller's prestige was enhanced by his award of the Nobel Prize and he was now secure at Indiana University where he developed a flourishing graduate program. The devastation by atomic bombs in Hiroshima and Nagasaki stimulated renewed research in radiation genetics and Muller became a major spokesman for radiation safety. He also developed in 1949, a theoretical analysis of the consequences of mutation in man. His paper "our Load of Mutations" pointed out that any detrimental mutation spreads in inverse proportion to its harmful

effects. In so doing it reaches an equilibrium value, with its rate of elimination matching the origin of the detrimental allele by new spontaneous mutation. The elimination mechanism occurs through a higher than average load of mutations. All humans are subject, at conception, to this load, some being lucky in having few detrimental mutations and others carrying an excessive load. The load expressed itself chiefly through the small partially dominant effect of recessive mutations (about one to five percent). From this feature of genetic load Muller later estimated the damage which would arise among survivors of the atomic bombings in Japan and compare this to the spontaneous accumulation of mutations. This spontaneous rate, one new mutation per ten human gametes meant a natural disadvantage of 20%. The conditions of modern civilization permit most of these individuals to live past maturity, but at the price of increased disability requiring surgery, medication, excessive absenteeism, chronic illness, and mental disability and irritability. The failure to eliminate the new addition of mutations each generation, Muller believed, would result in a higher genetic load, a process which could be ameliorated on a short term basis but not indefinitely because "it would in the end be far easier and more sensible to manufacture a complete man *de novo*, out of appropriately chosen raw materials, than to try to refashion into human form those pitiful relics which remained." To avoid this penalty of a relaxed natural selection, Muller advocated the guidance of human reproduction through intensive education on the nature of gene mutation and its effects on man's future (MULLER 1950).

From 1949 on Muller returned to these twin themes of genetic necessity (now expressed quantitatively as genetic load through his extension of the Danforth equations) and of genetic idealism in going beyond the maintenance of our present load. His first warnings and advice were devoted to the problem of the genetic load, but in the late 1950's he returned again to the positive eugenic ideals of producing "children who are likely to be especially fortunate in their genetic endowment." He believed the world was "in fundamental agreement in attaching especially high value to service to one's fellows, that is, to cooperative behavior, and to wisdom."

At the second International Congress of Human Genetics in Rome, 1961, MULLER introduced his concept of "germinal choice." The successful use of artificial insemination (also referred to as AID or as therapeutic insemination) from frozen stored semen samples of outstanding individuals was now possible. The prospective parents would choose the sample from among the holdings of sperm banks with the same seriousness as adopting parents are known to exhibit when appearing at adoption agencies. This voluntary choice of eugenically sound semen samples, Muller believed, would be used by sterile males, parents with a risk of passing on genetic defects, and idealistic parents seeking genetically superior samples than they themselves could provide. The passage of time, in particular, would provide the best safeguard for wise use, with the biases of a previous day unlikely to be perpetuated to a later generation evaluating the overall worth of the contributors (MULLER 1961).

Germinal choice permitted a threefold separation of the functions of marriage. Love would be based primarily on companionability and sexual fulfillment; family size could be kept small, even by genetically well endowed parents, because germinal storage would guarantee future use of such genotypes; and finally, the quality of heredity in the children could be enhanced by the voluntary use of sperm banks. Muller rejected as unlikely, and too distant a possibility, the reliance on genetic surgery or genetic engineering as solutions to the problem of genetic load. He felt that the mere repair of gene mutation was too short sighted a goal. He refused to accept the fears of his critics who equated germinal choice with the elimination of human variability. If man did not fear cultural change in the arts and humanities, neither should he fear changes brought about by increasing the health, intelligence, and social responsibility of mankind through germinal choice.

Muller died without seeing a response to his appeals for either correcting the damage of genetic load or for endorsing germinal choice and its underlying philosophy of positive eugenics. His one last effort, a Foundation for Germinal Choice organized in California, he disavowed when he became seriously ill and he feared he could not guarantee the safeguards he wanted to prevent solicitations based on the spurious elitism and class biases of the pre-Depression American eugenics movement (D. MULLER 1972). Muller's role in eugenic thought rests consequently, on his theoretical contributions to negative and positive eugenics, especially the consequences of genetic load and the concept of germinal choice through sperm banks and therapeutic insemination.

EUGENICS SINCE MULLER'S DEATH

Since Muller died in 1967, no geneticist of Nobel Prize stature has taken over his credo. There are now available, since 1971, a few commercial sperm banks but these are based primarily on vasectomy insurance and infertility insurance, especially by fathers for their sons. Only one aspect of Muller's sperm bank has been endorsed by these commercial enterprises - the storage of semen for men in high risk occupations where sterility or mutation might arise. In the future such sperm banks might shift to a eugenic policy, but this would only be in response to the financial demand for such services. Muller's idealism was quite different; he wanted such sperm banks to be non-profit organizations with their eugenic functions as their main activities.

The reluctance to take eugenics seriously today requires a detailed explanation. The most recurrent criticism comes from readers of ALDOUS HUXLEY'S *Brave New World*. Huxley later apologized to his readers for offering them a choice between the insanity of the Brave New World or a lunacy of the natural reservations maintained by that society. But his main thesis, that science, left to its own successes and values, would reduce the freedom of the individual in proportion to the

comfort and efficiency of his eugenic and psychological well being, is firmly implanted in the reader's mind. The chief instruments of the Brave New World, however, were not applications of positive eugenics but cloning, psychological conditioning, and drug induced euphoria. It is ironic too, that in his later years Huxley sought and promoted the euphoric religious ecstasy of his soma milk shakes in the form of mescaline, LSD, psilocybin, and other hallucinogens (HUXLEY 1965). Even when germinal choice is presented with special care to avoid cloning and genetic engineering, the fear of a transformed society persists. The vision is represented as a stratified society, a stagnant utopia with a restricted choice of Einsteins, Mozarts, and Mark Spitz's frozen in their past accomplishments. It is the same disappointment of the imagination that greets the reader when he turns to the *Paradiso* after finishing Dante's *Inferno*.

If the fears of the *Brave New World* are largely psychological, rooted in a comfortable and narcissistic image of ourselves, then a eugenic program must offer a more detailed projection of its effects on future populations of the world. In the absence of such carefully envisioned consequences, the fear of the unknown, reinforced by Frankenstein legends, will predominate. This was true in the history of medical technology. Instruments such as stethoscopes, thermometers, and the speculum were rejected by many physicians because their use would reduce the patients to mere machines or create an unnatural relationship between physician and patient (MERZ 1912). Anesthetics for childbirth were resisted as blasphemy against a divine mandate for women to suffer in expiation of Eve's temptation of Adam. Riots broke out when inoculation and vaccination programs were first initiated as public health measures against small pox. All of these examples illustrate that new concepts frequently encounter resistance and fears of creating an unnatural human state at odds with the narcissistic familiarity of prior habits and values (HAGGARD 1929).

Yet values have changed, even in the few years since Muller died. The Supreme Court decisions on abortion and birth control will have far reaching effects on germinal choice. The sexual revolution in standards of speech, literature, and life style is so sudden that we have not yet realized its implications. The women's liberation movement, the fall of the American birth rate below replacement level, and the development of the pill and the IUD as birth control devices, are all reflections of how rapidly changes occur even in our most conservative values associated with family intimacy.

If values do change, suddenly as well as gradually, then the objections to eugenics can be examined for their implications against present and future values. These objections might best be studied as a series of questions with possible responses:

1. Will eugenics deplete the variability of the human genotype?

Haldane's analysis of the elimination of undesirable traits by rigid selection showed how slow a process it was to make a substantial reduction of the gene frequency in the population. The same principles of population genetics would apply to the introduction of beneficial mutations since far less than a fraction of one percent of the population in any generation would be receiving a semen source from a single donor. If a single donor's semen were used for a maximum of 100 inseminations throughout the world, this would constitute 0.00004 of one percent of the world's new zygotes. Even this estimate is high because the traits Muller advocated: intelligence, cooperativeness, and health are not the products of single genes. These quantitative traits may contain numerous modifier and chief genes for their expression. Furthermore, any one of these traits may have thousands of different polygenic genotypes giving rise to their optimal expression. A semen source, it should also be kept in mind, is not a homozygous source but is itself highly variable from the independent assortment or crossing over taking place in germ cell formation. Thus any use of sperm banks, even on such a widescale level as one percent of all inseminations (about 400,000 yearly in the U. S., involving the full time participation of several hundred sperm banks), would have only a slight effect on the variability for these traits alone. It should be noted, too, that the genes involved in traits such as intelligence or cooperativeness would be a small portion of the total number of genes for the total attributes of an individual. Finally, it might even be argued that use of germinal choice would increase the phenotypic variability for high intelligence and talent because these now constitute such a minor fraction of all humanity.

2. Would a germinal choice program foster the spread of dangerous genes in the population?

This fear is unfounded. If each sperm bank uses several thousand semen donors and the choice of a semen sample resides in the user, the chances of a widespread contamination is unlikely. This is supported by the time factor; Muller emphasized the importance of using frozen sperm over a span of generations. Thus the first few uses of such a sample would be monitored so that any evidence of high genetic load or a serious mutation (e.g., retinoblastoma, hemophilia, precocious heart attack) could be entered on the reference file for that sample and its use would be discontinued. There is no known mutagenic effect from the freezing process; nor is there any teratogenic effect from thawed semen. These conclusions are being extensively documented from the present applications of therapeutic insemination; Dr. J. K. Sherman, for example, has used semen frozen and stored for ten years to generate two normal children in 1971. His use of frozen semen for more than 100 pregnancies has shown no increase in birth defects, spontaneous abortion, or neonatal mortality when compared to natural reproduction (SHERMAN 1972). Nevertheless, research in the mutagenic effects of freezing and thawing, if any, in microbial and other good assay systems is very much needed.

Most important, of course, is the large number of potential donors for sperm banks. If genius and talent occur with a frequency of 1 in 4000 as Galton and Terman estimated, then one half million males, for this generation, would be available world wide (27,000 of them in the United States). It is not the solitary Einstein but the sizable community of intellectually gifted and talented males who would be encouraged to contribute to these banks.

3. Doesn't the history of eugenic movements prove that man lacks the wisdom to carry out a program of positive eugenics?

This is a serious worry. Muller learned that his prose was insufficient to sway political leaders, intellectuals, or laymen. The repeated abuse of eugenics by racists and naive reformers makes it difficult to revive eugenics as a social force. MULLER'S solution, arrived at in 1961, was the principle of voluntary use of sperm banks. He resisted the equally free principle of voluntary donation because he felt this would attract too many eccentrics and narcissists. This may have been a mistake, for if the judgment of the user is what counts, there would be vast numbers of unused samples in sperm banks under a principle of voluntary donation. As in natural selection but on a smaller scale, the vast population of potential genotypes would be rejected in favor of a smaller number of highly advantageous genotypes. Certain legal protections could help. The staffing of a sperm bank should consist of medical specialists and licensed personnel rather than entrepreneurs. Donors should prepare detailed medical and biographical records so that potential users would be able to make a choice based on their values and social preferences. It must always be repeated and reinforced that such semen samples do not guarantee a child of comparable abilities. Raising the odds from one in 4000 to one percent may not seem promising to the individual family, but when practiced by several thousand families the demonstrable increase in gifted, talented, and outstanding progeny would be striking. Most important to allay this fear of abuse is the self-correcting principle of gradual use of samples over extended periods of time. Here, too, legal restrictions on the frequency and intervals of usage could prevent potential abuse of semen samples.

The fears of creating a race of supermen, somehow lacking in humanity, are unfounded. The selection involved in such experiments would require millenia to bring about or they would involve practices other than germinal choice, such as universal cloning. Even if such fantasies were to be put in effect, an immense variability of interests, professions, and careers would still exist through the influence of environment as is well illustrated by monozygotic twins raised together or apart.

We seldom ask if man has the wisdom to change his values or culture, to elect his leadership or overthrow it, to live the life style of conventionality or its numerous denials and alternatives. We know he does not need perfect wisdom to live and we accept the failures of man's behavior with the knowledge

we can correct and alter most of the potential disasters before they become apocalyptic. We do not live in dread with the knowledge that the music, literature, politics, and values of our children and grandchildren will be different from our own familiar culture. We have learned to treat with distrust or amusement the illusion of a 1000 Year Reich or a Pax Romana. The dreams of dictatorial power are short lived, even when the dictator dies of old age. No tyranny can outlive the demand for novelty and change brought about by new generations.

Yet even when we admit the folly of believing that a social system can last forever, or at least for millenia, we frequently transfer that belief to the biological future. Somehow, we try to convince ourselves, genetic change through germinal choice will fall into evil hands and genetic tyranny will result, with genetically stratified hordes doomed to dull or exploited lives. Somehow the fear of biological change chases away from our mind all our knowledge of environmental determinism and the diversity that exists even for identical twins.

The safeguards of a gradual use of stored frozen semen and the maintenance of accurate records should allay these fallacies. As long as choice belongs to the users we have the security of parental caution in the avoidance of higher genetic loads or the perpetuation of an unforeseen and deleterious genotype.

THE INEVITABILITY OF EUGENICS

The biological condition of man supports the inevitable introduction of negative and positive eugenics. We begin life with a ten percent chance of being sterile, a five percent chance of being born with a birth defect, and a twenty percent chance of being aborted in the first three months of our embryonic existence. These are universal conditions for the rich and the poor of all nations, developed or underdeveloped. They represent, in part, the failures of meiosis and the chance shuffling of gene mutations, old and new.

There is a difference, however, between the survival of the new born today and in the past. The thesis which Muller advocated, a genetic load which would have killed 20 percent of such new born infants prior to their reaching maturity, may be tested by a study of the leading causes of death. This has its pitfalls because diagnosis has changed in the 20th Century and we may question the reliability of the classification of our causes of death prior to our own century. Even if we restrict our attention to the 20th Century, Muller's thesis is borne out. In 1900 six of the ten leading causes of mortality were infectious diseases. The number one killer, accounting for 12% of all deaths was pneumonia. Tuberculosis, almost 12% of deaths, ran a close second. Diarrhea of the new born accounted for an additional 8% of these victims. All three of these top killers were primarily acting on young

individuals, especially children. Even in 1900 diseases such as diphtheria claimed 2% of all recorded deaths. The role of infectious disease as a major cause of death in the U. S. began to diminish about 1910 with the switch to hospitals for the birth of children, the introduction of pasteurized milk, and the urban programs of visiting nurses to assist the parents of new born infants. By 1935, the midst of the depression years, the chief killers were heart disease, cancer, and pneumonia. Tuberculosis dropped to fifth place and the serious pathogens among children were largely eradicated by public health measures and compulsory immunization laws. The introduction of antibiotics in the 1940's removed pneumonia from its previously high standing leaving heart disease, cancer, and strokes as the major causes of death. It also permitted the gradual recognition of birth defects among the 10 leading causes of death. Prior to these medical developments such children died of infectious diseases before their genetic abnormality could be explored and determined. Today we still retain heart disease, cancer, and stroke in the top three positions, accounting for 66 percent of all deaths (GROVE 1973). These are, of course, the mortalities of the aged, those who have already reproduced and passed on their genotypes to the next generation and their causes of death do not play a selective role in maintaining the genetic load at a status quo.

The importance of infectious disease as a selective agent is illustrated by the history of epidemic diseases in the United States. It was not uncommon for small pox and diphtheria to kill ten percent of the children in a city such as Boston or Philadelphia during its recurrent epidemics in colonial times (DUFFY 1953). What is forgotten, however, is the *differential* mortality it expressed. Several siblings would be infected in a single family but only one might die. If we assume that a higher genetic load constitutes a greater risk of dying from such an infectious disease, then we would have to assign to these childhood mortalities a major route for the elimination of excess genetic load. The expectation of having a large family with the hope that two or three will live to maturity was common before the 20th Century in the U. S. and Europe and still exists in those undeveloped countries of the world where modern medicine and public health measures are still scanty.

MULLER'S problem of genetic load is primarily a 20th Century problem. The *status quo* before then was not appreciably altered and the increments of new mutations each generation were successfully eliminated through infectious diseases and malnutrition. If each generation of reproduction adds one new mutation for every ten gametes, then a failure to eliminate an equivalent number of individuals before maturity produces an increment which must be added to the average load in man. Muller estimated this average load as equivalent to eight detrimental genes. Thus two or three centuries of living under conditions of modern medicine would have the effect of doubling the genetic load. This would be equivalent, he believed, to a

whole body dose of 75 roentgens applied to every living human being. The result, it is important to emphasize, would not result in monsters, but in a rise of the same ailments familiar to us now, but more of it in each family.

If Muller's view of genetic load proves to be correct there is no question that compensatory action will be taken sometime during the course of the next few generations. Those who favor today's values of the unrestricted right of natural reproduction accept the tolerance of the genetic load through the somatic repair of the phenotype. The euphenic or phenotypic repair can only be maintained on a short term basis (about a millenium) before the number of accumulated defects reaches such a high level that it defies the energies, resources, and imagination of medical practitioners. Another segment of the population is willing to accept some vaguely administered genetic repair to the germinal tissue (presumably *in situ* by injection of virus-carried transducing fragments replacing mutant allelic regions). Such speculative schemes are usually based on the assumption that single gene defects rather than polygenic genotypes are the basic concern for genetic load. Ideally, it awaits the development of a technological marvel, such as a miniaturized apparatus with appropriate nucleotide scanners which surveys each sperm as it passes through a eugenic gel in an electrophoretic diaphragm, trapping all major departures from an average genetic load. Whether such applications of Maxwell's demon can ever be accomplished by the genetic engineers of the future is a prediction beyond the implications of present technology.

It is more likely that germinal choice and not genetic surgery will be used in the next few generations as a response to genetic load. This can be predicted from the present trends in sexual values. The combination of publicly accepted birth control, the wide variety of chemical and mechanical devices to regulate conception, the liberalization or elimination of abortion laws, and the increased acceptance of premarital sexuality under conditions of strict birth control are sharply reducing the number of available babies for adoption. Yet the constant biological condition of ten percent permanent sterility in married couples creates the inevitable situation that most childless couples will not be able to adopt children. In half of these couples, where male sterility exists, the option for therapeutic insemination exists. Unfortunately germinal choice does not exist for these couples. They are supplied with a semen source by a physician who prefers not to reveal who the donor is, thereby preventing a check against the spread of a deleterious genotype. The physician usually chooses a medical student as a volunteer donor on the assumption that such a student has better than average health and emotional stability. How extensive an interview is carried out is not known nor are such interviews uniform in their depth of analysis of familial and individual traits. Few parents have the advantage of selecting from a file of potential donors or knowing that an option for germinal choice exists.

This is in sharp contrast to the adopting parents who have been to adoption agencies. There the parents, when the supply

of children was abundant, were given files on the children with detailed medical histories, ethnic backgrounds of the natural parents, and those social habits which might be of concern to the adopting parents, such as drug addiction or use of L.S.D. by a natural parent. In the State of California, the only feature not permitted entry on the child's file was incestuous origin on the grounds that this was too stigmatic a psychological burden for either the child or the adopting parents to know. Yet this is the most important fact for a parent to know about the genetic condition of the infant. Even for today's declining population of adoptable children, the prospective parents can discuss in detail the traits and medical background of the child available for adoption.

Because of the gradual disappearance of unwanted children as sources for adoption, there will be an increase in therapeutic inseminations. At first these will constitute a negative eugenic source for counteracting the genetic load. The donors at present are a non-random sample of the population and even a brief medical examination and interview by the physician provides donors with lower genetic loads than average. As public awareness of the change in adoption habits increases, there will be more concern by parents for the controls they, as parents, demand for the quality of the semen source to be used. Medical specialists in fertility can be effective in initiating the guidelines used for donor selection and in making known to the parents the choices available to them.

Muller's three criteria for germinal choice, good health, high intelligence, and socially responsible cooperativeness were based on his belief that we owe our culture to the contributions of genius and talent, and these represent only a small portion of all humanity. He believed that individuals should have a full lifetime to develop their potentials and that a society at peace can best be fostered by feelings of mutual love and respect rather than by a balance of power reflecting human aggression (MULLER 1967). Each of these assumptions should be examined carefully.

The major components of our culture - our governments, business activities, professions, sports, arts - may not depend on the high intelligence of Galton's men of eminence. This could be a valuable sociological study if carried out extensively. The IQ's of M.D.'s, lawyers, and Ph.D.'s in the United States average about 130. The relation of IQ to high creativity in the arts is questionable. In Terman's study of 1000 gifted children few of those studied entered the arts and humanities or became writers, musicians, painters, or actors. Most became scientists, lawyers, scholars, and business men. In contrast, the 400 eminent persons in the 20th Century studied by the Goertzels included a significant portion of creative personalities. In the Goertzel study the average IQ was 127, in contrast to the Terman gifted children who averaged 140. Terman's gifted students also came from stable middle class homes in contrast to Goertzel's eminent figures who came mostly from troubled homes.

Except for individuals of unusually high IQ (150 and up) the genetic contribution to social success, professional achievement, and contributions to society may be of less significance than the challenges of the home environment. This is important in evaluating the positive eugenic values of potential donors. Slow or insignificant increases of intelligence in the progeny from therapeutic insemination would be expected from the usual medical student source for donors. Prominence or social status would also be a poor guide for selection of intelligence. Peer evaluation, such as Nobel Prizes, membership in the National Academy of Science, Pulitzer Prizes and Distinguished Professorships would reveal a large proportion of the highly intelligent or highly creative. This is borne out in the studies of Roe, who tested the IQ's of members in the National Academy of Sciences and found them to average 165.

Studies of both genius and subnormality indicate that only a small fraction of all humanity, if raised in middle class values and living standards, would have IQ's below 70 and above 150. This is seen strikingly in the comparison of subnormal IQ's of white British middle class and white British poor, carried out by Huntley. The virtual absence of the 55-70 range in the middle class and the identical frequency of the 0-55 range in both groups, indicates that only the retarded in the low IQ range manifest strong genetic and biological components in their disabilities (MEADE and PARKES 1966).

There may be genetic components which distinguish IQ's of 100 and 120 or of 120 and 140; if so, they are difficult to evaluate. Environmental influences on the child were studied by Muller in 1925 in a pair of identical twins raised apart. In his study, despite the 4 years of elementary schooling for one twin and the completion of high school for the second twin, the high IQ's (over 150) of both twins contrasted sharply with their difference in occupations and social values. Newman, who extended such studies to many pairs of identical twins,raised apart, found as much as a 20 point IQ difference when the twins had strikingly different environments. Current estimates of heritability of IQ vary from 40 to 80 percent.

Quite apart from the precise hereditary component in intelligence is the degree, if any, of deterioration from genetic load. Eugenic patterns in society already exist without an intentional design to promote eugenic reproduction. Coeducational colleges foster marriages of couples with higher than average intelligence and studies of parents usually show an assortative mating pattern: brighter people have better than random chances of marrying bright partners. Urbanization intensifies the assortative mating preferences. Individuals who are retarded have difficulty marrying or marry later and thus tend to produce less progeny than the average. The seriously retarded are often segregated from society and are thus removed from the breeding pool. Such social factors should be taken into account in measuring the necessary rather than the idealistic aspects of a eugenic program for increasing intelligence.

This is quite different for longevity and overall health because genetic load in a modern society is likely to express its major disabilities in the mature years of an adult (from 30 to 50 years) after he has formed his family. Thus the deteriorating effects of genetic load on health are not offset by delayed marriage or the social stigma of being sickly. To some extent individuals with a high genetic load may express this through an unusually high rate of hospitalization or medical care or through surgery prior to maturity. In such cases the indispositions of the individual may thwart his own or his companion's desire for marriage and thereby serve an unplanned eugenic function. Studies of assortative mating patterns for longevity and general health are much needed to measure the effectiveness of these differential reproductive habits.

It is the concern and mutual interest in society through cooperativeness which is the weakest component in Muller's positive eugenic system. There is divided opinion on the heritability of human aggression. Lorenz, Ardrey, Morris, Storrs, and many scholars in ethology have presented evidence, primarily by analogy, for the inheritance of human aggression. This has been an indirect approach, tied to diverse evolutionary theories on human societal development in the stone age. There have been few attempts to measure aggression in man or to design tests which attempt to measure intrinsic aggressive responses rather than socially conditioned responses. Many anthropologists and other scientists have challenged the claims of innate aggression and the debate is unresolved (MONTAGU 1968; GORNEY 1972). Even more controversial is the complementary view of mutual aid, cooperativeness, and gregariousness as a genetically determined trait. There is little doubt that in mammals both aggression and cooperativeness can be selected through breeding as is demonstrated by studies of domesticated species of cats, dogs, cattle, rodents, or mink. Lacking for man is any quantitative measure of these traits and the attempt through twin studies and other approaches, to estimate the genetic components in their development. There is likely to be a strong assortative mating preference in these two traits which should be considered in evaluating the need for eugenic compensation or redirection.

Even if we grant Muller's assumption of the heritability of innate aggression, the most serious objection to cooperative behavior as the primary need for a eugenic program, is the time involved in bringing an overall reduction in human aggression. If it is a highly polygenic system then it may require dozens of generations of selection before the gregarious temperament predominates in society and war as a side effect of aggression no longer constitutes a threat to society. Whatever the causes of war and their relation to the theory of innate aggression, the world cannot wait centuries for a genetic solution to its chief problem; and short of cloning a few thousand individuals with unusually sympathetic and benevolent characters on an immense scale, no eugenic system could bring about a replacement of aggression within one or two generations.

If this overall assessment is valid, Muller's pleas for eugenics should not be ignored. The problem of genetic load cannot easily be answered by genetic surgery, nor can it, indefinitely, rely on phenotypic repair of the soma as a solution to genetic damage. Of Muller's three choices for inclusion in a eugenic program of germinal choice, human health remains the most compelling reason for its introduction as a medical measure.

There does not seem to be a compelling reason to initiate negative eugenic programs for intelligence and cooperativeness because there is insufficient evidence to show that there is a genetic decline in human intelligence or a genetic increase in human aggression. While the *necessity* for such programs may be lacking, the *desirability* for initiating them, especially from the most intelligent and humanitarian individuals in society, is a value that should be made available to those who presently must use sperm donors as the source of their future children. At worst the voluntary adoption of germinal choice would do no more than maintain the present equilibrium of genetic load; at best it can provide the slow and gradual spread of genetic components for a healthier, brighter, and more compassionate world.

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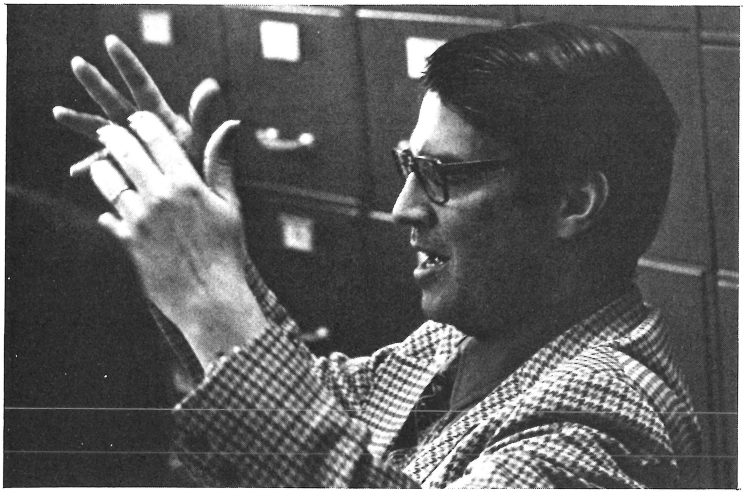

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