THEOLOGICAL IMPLICATIONS OF MODERN BIOGENETICS

by Hans Schwarz

When Aldous Huxley wrote his *Brave New World* in 1931, he dated the predicted events in the book to the sixth or seventh century A.F. (after Ford). Meanwhile our knowledge has increased in the field of human genetics so incredibly—it doubles every seven to ten years[1]—that in less than fifteen years Huxley had to admit in his book *Brave New World Revisited* that his visionary prophecies would become true much sooner than he had anticipated in 1931.[2] The picture which Huxley painted for us in *Brave New World* is an almost shocking vision of our immediate future: computerized breeding of mankind, chemically induced happiness, and methodological conditioning. In this essay I want to deal with biogenetics in a less visionary way. I will outline the possibilities and limits of modern biogenetics as far as they are applicable to man and question whether they bear any theological significance. Of course, it is almost impossible to treat these complex and much debated topics and at the same time present the immense amount of biological and genetic findings and manipulations,[3] especially in the confines of a short paper. But even at the risk of having some call this treatment superficial, such a treatment has to be ventured. If we hesitate any longer to interpret theologically the facts and possibilities of our surrounding world, a world which is largely dominated by applied sciences, then we need not wonder why this world does not care about us and goes its own way.

The question, however, arises at once if, in talking about biogenetics, we are dealing with utopian dreams. This concern is especially justified when we notice that some theologians get carried away with utopian projections, which they call secular variations of apocalyptic thinking. We will see that some of the biogenetic projections are indeed wishful thinking. But most experts will agree that biogenetic eugenics is an inescapable necessity for human self-preservation. The Swedish eugenicist Müntzing, for instance, points out that in a highly civilized country such as Sweden approximately fifty thousand people are under permanent care in homes or hospitals because of mental or physical

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defects. And there are another fifty thousand who are cared for by private means. This means that approximately 3 percent of the population have such a low level of intelligence that they are either entirely incapable of productive work or have other difficulties in taking care of themselves.[4] What is the reason for this amazingly high rate of serious genetic defects? One of the reasons can be found in an unequal birth rate. Members of the lower social classes usually have more children than those of higher social classes.[5] Perhaps people with greater foresight, and those with keener regard for their family, aim to have a lower-than-average number of children so that they may obtain higher benefits for the children they bear as well as for themselves and others near to them; while less skilled, less farsighted, and less careful people are unable to keep the number of their children at the intended level.[6] The other reason for a deterioration of the genetic heritage can be found, paradoxically, in the progress of medical research. Hoagland affirms that human medical practice is a greater threat to human heritage than radioactive pollution because it preserves the life of people with genetic defects who in past years would have been victims of natural selection.[7] Disregarding all ethical consideration, it would usually be disadvantageous to eliminate these people by refusing medical help to them because often they are valuable citizens intellectually and artistically. Thus they hand down their genetic defects to the next generation. The kind of chain reaction which is caused by this can be exemplified if one remembers that approximately 20 percent of the human population has inherited a genetic impairment that arose by mutation in the immediately preceding generation. To this have to be added the far larger number of defects which are inherited from former generations.[8] Until recently a natural balance was achieved, since approximately 20 percent of the population did not survive to maturity or, if surviving, did not reproduce because of these genetic defects.[9] Modern human medicine, however, can keep 0.9 of this 20 percent alive and also allow this group a normal rate of procreation. This means that in the next generation 18 percent of the defects will have originated in the immediately preceding generation, while another 20 percent new genetic defects must be added; the latter, fortunately, will coincide to some degree with the preceding 18 percent. Steadily improving medical practice, however, in the long run cannot counterbalance this deterioration of the genetic pool. Yet, a new balance may be regained after a corresponding increase in the number of defective genes. This new balance presupposes a steady progress of human medicine; that is, if one would remove the vital crutch of medical treatment, only few would be able to live and to procreate. Medical

interference has suppressed the principle of natural selection and thus forces us to steady medical progress. This progress is, in the last analysis, only a brutal struggle for survival and not true advancement. Hence the question arises whether "heroic deeds," such as organ transplants for young people, are not ultimately a disservice to mankind, because they preserve people for procreation whose defective genes and the ensuing life-impairing diseases are handed on to the next generation.[10]

Confronted with this situation, there are three possibilities.[11] (1) We could continue present medical practice and extend help to everyone who desires it. With this we would enable most people to survive and to have children of their own. This would also mean that we would contribute to a steadily increasing pollution of the genetic pool and, according to some estimates, within five to ten generations (75–150 years) one out of ten children born would be seriously defective in one way or another. (2) We could limit the current medical practice to those people who have already reached the age of procreation, and thus we could again eliminate to some degree severe genetic defects through natural selection. (3) We could try to influence the genetic heritage of man through genetic manipulation.

While the first possibility seems to be irresponsible and the second inhuman, the last one sounds promising. Genetic manipulation offers advantages for the present generation, and it promises a responsible attitude toward future generations. Muller already emphasized that human reproduction cannot be considered only under the aspect of self-glorification and self-satisfaction—though it is this too—but must be considered also under the social aspect of the well-being of the children and of the following generations.[12] That genetic manipulation is not a panacea will be evident when we consider the possibilities and limits of modern biogenetics.

Possibilities and Limits of Modern Biogenetics

Genetic Basis for Defects. The insight that many so-called diseases also have genetic causes is constantly affirmed by a more accurate study of the genetic code and of the hereditary laws. Man is a unity, and his genetic potential interacts with his environment from the moment of conception to the time of death.[13] Almost all diseases, including so-called mental ones, can be regarded as part of the total biological-physical world. Disorders or deviations which can be called either "disease," "sin," or "crime" are results of natural forces which are made familiar to us by the physical, biological, and social sciences. This does not mean that all deviations have genetic causes, but in most cases

one can speak of a genetic disposition or even necessity. Approximately 80 percent of the different types of imbecility and feeblemindedness have genetic causes; and of the mental diseases the most frequent ones, that is, schizophrenia and manic-depressive psychosis, have a genetic basis.[14] An abnormal number of sex chromosomes result in mental retardation. The XXY constitution is accompanied by different degrees of imbecility, while XO deficiency results in a special kind of space-form blindness which evidently does not affect knowledge and understanding.[15] Another kind of mental retardation, mongolism, was discovered to be a triplication of one of the smallest chromosomes (apparently no. 21), and mongoloid people have forty-seven instead of forty-six chromosomes. Through defective separation of chromosomes the characteristic features of mongolism appear. This kind of defective separation of chromosomes (XXY and XO constitution evidently also due to defective separation) is not inheritable.[16] Although children with the trisomic-21 syndrome are born to normal parents, the mother is to some degree the cause of this abnormality. With increasing age of the mother this kind of mongolism increases steeply.[17] Another kind of mongolism with forty-six chromosomes is caused through translocation of chromosomes or parts of chromosomes and will be inherited, on the average, by half of the offspring. Altogether we know today more than five hundred dominating traits which we can regard as defective.[18] There is almost as large a number of recessive defective traits known today, for example, cystic fibrosis and muscular dystrophy.

A very interesting kind of doubling of chromosomes which could have sociological, legal, and ethical consequences is the phenomenon of an extra Y chromosome (the Y chromosome determines the male sex) which causes unusual growth in height and strong aggressiveness.[19] At the State Hospital in Carstairs, Scotland, a hospital for treatment of dangerous, violent, or criminal patients who require special security,[20] 315 of the 342 inmates were examined. All but ten had a previous criminal record, and 253 suffered serious personality disturbances of unknown cause. Sixteen, or 5.1 percent, of the 315 examined had an abnormal number of chromosomes. Nine of them had a forty-seven XYY constitution, one a forty-eight XXYY, one a forty-seven XXY, and one a mixed constitution (46 XX, 47 XXY, 48 XXXY); four men had other abnormal chromosome constitutions. The frequency of the XYY deviation in this hospital was at least fifteen times higher than with newborn baby boys outside this institution. Physically the XYY deviators showed no abnormalities, except that their average height (181.2 cm) considerably surpassed that of the other inmates with only one Y chromosome (170.7 cm). On the average, their first criminal

offense had been committed much earlier (age 13) than that of the other inmates (age 18), and they had not responded favorably to punitive or corrective measures. They also demonstrated an absence of genuine remorse or guilt, a limited capacity for affection, and an inability to establish meaningful interpersonal relationships.

Confronted with these facts, it seems almost irresponsible not to respond with some sort of preventive or corrective action. The first and most logical possibility is that of the eliminative eugenics which attempts to correct disadvantageous constellations already present and/or to avoid them in the future.

Eliminative Eugenics. If the genetic constitution of all prisoners were examined, one could at once seek out the ones who, according to their chromosome constitution, would be inclined to become criminal again, and one could place them under permanent supervision. Another promising possibility was discovered in an experiment at the Center for Research in Personality at Harvard University.[21] The effects of psilocybin, a drug similar to LSD, were studied on a group of prisoners of the Correctional Institute in Concord, Massachusetts, who agreed to participate in these experiments. The new insights into themselves and the world surrounding them which were gained through use of the drug in group sessions were discussed with the inmates by a group of psychologists who also participated in the experiments. In the course of these experiments some even experienced classical mystic "conversions." Twenty-four of the inmates had been on the street an average of ten months (1963). Although the expected return rate of ex-convicts to this prison after eight months was between 50 and 70 percent, so far only 25 percent had come back; and they were charged only with technical parole violations such as drinking and failure or inability to find and hold a job.

Aggressive behavior resulting from chromosomal abnormality can also be influenced by drugs and through brain surgery. Most of the research, however, is still in the status of animal experimentation. For instance, it has been reported that cats treated with chemical agents developed for chemical warfare became afraid when they saw mice.[22] Experimental brain surgery on monkeys eliminated most reactions of fear and anger, without gross motor or sensory deficiencies.[23] The animals still could express anger and rage in response to appropriate stimuli, but they were rendered remarkably docile and fearless, and their behavior was accompanied by a reduction in sexual activity. Through another type of brain surgery they could be turned into vicious animals. In similar experiments (frontal leucotomy) on humans, mentally disturbed and aggressive patients became much easier to take

care of, and many were able to take part in the social activities of the hospital, to their great benefit.[24] When later, however, some of these patients were able to return home to their families, people who had been close to them noticed a change in their personality. They had become less truly affectionate and less considerate. They also tired much more easily, were quickly irritated, and were less able to concentrate or sustain mental activity. They were also lacking in all social sense and were unable to plan ahead. By now this has become a general pattern of the postleucotomy. This example shows that positive results may be counterbalanced by negative effects. Furthermore, the elimination of negative characteristics need not result in a positive outcome. This is fairly typical for the whole realm of eugenics.

Beside these attempts which are limited to the elimination of mental and psychic defects, we also have to deal with the treatment of genetically caused physical defects. Without doubt the most spectacular experiments in this direction are organ transplants, from kidney transplants to heart and lung transplants. Beside the large teams of doctors involved and the complicated technical apparatus needed for such operations, there exist many other problems. Except in organ transplants between identical twins, the body of the patient forms antibodies and tries to eliminate the foreign tissues. Thus, using drugs or radiation, it is necessary to destroy the recipient's ability to produce antibodies. As this eliminates the ability to fight off bacterial infections, one has to load the body with high doses of antibiotics. Nevertheless, more people die after kidney transplants through subsequent infections against which they have lost protection than through the actual operation involved in the transplant.[25] The "abolition of immunity to transplants introduced in early life,"[26] which Lederberg calls for, would not be very beneficial because it would only increase the danger of infectious diseases. Much more promising seems his proposal of a systematic registration of all organ transplants, so that one has at once a survey of the present stand of this technique, and one is able to develop it accordingly.[27] A much older and more reliable way is that of organ prostheses. Arm and leg prostheses and synthetic heart valves, arteries, parts of bones, and electric pacemakers are only a few of the multitude of exchangeable parts which are available. A big advantage with prostheses is that they are generally not rejected by the human body. Another very promising possibility which is still in the infant stage is the so-called organ breeding. Organs may be bred through clonic reproduction—nonsexual reproduction of body cells—so that the resulting genetic material is identical.[28] Thus one would no longer need to rely on organ donors, and the problem of immuniza-

tion reactions would also be eliminated. Although it is already possible to grow human tissues in cell cultures, the main difficulty seems to be that after a few divisions the cells are unable to regain their ability to differentiate the specific positions which they are going to hold within the whole developing organism, and thus they degenerate.[29] In experiments with plant cells the ability to differentiate was regained through certain chemicals, but the results varied from experiment to experiment. Though this kind of organ replacement still encounters unconquered difficulties, it seems to point in a very promising direction.

So far we have confined ourselves to that field of eugenics which tries to eliminate already existing defects for the present generation. But now we have to investigate the attempts which are made to avoid defects which are inflicted on future generations. The easiest method is genetic counseling of parents before they plan to have children.[30] If there exists a dominant dangerous trait among relatives, the decision is relatively easy. No partner can carry this trait unless it shows itself in its effects. If one of the partners, however, is afflicted by a dangerous dominant trait, the chances are fifty-fifty that the children will also inherit the deleterious trait. Things are more complex when the dangerous traits are recessive[31] and when the danger becomes evident only if both partners have the same gene constitution (homozygosity). The statistical evidence that such and such a percentage is affected by a disease traceable to a certain recessive gene constitution is not much help in this kind of genetic counseling. Hereditary laws also tell us that parents with a child who is stricken by a disease because of a homozygous recessive constitution have a 75 percent chance that their next child will be healthy. Healthy brothers and sisters of such a child have a 33 percent probability they are free of such a recessive trait and a 66 percent certainty they are heterozygous carriers of this recessive trait. Fortunately, one need not just sit and wait for homozygous cases and for the resulting hereditary probability to predict when the dangerous trait will strike again. Today we can already detect clinically nineteen different recessive genes even before the first defective child is born.[32] The tests are not yet developed well enough for one to obtain accurate results in all cases. For instance, in the case of the recessive trait which causes cystic fibrosis, one can give definite answers only in 60 percent of the cases. But it can be assumed that there will be more progress in this field.

Biogeneticists, however, do not confine themselves to detecting defective constitutions; they seek to change these very constitutions. In animal experiments inherited anemia can be cured with transfusions of normal cells from bone marrow.[33] Yet, with man the same problem

occurred as in organ transplants: the injected cells were rejected. Another possibility is a change in the reproduction cells themselves. Due to the immense number of male sperm cells this seems impossible with man, but women ovulate only from five hundred to one thousand eggs during their reproductive period. It seems feasible that one could repair at least some genetic abnormalities in this relatively small number of cells and replant the cells afterward into the ovaries and let them develop.[34] Apart from the technical difficulties with which these experiments are confronted, two big problems emerge. First, the genetic system of man is so immensely complicated that we can neither identify nor locate all genes.[35] Accurate localization, however, is mandatory for genetic corrections. Second, although accurate localization could be regarded as one of the technological difficulties which can be overcome, it still seems as if, from a technological point of view, specific genetic transformations are far away.[36] This is even more likely because the genetic constitution of each living being is singular, and genetic characteristics are differently interconnected among different species. For instance, through accidental virus infection it was discovered that a certain virus stimulates the human body to increased production of arginase, a ferment which when missing in the human body causes severe cases of mental retardation.[37] When rabbits were infected with this virus, not only was their arginase production increased way above the normal level as in man but they also contracted lethal skin cancer. In man, however, infection with this virus does not seem to have any disadvantageous consequences. Yet, more accurate predictions are possible only after several generations. This means that in the last analysis man himself has to serve as his own guinea pig on whom to test whether certain genetic defects can be repaired. Much safer is a method which Leroy Augenstein suggested for the state of Michigan and which he called Genetic Early Monitoring System.[38] According to him each doctor who treats a child suffering from a disease which seems to be traceable to a known genetic defect should send this observation together with all available information to a central place. In this center valuable statistical material about the hereditary spread of diseases could be collected. Furthermore, the center can give to the doctor involved the latest information about this disease. Thus the present generation would profit through treatment and future generations through possible voluntary limitation of reproduction. But many scientists are not satisfied with these prospects. They want not only to correct defective genes but also to change the phenomenal appearance of man. Joshua Lederberg, Nobel prize winner for medicine in 1958 and professor of genetics

and biology at the School of Medicine at Stanford University, Palo Alto, California, coined for this endeavor the term euphenics.[39]

Genetic Euphenics. Molecular biology can lead to an understanding and finally to a control of human development.[40] The engineering of human development would be effective much more quickly than development through planned breeding.[41] The possibility and probability of a natural human development is admitted even by scholars who are not involved in euphenics. For instance, the German neurologist Hugo Spatz argues that the outer parts of the human brain seem to be the youngest.[42] Brain parts which are still impressible in the human skull are in a process of expansion, and they have not yet completed their evolutionary process. As this is especially true for the basal neocortex of the human brain, a cerebral increase of efficiency seems to be possible. In a much more speculative way, Teilhard de Chardin claims: "With the discovery of genes it appears that we shall soon be able to control the mechanism of organic heredity. . . . We may well one day be capable of producing . . . a new wave of organisms, an artificially provoked neolife."[43] One starting point for genetic euphenics seems to be the human brain. Thus by prenatal or early postnatal intervention the size of the brain could be regulated. It is surprising how little experimental work has been done to test some elementary questions on the hormonal regulation of brain size in laboratory animals or the functional interconnection of supernumerary brains.[44]

A vast and fairly unexplored field seems to be the change of brain functions through biopharmaca. It is commonly known that male hormones influence masculinity and courage while additions of female hormones increase the motherly instinct.[45] It can be assumed that within the next fifteen years psychotropic drugs will be available for everybody through which feeling can be deepened and varied.[46] Already we know four different groups of psychopharmacological agents which primarily influence human feelings.[47] There are first of all stimulant drugs, such as ephedrine, which decrease fatigue under certain conditions. However, they have some undesirable side effects on the central nervous system. Then there are antidepressant drugs, such as iproniazid, which may produce euphoria, increase verbal productivity, speed reaction times, and otherwise act as stimulants. They are mainly used in combating severe depressions of mental patients. Third, there are tranquilizers, such as chlorpromazine, which are employed in the treatment of disturbed mental patients including schizophrenics. Finally, there are weak tranquilizers and sedatives, such as meprobamate, which relieve neurotic anxiety without producing the sedative effects of barbiturates and bromides. There is also a group of

psychoactive drugs which causes transient psychotic states. These include the already mentioned psilocybin, then mescaline and LSD-25 (lysergic acid diethylamide) to name a few more! Some of these drugs were used in ancient times for religious rites and are used in experiments today to produce model psychoses in normal persons. However, the physiological and psychological side effects, especially of the extremely strong-acting LSD-25, are not yet sufficiently understood.[48] Some side effects—for example, an increase in the mutation rate of the offspring—seem to be irreversible.

There are also medicaments in the experimental stage which increase the ability to learn and the inclination to be influenced. Here a new problem seems to emerge. If such drugs were to be added to the public water supply, a whole population could be exposed to "brainwashing." Yet we should remember that during the colonial period Americans used intoxicating beverages to break the resistance of Indian tribes and that oriental despots employed opium in a similar way.

Another starting point for genetic euphenics is human procreation. More than thirty years ago parthenogenetic procreation (this means procreation without the male sperm) had been successfully conducted with rabbits.[49] The young rabbits had only the characteristics of their mother. But this is no actual progress because one does not go beyond the genetic heritage of the mother. Much more far-reaching is a series of experiments, conducted in the fifties, in which the cell nucleus of frog eggs was replaced by another nucleus upon which the eggs were parthenogenetically fertilized. If one would apply this method on man (which does not seem to be too difficult), the resulting children would be as similar to their genetic parent and to each other as identical twins. Neglecting the influence of the environment, their pattern of conduct would be predictable to a higher degree than is possible with normally procreated children because of the genetic influence of only one parent. Due to their similar genetic constitution the children could learn from the mistakes of their parent—for instance, in training for a certain profession. A far more promising possibility for the future was discovered in working with bacteria. When DNA (desoxyribonucleic acid, the determinator of the genetic code) was extracted from one kind of bacteria and purified and infused into another kind, this second strain adopted certain characteristics of the former. Although the experiments have been successful with different strains of bacteria, thus far they have failed with higher living beings.[50] Again this kind of euphenics seems to lie in the distant future. Similarly, breeding of men with three or four sets of chromosomes seems to be a very remote possibility.[51] Where such triploid or quadruploid sets of single chromo-

somes has occurred (compare the above-mentioned), there it always had deleterious effects. Muller's prediction—that "for a long time yet to come (in terms of the temporal scale of human history thus far), man at his present best is unlikely to be excelled, according to any of man's own accepted value systems, by pure artifacts"[52]—seems to be justified. But Hermann J. Muller (1891–1966), 1946 Nobel prize winner for physiology and medicine and professor of zoölogy at the Indiana State University, also wanted to influence the genetic constitution of man. For over fifty years he advocated artificial insemination as mankind's first step toward controlling his own future development.[53]

Sperm Banks. Artificial insemination has the economic advantage of being relatively inexpensive and the technical advantage of being easy to administer. Estimates claim that already five to ten thousand children are engendered in the United States each year through artificial insemination.[54] Artificial insemination through a donor (AID) is not only used to circumvent the husband's sterility, but more and more frequently it is used by couples where the husband carries, or has a strong chance of carrying, some grave genetic defect or a constitutional trait that may be incompatible with a trait of his wife (for instance, the same recessive defective gene). There are also several banks of frozen human semen now in operation. A method has been developed by which one can store deep-frozen spermatozoa virtually indefinitely without deterioration. According to Muller the selection of the donor should not be left to chance; the sperm should be from donors with superb abilities and faculties. Free choice should be guaranteed through a multitude of sperm banks. But a choice is not a real one unless it is a multiple choice, one carried out with a maximum foreknowledge of the possibilities entailed and hampered as little as possible by irrational restrictions and by direct personal involvement. Thus the results of the different physical and mental examinations and observations of all donors together with the important facts of their lives and of those of their relatives should be cataloged. Says Muller, "The couple making a choice should have access to these records and the benefits of advice from physicians, psychologists, geneticists, and specialists in the fields in which the donors had engaged. The germinal material should preferably have been preserved for at least twenty years."[55] Muller also says that the sperm material should be used not sooner than twenty years after the death of the donor, because then all the personal ties and animosities which existed during his lifetime are removed and one could judge more objectively the actual merits and shortcomings of the donor.[56] In the meantime, one could also test his genetic possibilities through a limited number of artificial inseminations. Fur-

thermore, Muller assumes that in the near future human sperm cells can be cultivated outside the body and their number increased through clonic propagation according to demand. Thus one could use the sperm of one donor as frequently as necessary. It was also discovered that eggs can be released from the female ovaries through hormone injections. It should be relatively easy to develop a method to remove these fully grown eggs from the reproductive system of a woman at the right time, to fertilize them artificially, and to store them under refrigeration until one of them is implanted in the reproductive system of another woman. This would be a valuable supplement to artificial insemination and would allow the use of the paternal sperm for the future child of the couple, in case it is impossible for the wife or genetically disadvantageous to have her own egg cell impregnated. Muller sees in the method of planned choice of sperm (or of eggs) the most practical, most effective, and most satisfying instrument of genetic therapy. Indeed, a conscientious genetic selection seems to result in "better" children and in an increased quality of the genetic pool. But actually genetic selection is nothing new;[57] most people feel that the one they marry is the best choice for them also in the genetic respect. Although a genetic selection on scientific basis may sound shocking to many, we should at least ask whether parents who are convinced that they should give their children the best start for life in scholastic and economic respects should deny this to them in genetic matters.[58]

Reproduction Control. Finally, I want to refer to a field of biogenetics which seems to be gaining an ever-increasing importance: the control of human reproduction. Since time immemorial human reproduction was controlled at least to some degree. But medical progress has so decreased the number of people who die before they reach reproductive age that conventional control methods no longer suffice. If we restricted each human inhabitant on our earth to one square yard of land, we could crowd the total human population of our earth today into the corporate limits of Greater Chicago. However, if the present population increase continues unchecked, within five to six hundred years each person living on our earth would actually be restricted to one square yard.[59] A drastic birth control seems to be the only chance for human survival in a dignified way. A safe control, however, can be exercised only when we interfere with the reproductive system itself.[60] Already widely used are ovulation inhibitors, such as Enovid, which prevent the egg from maturing. There are implantation inhibitors which prevent the nesting of the already impregnated egg. Although some patients suffer initial discomforts, these methods seem to cause no dangerous effects either with the patients or with the children born

after the medication is stopped. A final evaluation, however, can be made only after several generations. Finally, experiments to prevent the formation of male sperm through hormone medication should be mentioned.[61] Success in this direction seems to be limited because this method affects libido and potency at the same time.

Theological Implications

After this brief survey of the limits and possibilities of modern biogenetics we want to attempt a theological evaluation. It would be useless to raise the moral voice and declare this or that field of inquiry or application as morally dubious. Such ethics or dogmatics would sound anachronistic. What is possible in technological or economic respect will be practically applied at one time or another. The problem, however, is much more profound and requires a reflection on the interrelatedness between modern biogenetics and the whole realm of reality. Each biogenetic possibility causes implicitly or explicitly ethical problem situations. This necessitates the recognition that at least this field of science no longer exists for itself but is value oriented.

Value Orientation of Biogenetics. Modern biogenetics requires constant human decisions which in their consequences decisively influence the life of some or of many. Heisenberg's uncertainty principle pointed for the first time to the fact that the human decision is an essential factor in scientific knowledge because it depends on the observer's decision on which aspect of reality he will see. In modern life sciences, however, the necessity for decisions is so evident that we can no longer think of science as pure science. No scientist can exempt himself from the responsibility regarding his scientific activity. More and more scientists recognize the dubious character of so-called pure facts and see their activity in close affinity to creative human activities, such as art, music, and poetry.[62] This rediscovery of the relationship of the life sciences to such remote disciplines as art witnesses to a sense of most innermost relationship between all human activities. In biogenetics as well as in many other fields of science this togetherness is also emphasized by the fact that there is hardly any longer a solitary scholar behind the locked doors of his laboratory. Teamwork and eclectic integration of many other fields of research into one's own activity show that pluralism and vastness of scientific research have not changed the necessity and actuality of the unity of human knowledge. Biogenetics contributes to a "monistic" view of reality of life and of its phenomena. This monistic view of reality is based on scientific research which is convinced of the ability to make and to manipulate the present and future of mankind and of its environment.

This, however, leads to a total mechanistic understanding of man and of his world. But one realizes more and more that such an understanding is itself mechanistically caused and therefore is without ultimate binding value. If we confine ourselves to the assertion that the function of man can be explained in analogy to the function of his environment in a total mechanistic way, then we avoid by necessity again a uniform view of reality, which is the actual aim of the life sciences. Many prominent biogeneticists are searching for an ultimate foundation of their own endeavors. But this foundation is sought beyond their own field, although somehow related to it. In other words, they are convinced of the necessity of a rational but nevertheless metaphysical foundation of their own acting.

Necessity of an Ultimate Foundation. The necessity for an ultimate foundation seems even more urgent if we remember that the naïve trust in technological progress as a pattern of conduct has been destroyed. The ensuing faith is shaky, too, because there is always a plurality of possible patterns of conduct. For instance, Medawar asserts that despite the divergence among geneticists on formulating long-term eugenic objectives, most have a pretty good opinion of their own intellect and their worthiness to be sperm donors.[63] For the constant decisions which modern biogenetics requires of the individual person thus seem to be a very inadequate measure. Lederberg, for instance, sees the dilemma in the fact that the present population of the world is not intelligent enough to keep itself from being blown up. On the one hand, he has serious doubts that the proposals for controlling reproduction and for genetic improvement will remain effective if it is up to the individual person to implement them. On the other hand, if they are controlled by society he is afraid that in our present world this implies very offensive and extremely dangerous aspects.[64] This example shows another phenomenon which necessitates an ultimate foundation of human actions: the traditional Kantian and humanitarian principles, to act always in such a way that the object person of this acting is not regarded as a means but as a goal, have become insufficient because this principle does not distinguish between an individual person and mankind in toto. Legislation to eliminate defective genes would certainly be of advantage for mankind, but the carrier of defective genes would at the same time be disadvantaged because very likely he would be excluded from propagation. Similarly, the categorical imperative—act always in such a way that you can will that the principle of your acting can become a common law—is useless for biogenetic conduct patterns. Organ transplants would be desirable for all people with defective organs. Notwithstanding technological difficulties and

high financial costs, they are practically impossible because of the scarcity of spare parts. Even Albert Schweitzer's maxim of reverence for life is problematic. According to the Hippocratic oath, a doctor should prevent suffering and should preserve and prolong life. But if he preserves and prolongs life with modern medical equipment, he violates the promise to prevent suffering. However, if he prevents suffering, he is often forced to violate his promise to preserve and prolong life.[65]

Many prominent biogeneticists are uncomfortable in this dilemma because it leads to contradictory conduct patterns and is contrary to a monistic view of reality. But, rightly, suspicious of all irrational dogmatism and despotism, they often search for a nonimmanent integrating factor which leads to uniform and rational patterns of conduct. Lederberg, for instance, asserts that in the inquiry of man's future the aims of human existence are inseparable from the power and responsibility for human nature.[66] Responsible biogenetics is possible only if one knows about the meaning and goal of being human. Muller finds the human goals in their most generalized rational definition in the promotion of the greatest overall happiness. Happiness is here understood as the sense of fulfillment derived from the attainment, or from approaching the attainment, of whatever is deeply desired.[67] Dobzhansky, however, sees that which is the innermost desire not as the goal of human existence but as its characteristic. Man is the only living species who feels an ultimate concern. Man is aware of himself, he can objectify himself and his own actions,[68] and thus he feels fear, anxiety, and death awareness.[69] Man needs a faith, a hope, a purpose to live by, and he needs to endow his existence with meaning and dignity.[70] For modern man the simple biological pleasures of survival and procreation are no longer sufficient to give the human existence meaning and a goal. Thus he needs a religious synthesis.[71] Already before Dobzhansky, Julian Huxley demanded that a belief or value system has to be developed which is founded on evolutionary thinking and which enables us to think in terms of an overriding process of change, development, and possible improvement.[72] This system must be directed toward our future and must be based on our constantly increasing knowledge.[73] This belief or value system, or simply religion, is the "organ" of developing man and is, like him, subject to development. But how can religion as the all-encompassing noetic integrator embody the true answer to the question of man's nature and destiny[74] if it is based only on the knowledge which is deduced from and through man himself? If it is really part of human nature to question himself and his environment, then it seems that he cannot himself give answers to these ques-

tions without indicating at the same time that this questioning is only rhetoric or fiction. From a Judeo-Christian point of view it would be shortsighted to attribute to these questions only rhetoric value. Augustine seems to have discovered a very basic feature of man when he wrote in his *Confessions* that God has created us toward him and consequently our heart is restless until it rests in him. Judeo-Christian anthropology affirms, furthermore, that man has estranged himself so much from his intended nature and destiny that he is unable to give appropriate answers to these questions. This seems to indicate that only the whence of questioning human existence, or simply God, can be the ultimate foundation of human existence and human actions.

Imago Dei as Commission and Limitation. In this context the understanding of man as *imago Dei* deserves special significance. In Judeo-Christian faith man conceived himself for the first time as cooperator with God. He understands himself as being commissioned to cooperate with God in a positive way as technician and artist to fulfill the kingdom of God and to participate in the dominion of God over the earth.[75] Being the image of God involves also the privilege and the task of being God's cooperator in the world. World is the totality of the physical world and also incorporates the realm of biogenetics. Man as God's cooperator in the world is also his representative. In this function man is commissioned to pursue his intentions and activities in analogy to God's intentions and activities by supporting and furthering them. God's intentions and activities resulted once in the basic structure of the world as his creation. They endow the world in its present form with meaning, and they direct it to a future fulfillment. In the same way God created man as a God-responsive and God-responsible being and endowed him with a life-preserving and pleasure-providing environment which is as perishable as man.

Accordingly, biogenetic endeavors should lead to an increase in the specific characteristics of man: the ability to reflect upon himself and upon his environment, and to attain the possibility of an increased responsiveness and responsibility. The life-preserving and pleasure-providing character of his environment should be preserved and increased too. Most possibilities of eliminative eugenics would fall into this category. The recent demand, "Not quantity, but quality of life is decisive," goes even beyond the measures of reproduction control and can be interpreted as an expression of increased responsiveness and responsibility. Representation of God, however, does not exhaust itself in a preserving and beautifying administration of the creation. It also implies participation in the divine activity of a new creation in proleptic anticipation of the future fulfillment. Man as *homo faber* (cre-

ative man) has always meant this.[76] In consequent pursuit of his task as God's representative, man has opened possibilities of making and manipulating more and more inclusive areas of his own being and environment. As the significance of his position as God's representative rises to an almost Promethean dimension, it is no longer sufficient only to emphasize in an idealistic vision the aspects of proleptic anticipation or of "revolutionary-conserving" transformation.[77] The problems of ecology, of which biogenetics is not exempt either, have painfully shown the ambiguity of such blind trust in progress.[78] For instance, would the breeding of supermen with doubled brain capacity and doubled life expectancy outweigh the difficulties of adaption to an environment which is not used to such phenomena? (We must consider here that the commonly prolonged life expectancy caused by medical progress now poses unforeseeable problems of population explosion and that the emphasis on higher education in some countries now leads to the import of unskilled workers.) This example shows us that it cannot be the task of the theologian to endow the blind pursuit of progress with metaphysical sanctification or to try to protect certain "thou shall not" laws which would be broken anyway. It is up to the biogenetic expert to consider the advantages of one manipulation against the disadvantages of omitting it. The theologian's task, however, is to point out to the biogeneticist that he cannot confine his attempts solely to ratifying technological possibilities or to work toward the greatest advantages in a utilitarian way. The good of the individual man as a God-responsive and God-responsible being, within the context of his life-preserving and pleasure-providing environment, must be the ultimate goal of all biogenetic progress. This would prohibit, for instance, the breeding of a dominating superrace similar to what H. G. Wells foresaw in his short story, "The Time Machine," where he described the life-enjoying "Upper worlders" and the subterranean, lemur-like working class of the future. Biogenetic possibilities are not to be used to the advantage of a certain group or a certain nation since *all* men share in the commission of the image of God. Humanistic attempts to increase and further the humaneness of all men should be encouraged, because they might bring man closer to his original position. This might even include some of the possibilities of Lederberg's euphenics.

However, we would do a great injustice to our present situation if we would confine ourselves only to the commissioning aspect of man as the image of God. We must point out also the limitations of this position. Theology always has to remind man that he is man and not God. For instance, man attempts even through biogenetic progress to per-

petuate life, even though he knows that change and temporality are a fundamental characteristic of man and of his environment.[79] This indicates that man has left his position as God's image and representative and constantly rejects it. In subjecting the world to his own selfish goals, he denies his dependence on and his commissioning by God. He will be prone also to misuse biogenetic possibilities for such aims and selfishly exploit them. The political and social program of a genetically pure Germanic master race in the bygone days of the Third Reich shows how far these sidesteps have already taken us in the past. But, in addition, the more palatable idea of a partial or complete transformation of man into a "good" and "faultless" being neglects man's fundamental intention to self- and therefore God-estrangement.

The secular idea of progress, even in biogenetic respect, is "an illegitimate child of Christianity."[80] In the last analysis it will only result in the benefit of man if it is knowingly or unknowingly incorporated into the original Judeo-Christian context. Otherwise there exists the constant threat that biogenetic progress leads not only to a desacralization of the world but also to a dehumanization of man. Incorporation into the original context would consider first of all the attempt to regard biogenetic or technological progress as a panacea, as demonic and anti-God. This incorporation, however, would open the possibility in a positive way to understanding biogenetic progress as divine commission in analogy to God's creative and conserving actions. Through this incorporation biogenetic progress can also give us a divine "preview" of that which is promised to us in Jesus Christ as the "new world." Thus modern biogenetics can and must be understood not only immanently as progressive dynamics but also "metaphysically" as divine administration and proleptic anticipation.

NOTES

1. Leroy Augenstein, *Come, Let Us Play God* (New York: Harper & Row, 1969), p. 3.

2. Aldous Huxley, *Brave New World* and *Brave New World Revisited* (New York: Harper & Row, Colophon Books, 1965), 2:1.

3. Unfortunately, Paul Overhage, S.J., in his excellent book *Experiment Menschheit: Die Steuerung der menschlichen Evolution* ([Frankfurt am Main: Josef Knecht, 1967], p. 6), deliberately excludes such a theological understanding. A theological understanding, however, is more urgent than ever if Christian faith is to remain relevant to modern thought.

4. Arne Müntzing, *Genetics: Basic and Applied; a Survey of Methods and Main Results,* 2d ed. (Stockholm: LTs Förlag, 1967), p. 412.

5. Ibid., p. 413.

6. Hermann J. Muller, "Genetic Progress by Voluntarily Conducted Germinal Choice," in *Man and His Future,* ed. Gordon Wolstenholme (London: J. & A.

Churchill, 1967), pp. 253 f. This volume contains the papers and discussions of a symposium of the Ciba Foundation which brought together twenty-seven renowned biologists, psychologists, and sociologists and took place in London from November 26–30, 1962. For a drastic example of the deterioration of the genetic pool, see Augenstein (p. 33). See further P. B. Medawar (*The Future of Man* [London: Methuen, 1960], pp. 72–87), who also gives a good introduction to the still ongoing discussion.

7. Hudson Hoagland, "The Brain and Crises in Human Values," *Zygon* 1 (1966): 141.

8. Muller, p. 252.

9. See Hermann J. Muller, "The Guidance of Human Evolution," in *Evolution after Darwin: The University of Chicago Centennial,* ed. Sol Tax, 3 vols. (Chicago: University of Chicago Press, 1960), 2:430–33.

10. John R. Jablonski, "Man, Culture, Evolution and Environment," in *Changing Man: The Threat and the Promise,* ed. Kyle Haselden and Philip Hefner (Garden City, N.Y.: Doubleday & Co., 1968), p. 83.

11. According to Augenstein (p. 32).

12. Muller, "Guidance of Human Evolution," p. 436. See also the striking example in Augenstein (p. 16).

13. Henry W. Brosin, "Evolution and Understanding Diseases of the Mind," in *Evolution after Darwin* (see n. 9 above), 2:388.

14. Müntzing, p. 412.

15. Gerald E. McClearn, "Behavioral Genetics," in *Proceedings of the XII International Congress of Genetics, Tokyo, Japan, August 19–28, 1968,* (ed. C. Oshima, 3 vols. [Tokyo: Dai Nippon Printing Co., 1969], 3:422), where he also describes findings about the genetic basis of psychosis and schizophrenia.

16. Müntzing, pp. 419 ff.

17. Augenstein (p. 19) mentions that the chances for mongolism for children are less than two out of ten thousand when the mother is twenty, one out of a thousand when she is thirty, one out of a hundred when she is forty, and when she is forty-nine they are between one in forty and one in twenty-five.

18. Ibid., p. 18.

19. Jerôme Lejeune, "Chromosome Mechanics and Human Pathology," in Oshima, 3:380.

20. For the following, see Patricia A. Jacobs et al. ("Chromosome Studies on Men in a Maximum Security Hospital," *Annals of Human Genetics* 31 [1968]:339–58). Literature about other similar investigations is mentioned here.

21. Timothy Leary and Walter Houston Clark, "Religious Implications of Consciousness Expanding Drugs," *Religious Education* 58 (1963):251–56. Of course, on the basis of this one experiment one cannot say anything conclusive about a "correction" of criminal behavior through drugs. Notwithstanding the tragic results for Timothy Leary himself, experiments in this direction should be encouraged.

22. Hoagland, p. 151.

23. According to Hudson Hoagland ("Potentialities in the Control of Behavior," in Wolstenholme, p. 309).

24. For the following, see C. W. M. Whitty, "Changes in Conduct and Personality Following Localized Brain Lesions" (in *Biology and Personality: Frontier Problems in Science, Philosophy and Religion,* ed. I. T. Ramsey [New York: Barnes & Noble, 1965], pp. 319–49), which also cites some typical clinical cases.

25. Leroy Augenstein, "Shall We Play God?" in Haselden and Hefner, pp. 90 f.

26. Joshua Lederberg, "Biological Future of Man," in Wolstenholme, p. 267.

27. Ibid., p. 269.

28. See Robert DeMars, "Investigations in Human Genetics with Cultivated Human Cells: A Summary of Present Knowledge," in *The Control of Human Heredity*

and Evolution, ed. Tracy M. Sonneborn, 5th ed. (New York: Macmillan Co., 1967), p. 55.

29. Augenstein, "Shall We Play God?" pp. 91 f.

30. Müntzing p. 417.

31. See Eldon J. Gardner, *Principles of Genetics,* 3d ed. (New York: John Wiley & Sons, 1965), p. 319.

32. According to Augenstein ("Shall We Play God?" p. 95).

33. N. A. Mitchinson, "Erzeugung biologischer Stoffe durch Gewebekulturen," in *Unsere Welt 1985,* ed. R. Jungk and H. J. Mundt (Munich: Kurt Desch, 1967), p. 59.

34. Augenstein ("Shall We Play God?" p. 97) is toying with this idea.

35. For example, the bacteriophage T 4 has approximately one hundred genes, of which some twenty have already been identified and located. But man has probably between fifty thousand and one million genes. Of these so far only about one hundred have been identified and only a few have been crudely located (according to G. Pontecorvo, "Prospects for Genetic Analysis in Man," in Sonneborn, p. 89).

36. See also Herman J. Muller, "Means and Aims in Human Genetic Betterment," in Sonneborn, p. 113.

37. According to Augenstein (*Come, Let Us Play God,* pp. 21 f., 28 f.), in reporting about an incident at the Oak Ridge National Laboratory in Tennessee.

38. Ibid., p. 35. Due to Augenstein's untimely death (1969), this plan was probably abandoned.

39. Pontecorvo, p. 83.

40. Joshua Lederberg, "Molecular Biology, Eugenics and Euphenics," *Nature* 198 (1963):428–29. This essay is a condensation of his paper read at the above-mentioned Ciba Symposium in London.

41. Lederberg, "Biological Future of Man," p. 265.

42. For the following, see Hugo Spatz ("Gedanken über die Zunkunft des Menschenhirns und die Idee vom Übermenschen," in *Der Übermensch: Eine Diskussion,* ed. Ernst Benz [Zürich: Rhein-Verlag, 1961], pp. 357, 359, 364, and other places). Of course, we have to emphasize here the hypothetical character of Spatz's theses.

43. Pierre Teilhard de Chardin, *The Phenomenon of Man* (New York: Harper & Bros., 1959), pp. 249 f. His whole system is built on the premise of a constant evolution. Whether this evolution will proceed artificially or naturally seems to be unimportant to him.

44. Lederberg, "Biological Future of Man," p. 266.

45. Jean Rostand, *Can Man Be Modified?* (New York: Basic Books, 1959), p. 80.

46. Lord Brain, "Wir werden uns selbst besser kennenlernen," in Jungk and Mundt, p. 47.

47. For the following, see Hoagland ("Potentialities in the Control of Human Behavior," p. 306 f.).

48. Jablonski (pp. 84 f.) points out that there are many unknown dangers in experimenting with mind drugs. In this context we would like to acknowledge thankfully the commercials in our mass media concerning the dangers of drugs and nicotine (cancer causing).

49. For the following, see Muller ("Guidance of Human Evolution," pp. 453 f.).

50. According to G. H. Beale ("Das Verändern der Erbeigenschaften der Zelle," in Jungk and Mundt, p. 65 f.). There he rejects French reports about experiments with DNA injections in ducklings of the Pekin breed from extracts of DNA material from Khaki Campell ducks. The majority of the treated birds, and their offspring, supposedly developed characters of Khaki Campell ducks (see report of Brosin, "Evolution and Understanding Diseases of the Mind," p. 402). This shows that genetic euphenics is such a debated field that even research reports may be exaggerated.

51. Rostand, p. 92.

52. Muller, "Genetic Progress," p. 255. Lederberg, who is convinced of the success

of genetic euphenics, includes under the term "euphenics" also organ transplants, organ prostheses (for example, artificial heart valves), progress in protein biochemistry to prolong life expectation, influence of brain development in the prenatal or postnatal period, and nonsexual procreation (for instance, parthenogenesis) (see Joshua Lederberg, "Die Evolution in der Krise," in Jungk and Mundt, pp. 39 f.). We included some of these possibilities under different categories.

53. Tracy M. Sonneborn, "H. J. Muller, Crusader for Human Betterment," in Oshima, 3:101.

54. For the following, see Muller ("Genetic Progress," pp. 258–61; "Guidance of Human Evolution," pp. 437–52; and "Means and Aims," pp. 114 ff.).

55. Muller, "Genetic Progress," p. 260.

56. Muller, "Guidance of Human Evolution," p. 451. Although he already advocated this idea in 1935, he bewilders the reader with his statement at that time: "How many women, in an enlightened community devoid of superstitious taboos and sex slavery, would be eager and proud to bear and to rear a child of Lenin or of Darwin!" (*Out of the Night: A Biologist's View of the Future* [New York: Vanguard Press, 1935], p. 122); see also M. Klein's remark in the discussion following Muller's paper on "Genetic Progress" (in Wolstenholme, p. 280).

57. Rostand (pp. 88 f.) cites some interesting historical illustrations.

58. Augenstein, *Come, Let Us Play God,* p. 29.

59. Augenstein, "Shall We Play God?" pp. 92 f.

60. Gregory Pincus, "Control of Reproduction in Mammals," in Wolstenholme, pp. 79–80.

61. According to Overhage (pp. 119 f.).

62. Warren Weaver, "Some Moral Problems Posed by Modern Science," *Zygon* 1 (1966):299. This is similar to Bultmann's discovery that due to his prior understanding the "pure" exegete is always also a secret dogmatician. Unfortunately, Bultmann did not apply this discovery to his own exegesis.

63. See P. B. Medawar in the discussion following Lederberg's presentation of "Biological Future of Man" (in Wolstenholme, p. 295). See also Theodosius Dobzhansky, "Evolution: Implications for Religion," in Haselden and Hefner, p. 155.

64. See Lederberg in the discussion following his presentation "Biological Future of Man" (in Wolstenholme, p. 288).

65. For a more extensive discussion, see Joseph Fletcher (*Morals and Medicine* [Princeton, N.J.: Princeton University Press, 1954], p. 172).

66. Lederberg, "Biological Future of Man," p. 270.

67. Muller, "Guidance of Human Evolution," p. 441. Muller here seems to be still favoring a pragmatic optimism, especially when he emphasizes that hedonism, altruism, and a spiritual attitude toward existence become finally resolved into the pursuit of the same objective.

68. Theodosius Dobzhansky, *The Biology of Ultimate Concern* (New York: New American Library, 1967), p. 52.

69. Ibid., p. 68.

70. Ibid., p. 108.

71. Ibid., p. 109. Dobzhansky admits that, because of his own cultural disposition, the framework of Christianity for him would be most important for such a synthesis. I would like to mention here that Dobzhansky is strongly influenced by Teilhard de Chardin, Paul Tillich, and Julian Huxley.

72. Julian Huxley, "The Evolutionary Vision," in Tax, 3:256 f.

73. Julian Huxley, *The Human Crisis* (Seattle: University of Washington Press, 1963), p 38.

74. For a more extensive discussion, see Perry LeFevre (*Understandings of Man* [Philadelphia: Westminster Press, 1966], p. 39).

75. Ernst Benz, *Evolution and Christian Hope* (Garden City, N.Y.: Doubleday & Co., Anchor Books, 1968), pp. 123 ff.

76. Karl Heim (*The World: Its Creation and Its Consummation* [Philadelphia: Muhlenberg, 1962], p. 61 ff.) sees as a specific characteristic of man his "technical intelligence," which is a blessing for him in the sense of making life easier and more comfortable, but it is also a misfortune since he uses it in the merciless struggle for existence against his fellowmen.

77. Jürgen Moltmann (*Theology of Hope* [London: SCM Press, 1967], pp. 327 ff.) seems to go in this direction. This suspicion is nourished when one discovers that his approach is exploited—though against his will—in the sense of a naïve belief in progress. See Hans-Georg Geyer, "Ansichten zu Jürgen Moltmanns 'Theologie der Hoffnung,'" in *Diskussionen über die "Theologie der Hoffnung" von Jürgen Moltmann,* ed. W.-D. Marsch (Munich: Christian Kaiser, 1967), p. 73. With this critical observation we by no means want to question Moltmann's important rediscovery of the dynamic-progressive component of theology.

78. See about the questionableness of a "gospel of progress," in Robert E. Neil, "The Relevant Issue" (*McCormick Quarterly* 23 [1969]:17–35).

79. Martin Heidegger (*Being and Time* [London: SCM Press, 1962], p. 289) characterizes our situation very strikingly when he says: "Death is a way to be, which Dasein takes over as soon as it is. 'As soon as a man comes to life, he is at once old enough to die.'"

80. Emil Brunner, *Eternal Hope* (London: Lutterworth Press, 1954), p. 25.