GUIDED HUMAN EVOLUTION: A NEW CHALLENGE TO SOCIAL AND MORAL PHILOSOPHY

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The spectacular progress made in modern genetics has convinced some thoughtful scientists that we are on the threshold of a new era in which man will be able to control his genetic future. Man will be able to deliberately modify and presumably improve his genetic makeup in much the same manner that he has altered wild species of plants and animals to suit his needs and whims. The prospect of man designing his own future has been widely popularized in newspapers and magazine articles. Some of the statements in the popular press have led the public to expect a complete reconstruction of the human body and personality. Several journal accounts have been accompanied by sensational pictures of new kinds of people, as if to intimate that we will be shortly writing prescriptions for any kind of person we crave. Some of the vivid portrayals include a new breed of astronaut, legless for efficiency on long space voyages; a four-legged human variety with protruding eyes, who would be eminently suitable for high-pressure areas of outer space; and men with prehensile feet that would enable them to cling to planets with low gravitational pull.

One of the more startling possibilities is that of producing exact copies, or genetic replicas, of a human being from a single parent. An individual may be able to confer immortality on himself simply by giving up a few of his body cells. In other words, a person in one generation can prepare an additional copy of himself for another trial in the next generation. This would be accomplished by implanting the nucleus of a body cell of that person into a freshly obtained, enucleated human egg. The resulting new offspring is, in reality, not an offspring; he is his own parent reincarnated in new cytoplasm.

Extravagant claims of the popular press serve only to contribute to an already distorted public view of the aspirations and accomplishments of scientists. Sensational pronouncements have greater news value than sober statements of fact, and for this reason news concerning science and technology often appears in an exaggerated form. Actually, most geneticists have restrained thoughts concerning the possibility of the deliberate and controlled modification of our genetic makeup. Clearly, before we evaluate

objectively the prospects for modifying the genes of man, we must first define the basic problem that faces us, at least as understood by contemporary geneticists. Very simply stated, the concern of contemporary geneticists is the marked increase in the incidence of harmful genes responsible for serious hereditary defects. Harmful, or detrimental, genes are accumulating in the human population at a great rate. The paramount concern, then, is that the human species is deteriorating genetically. Is there a valid basis for this concern?

Hospital records in widely scattered parts of the world reveal that approximately two percent of all infants born alive suffer serious disorders. Stated another way, two babies in 100 are born with defects so serious, either physically or mentally, that the infant either dies or is severely handicapped. In the United States alone, 250,000 infants are delivered each year with significant birth defects. Although not all birth defects have a genetic origin, the proportion of genetically determined abnormalities is high.

The incidence of birth defects varies widely in different ethnic groups. Spina bifida, in which the spine fails to close over and a gap is left in the spinal column, occurs at least twice as often in Caucasians as in Negroes and twelve times as often as in Japanese. On the other hand, polydactyly is seven times more frequent in Negroes than in Caucasians. Tay-Sachs disease is almost confined to Jewish communities, and harelip and cleft palate occur more frequently in Japan than in any other country. The reason for these irregularly distributed incidences is still obscure.

The age of the expectant mother has a decided bearing on the occurrence of certain congenital malformations. The incidence of hydrocephaly and Down's syndrome (mongolism) increases markedly with advancing age. Women above 35 years of age are eight times more apt to have a child afflicted with Down's syndrome than women under 25. In other congenital deformities, such as cleft palate and spina bifida, there is no evidence of association with the age of the mother.

More than one-third of the malformed babies exhibit defects of the brain and spinal cord. One of the more frequent malformations is hydrocephaly, a condition in which the head of the infant is greatly enlarged because of excess fluid in the brain cavities. Defects at birth that doom the infant to an early death or a lifetime of illness take an enormous toll of human life and human potential. No statistics, however, speak for the psychological trauma suffered by the parents. The rearing of a deformed child – such as a child affected with phenylketonuria – imposes an emotional crisis on the parents to which adjustment is slow and agonizing. Phenylketonuric individuals

generally are mentally retarded, usually so severely that they are institutionalized. It is difficult to overcome the deep anxieties and feelings of guilt or shame experienced by the parents. In our affluent society, birth defects still loom as one of man's serious problems.

The statistics I have cited are based on live births, and give no indication of the number of deformed embryos lost through spontaneous abortions early in pregnancy. Recent estimates indicate that one in 10 pregnancies terminate in miscarriage. Moreover, many anomalies are not noticeable at birth. Some manifest themselves during the first year after birth; others appear only after many years. An obstruction of the intestinal tract, known as pyloric stenosis, develops in the neonatal period, between the third and seventh week after birth. The inherited degenerative disease of the nervous system, known as Huntington's chorea, first reveals itself in persons in their late thirties. When we group together the figures reported for spontaneous abortions and stillbirths, the malformations present in infants at birth, and the deformities that do not become manifest until later life, the total or overall percentage of major deformities in humans is about 5 percent, or one in 20!

The incidence of malformations is not likely to decrease. In fact, as I expressed earlier, the frequency of detrimental genes is increasing. A careful consideration of a particular genetic disorder in man will be useful at this point. The inherited dominant abnormality, retinoblastoma, or cancer of the eye in newborn babies, has until recently been almost always a fatal condition. The malignant tumor arises in the retina of one or both eyes, and tends to spread by way of the optic nerve into the brain. Except for rare cases of spontaneous regression, untreated infants do not survive. The transmission of the dominant detrimental gene for retinoblastoma is opposed by natural selection. The operation of natural selection is here revealed in its most relentless form, inasmuch as the harmful dominant gene is generally eliminated before it can be passed on even once.

Since individuals with retinoblastoma have great mortality and very low fecundity, it might be expected that the detrimental gene would rapidly pass from existence, or at least steadily decrease from one generation to the next. Each failure of an affected person to transmit his defective gene would result each time in the loss of the defective gene from the population. Yet the gene for retinoblastoma has not decreased in frequency!

The factor that maintains the gene for retinoblastoma in the population is mutation. A mutation is a mishap in the normal copying process of the gene. New mutations arise from time to time, and the same mutations may

occur repeatedly. In fact, all genes undergo mutation at some definable rate. In each generation, it can be expected that a certain proportion of normal genes will be converted into defective genes. Accordingly, while in every generation a large number of genes for retinoblastoma are lost from the population by the inability of the affected individuals to leave descendants, this same number is replaced by the process of mutation. As long as the rate of elimination of the gene for retinoblastoma equals its rate of origin by mutation, the incidence of this cancerous defect in the human population will not change. Such a population is said to be in genetic equilibrium with respect to the detrimental gene for retinoblastoma.

A simple analogy will help to illustrate the concept of genetic equilibrium. Picture a glass beaker or container, open at the top to permit water from a faucet to enter the beaker but with an outlet at the bottom that enables water to flow out. The water level in the beaker equals the rate at which it leaves the hole in the bottom of the beaker. The water flowing from the faucet into the beaker represents the inflow of newly mutated genes; the water escaping through the hole at the bottom represents the elimination of the harmful gene through the failure of reproduction of affected individuals. Thus, a constant water level in the beaker – that is, a state of genetic equilibrium – is reached when the rate at which the detrimental gene is replenished by mutation equals the rate at which the gene is lost by natural selection.

Some one hundred or more years ago, before we moved fully into our modern environment of public health, therapy, and radiation, the balance of mutated deleterious genes was probably at or close to equilibrium. Since then, at least two factors have contributed to disturbing the balance – for the worse. One change that has affected the genetic equilibrium is the increase in man-made radiation. Man today lives in an environment in which high energy radiation is assuredly not calculated to improve the human germ plasm. Genes are highly susceptible to the action of ionizing radiation. A higher incidence of mutations from high-energy radiation is comparable to an increased flow of faucet water into the beaker. The water level in the beaker will rise and water will escape more rapidly through the hole in the bottom of the beaker. Similarly, defective genes will be found more frequently in the population and will be eliminated at a faster rate from the population. A balance will be restored eventually between input and output; however, the population will then have a larger store of defective genes. Physicians in years to come will be called upon to treat a greater number of defective infants.

An even more serious threat to the genetic equilibrium is the saving of

life through the greater medical control of genetic disorders. The outstanding advances in modern medicine have served to prolong the lives of genetically defective persons who might otherwise not have survived to reproductive age. This may be compared to partially plugging the hole in the bottom of the beaker, the effect of which is to reduce the rate of outflow of water. The water level in the beaker will obviously rise, as will the amount of defective genes in the population. That this circumstance has already occurred is dramatically exemplified by our recent medical control of retinoblastoma. Today, with proper surgical treatment, almost 80 percent of the individuals afflicted with retinoblastoma survive, become able to reproduce, and therefore can transmit the defect to their children (theoretically, half their children). There may be no loftier motive in society than to save lives by the application of medical knowledge. But the price of our humanitarian principles is the enlargement of our pool of harmful genes and a legacy of suffering for future generations as a result of an increased incidence of genetically malformed infants.

Let us make this point clear by another specific example. Cystic fibrosis is an inherited recessive disorder to the pancreas. One child in every thousand is born with this genetical disease. About 6,000 infants are born with the disease each year in the United States. Less than 35 years ago, cystic fibrosis was not even recognized as a distinct disease. Today it has the unenviable reputation of being one of the most devastating disorders of childhood. Intestinal obstruction is the first symptom of the disease. The pancreas of the infant produces a thick material that blocks digestion in the intestinal tract. The lungs also produce the sticky material; the lungs become clogged and the child has repeated bouts of pneumonia.

Before the introduction of antibiotics, affected children usually died in infancy of constant infection. Today, new drugs, inhaled a vapor, soften the thick mucus of the lungs and permit some children to weather the difficult first years. Indeed, some women suffering from cystic fibrosis have responded so well to the special treatment of drugs that they have now borne children of their own. All these children are outwardly normal. But, these outwardly healthy children carry the detrimental gene for cystic fibrosis and consequently the potential for perpetuating this affliction. As these children themselves approach child-bearing age, they must understand that their own babies might be affected with cystic fibrosis.

Evidently then, modern medicine, by finding ways to keep alive individuals who carry deleterious genes, encourages the survival of those who more than likely will pass on their defects to future generations. The conventional

ethics of medicine is shaken when, with increasing knowledge, it becomes clear that to save the life of a child with a hereditary disorder is to ensure the retention and increase of detrimental genes that ordinarily would be kept at very low frequencies by natural selection. Should we continue indefinitely to load our population with hereditary disabilities?

Some geneticists have looked upon this situation with grave concern. In particular, the late Nobel laureate Hermann J. Muller was most distressed about the continual pollution of the human gene pool. Muller had been predicting genetic disaster since 1935, and throughout his career he was a persuasive and articulate prophet of doom. Muller presented the most vivid portrayal of the impending genetic disintegration of the human species. In the eventual and not too distant future, according to Muller, the task of taking care of genetically defective individuals will consume all the energy that society can mobilize. Most everyone will be an invalid. Muller's gloomy forecast was that the human species would end up with two types of individuals: one kind would be so genetically incapacitated as to be wheelchair patients, and the other kind would be somewhat less disabled but would spend all their time taking care of the first kind. It is unreasonable, Muller contended, to expect medicine to keep up with the problem especially because medical men themselves in that near or distant future will be subject to the same genetic decomposition. Eventually even the most sophisticated techniques available will no longer suffice to save men from their genetic deterioration. According to Muller, then, mankind is doomed unless positive steps are taken to regulate his genetic endowment.

Muller was convinced that in practice man would be unable to determine and agree upon the application of measures which would reduce the load of unfavorable genes. He suggested as a countermeasure, therefore, a program designed to increase significantly the number of favorable genes in the human population. Muller proposed a plan called *AID*, or "Artificial Insemination from Donors." He recommended the establishment of sperm banks, which would make available the sperm of highly qualified donors whose family histories showed the least possible likelihood of defects or abnormalities. To make sure of the eminence of the donors, the sperm would be frozen and made available only after 20 years or more, when the donor would no longer be alive, and posterity could judge dispassionately of his value. When a woman decided to have children, she would need only to choose sperm from the donor whose qualities she most admired. "How many women," Muller cried when he enunciated his plan, "would be eager and proud to bear and rear a child of Aldous Huxley or Charles Darwin!"

A number of serious questions must be answered before employing artificial insemination on the grand scale that Muller proposed. In the present state of knowledge even the best of geneticists would disagree on who should be the donors. There is no guarantee that even the most distinguished donor would be free of hidden detrimental genes. As one scientist stated, "The trouble with Muller's sperm bank is that he's always having to take people out of it." One of his rejects, for example, is Abraham Lincoln, who is now suspected of having suffered from a genetic disorder called Marfan's syndrome. Patients with Marfan's syndrome have poor musculature, long, thin extremities, and heart defects.

More importantly, the participants would be asked to surrender their pride in generating their own biological children and substitute for this pride the greater satisfaction to be gained from the knowledge that the child has the best possible set of genes. Muller confidently expected the gradual emergence of a new superior form of self-esteem and gratification in contributing to the genetic improvement of the human species. It seems more likely, however, that many people would be reluctant to renounce their claim to having their own biological descendants, and volunteers might be difficult to find in substantial numbers.

I wish now to bring under serious scrutiny the suggestion that humans be propagated by cloning. The possibility of producing exact copies, or replicas, of a person stems from studies performed on the frog. Specifically, a nucleus from an embryonic cell of a frog can be implanted, or transplanted, into an unfertilized egg whose own nucleus had previously been experimentally destroyed or eliminated. The transplanted nucleus can promote normal development of an enucleated egg, thereby bypassing the usual process of fertilization of egg by sperm. This process may be repeated to produce several genetically identical individuals, or technically, a *clone*. Thus, an early embryonic cell, not merely the sperm and egg, contains all the genetic information to create a new individual. The procedures for the successful transplantation of a body cell into a human egg have yet to be perfected.

Many embryologists dismiss the possible application of the nuclear transplant technique to man as the blue-sky rambling of a handful of imaginative scientists and flamboyant journalists. The Oxford University embryologist J.B. Gordon stresses the technical difficulties of manipulating the human egg, which is about one-twelfth the size of the frog's egg. Moreover, even if the enucleation of the human egg were to become a reality, such technical mastery would not be sufficient reason to attempt to clone a human. Even under the most optimum conditions, an appreciable number of the nuclear-

transplant frog embryos are grossly abnormal. There is no basis for being more optimistic about the outcome in human clones.

Several scientists, particularly geneticists, have proposed that cloning be introduced into the human population as a means of preserving or perpetuating favorable genes. Joshua Lederberg, a geneticist at Stanford University, has proposed that we should replicate already existing men and women who have proven themselves outstanding in intellectual and cultural endeavors. If a superior individual can be identified, why not, Lederberg states, copy it directly rather than suffer the risk that the favorable arrangement of genes will be disrupted by the normal process of biparental reproduction. However our state of knowledge, at least at present, almost demands that embryonic cells be used as the source of donor nuclei rather than adult cells. Since the potential of an individual in the embryonic state cannot be gauged, we would have to resort to placing a few embryonic cells of all individuals – or of individuals selected from generally healthy families – in cold storage, and holding out to each of such individuals the flattering (or grim) prospect that his or her cells might be cloned in later life.

However laudable the desire to improve the genetic makeup of mankind, most scientists have restrained thoughts concerning any first attempt to clone a man. Lederberg himself recognizes the unavoidable hazards involved in the experimental procedure of cloning. "What to do with the mishaps," he writes, "needs to be answered before we can undertake these risks in the fabrication of humans." In the eyes of many of those who oppose research in this direction, the dual issues of the production and disposition of deformed cloned embryos provide sufficient ethical grounds for resisting or rejecting any endeavor to produce human clones.

Let us now turn to the prospects for genetic surgery – that is, the experimental conversion of the harmful gene to its normal form. The riddle of the structure of the gene has essentially been solved. We now know that the genetic substance of the chromosome is composed of extremely long molecules of deoxyribonucleic acid, or in abbreviated form, the now famous DNA. According to the widely accepted Watson-Crick model, the DNA molecule consists of two parallel strands, twisted around each other somesteps are composed of pairs of specific nitrogenous bases. We now say that a gene is a linear sequence of several hundred bases, which directs the synthesis of proteins of the body.

The artificial synthesis of a small gene of specific base sequence was accomplished in June 1970 by the biochemist Khorana and his colleagues at the University of Wisconsin. They painstakingly assembled a single gene from

relatively simple laboratory chemicals containing carbon, hydrogen, oxygen, and phosphorus. The gene specifies the production of a large molecule in the cytoplasm of yeast cells. The artificially synthesized gene is relatively simple, containing only 77 pairs of bases. While the chemical synthesis of a human gene appears to be a formidable task, it most likely will be accomplished in the near future.

Contemporary work with animal viruses suggests that certain viruses are capable of introducing genetic information into human cells. For example, when human cells in tissue culture are infected with the SV40 virus of monkeys, specific DNA sequences of the virus become integrated into the chromosomal DNA of the human cell. This suggests the possibility of "engineering" the viral DNA – that is, artificially modifying the virus so that it carries a DNA sequence that codes for a particular protein. Thus, it may be possible to attach to the viral DNA a sequence of bases that specifies, for example, the production of the enzyme phenylalanine hydroxylase. The "carrier' virus can then be introduced into an infant afflicted with phenylketonuria, with the expectation that the tailor-made virus would promote production of the enzyme that has been errant in the patient. Ideally, the virus should be inserted only in liver cells, which are the only cells in the body that normally exhibit phenylalanine hydroxylase activity. Uncertainty exists about how the "carrier" virus would express itself in other cells. A disquieting aspect is that the newly integrated virus might transform the cell's behavior to the extent that the cell becomes malignant, or cancerous.

In October of 1971, in an investigation that has been hailed as revolutionary, Dr. Carl Merril and his associates at the National Institute of Health transplanted the genes of a virus into living human tissue in culture. These investigators took advantage of a particular virus (lambda) whose DNA contains a cluster of genes, previously obtained from a bacterial cell, that controls the production of a galactose-metabolizing enzyme. With this galactose-metabolizing virus, they infected human fibroblast cells taken from a patient suffering from a hereditary disease known as galactosemia. Victims of galactosemia are unable to produce the essential enzyme that enables the body to metabolize galactose, a simple sugar found in milk and other dairy products. The remarkable finding was that the virus instructed the human cells to manufacture the galactose-metabolizing enzyme that is missing in the defective cells. These experiments have been performed in the artificial *in vitro* environment of a tissue culture system; the techniques have yet to be successfully applied to *in vivo* systems.

In spite of these important new findings, it should be emphasized that

the externally supplied genetic material benefits only those defective cells that have incorporated the externally supplied gene. Improving the body cells in this manner without altering the germ cells does not prevent transmission of the hereditary defect. A positive genetic effect will occur only if the correction of the gene can be made in the germ cells — the egg cell and the sperm cell. The means of genetically manipulating the gametes are not in sight.

It should also be clear that the traits we have thus far considered are sharply differentiated and are governed essentially by single gene determiners. There are, however, many characteristics in man that cannot be classified into two discrete, alternative classes but show a great range of variation and many gradations between the extremes. These are the measurable or *quantitative* characters, such as certain physical attributes, like height and weight, and mental capacities, expressed as intelligence. Quantitative characters result from the action and interaction of many genes, or *polygenes*. Man undoubtedly has numerous polygenes for each quantitative trait. The improvement of a quantitative trait would certainly necessitate the transfer of large, if not many, sequences of the DNA molecule. The replacement of large sections of DNA, particularly in a controlled manner, is difficult to imagine in the immediate, or even foreseeable, future.

It should be apparent that, at the present time, the outlook for genetic surgery is not bright. What, then, is the answer to overcoming, or at least forestalling, the genetic deterioration of man? There is emerging at present an approach that is generally socially acceptable and completely voluntary. This approach is that of counseling individuals and families so that they can avoid the disastrous occurrence of genetic disorders. Genetic counseling centers in hospitals, clinics, and medical schools across the United States are already helping parents. At a symposium sponsored recently by the National Foundation March of Dimes it was announced that the number of counseling centers has grown from 20 in 1955 to well over 200 today.

It is axiomatic that the vast majority of harmful genes are carried by heterozygotes. Heterozygous individuals are those who carry the defective gene but are themselves unaffected by the harmful gene. Heterozygous individuals are not as rare as might be supposed. Indeed, the frequency of heterozygous carriers is many times greater than that of homozygous individuals afflicted with a trait. Thus, an extremely rare disorder, like alkaptonuria (indicated by blackening of urine), occurs in 1 in one million persons. This detrimental gene, however, is carried in the hidden state by 1 out of 500 persons. There are 2,000 as many genetic carriers of alkaptonuria as

there are individuals afflicted with this defect. For another recessive trait, cystic fibrosis, one out of 1,000 individuals is victimized by this homozygous trait. It may be thought that most affected children come from marriages of two affected individuals. This is not true. The great majority of affected children – more than 99 percent – come from marriages of two normal parents, both of whom are heterozygous carriers. One of 16 persons is a carrier of cystic fibrosis.

The implications are clear. A successful genetic counseling program requires two important ingredients. First, there must be a simple, inexpensive means of detecting heterozygous carriers of inherited disorders. Secondly, there must be a means of diagnosing the disorder in the fetus of the expectant mother. Both these conditions have already been satisfied with respect to certain disorders. We may consider the recessively inherited condition known as Tay-Sachs disease. Affected infants appear normal and healthy at birth, but within six months the nerves of the brain and spinal cord exhibit marked signs of deterioration. The child becomes mentally retarded, progressively blind, and finally paralyzed. The disease takes its lethal toll by the age of three to four years. There are no known survivors and no known cure. Today, the heterozygous carriers of Tay-Sachs disease can be identified. Individuals suffering from the disease lack a specific enzyme in their blood (hexosaminidase); in carriers, the amount of enzyme is intermediate between levels found in normal persons and affected persons. If both parents are identified as carriers, they can be informed that the risk of a defective child is one in four.

Moreover, the technique of transabdominal amniocentesis has become an important tool in the prenatal detection of certain hereditary disorders. The technique consists of inserting a hypodermic needle into the uterine cavity of the expectant mother, and withdrawing a small sample of amniotic fluid. The procedure is typically performed at 16 weeks' gestation, but can be done successfully at 14 weeks' gestation. The cells in the amniotic fluid are examined both biochemically and chromosomally. The amniotic-fluid cells are of fetal origin, derived mainly from the fetal skin. In the case of Tay-Sachs disease, the amniotic cells can be analyzed for the presence – or absence – of the essential anzyme. Chromosome studies have been used in several cases where the possibility of Down's syndrome existed. Down's syndrome is the preferred medical term for mongolism. Down's syndrome is now known to be associated with mishaps or disturbances in the chromosomes. The afflicted infant has 47 chromosomes, or one chromosome more than the normal number of 46. This chromosome abnormality can be detected in the

amniotic cell cultures, and therapeutic abortions can be performed. Using amniocentesis, Dr. Henry Nadler, the Northwestern University pediatrician, diagnosed Down's syndrome in 10 of 155 high-risk pregnancies. Subsequent examination of the 10 aborted fetuses showed the diagnosis to be correct in all cases.

Different ethical attitudes may be expected concerning the early interruption of pregnancy. Human life is sacred, yet the human suffering associated with an unmanageable genetic disorder is so great that the avoidance of the birth of an incurably afflicted infant may be the most acceptable and humane solution. As expressed by Joseph Dancis of New York University, the "right to be born" is becoming qualified by another right: *The right of the infant to have a reasonable chance of a happy and useful life.* In the years to come, many couples may desire to plan children only on the condition that the expectant mother will be offered screening of the embryo and the termination of pregnancy if the unborn infant is demonstrably abnormal. In essence, in some countries the decision to abort a defective fetus may ultimately become the private judgment of the parents. This point of view is disconcerting to those who believe that parents should not have the final or sole responsibility of choice for the quality of their offspring.

It remains to be seen how different governments will respond to the social, moral, and legal issues raised by the new capabilities in medical science. An awe-inspiring accomplishment in recent years has been the successful fertilization of the human egg by sperm in laboratory glassware, or technically, *in vitro*. In the late 1960s, the developmental physiologist Robert Edwards, at the University of Cambridge in England, sought the means of obtaining a mature egg directly from the ovary of a female just prior to ovulation. At the suggestion of his clinician colleague, Dr. Patrick Steptoe, a surgical technique called laparoscopy was modified to extract the preovulatory egg. A clear view of the ovary is obtained with a slender illuminated telescope, or laparoscope, which is inserted through a small incision made in the abdominal wall. A specially designed hypodermic needle is then passed through a second slit in the abdomen, and the egg is aspirated.

Concern has been voiced that the implantation of a laboratory-grown embryo involves far too great a risk. One cannot assess or predict whether or not the resulting infant — if it should survive — would be deformed because of the experimental manipulations. However, it may be argued that all new medical technologies are risky. In any new and dramatic technological procedure, the searching questions that invariably arise are: *can* man, *will* man, and *should* man? Edwards believes that we should attempt artificial

implantation in a human recipient.

Some societies may come to accept the idea of artificial implantation, especially when the egg and sperm are furnished by the wife and husband. The more thorny problem arises when one contemplates the possible use of either egg or sperm, or both, from strange donors. It is of particular interest that society today sanctions the adoption of postnatal children. In fact, the adoptive parents rarely have knowledge of the true, or biological, mother and father of the adopted child, and of the genetic qualities of such children, especially where the child is illegitimate. Essentially, then, only one new feature is introduced by the new medical technologies – the earlier age of the child to be adopted. With the situation viewed in this manner, a couple, rather than adopt a grown child, may choose to accept an early blastocyst that could grow in the woman's womb.

The last two decades have seen a surge of scientific knowledge and technological advances that few could have foreseen or have dared to prophesy. Equally, we can be sure that the next two decades will contain surprises that promise to strain existing ethical, cultural and technical fabrics. This evinces either a tragic sense of despair that man can become lost in his own machinations, or a sober realization that man has the capabilities to manage constructively his own destiny. In either case, the decisions made by future governments in different countries will profoundly affect the destinies of the nations over which they rule.

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BOOK REVIEWS

BOYSON, RHODES (editor)
1985: An Escape From Orwell's 1984
London, Churchill Press, 146 pp., $2.20 (paper), 1975

Dr. Rhodes Boyson, M.P., a former headmaster and now deputy shadow minister of education, has assembled a noteworthy collection of timely essays by some of those Britons who have not yet given up on an island which was once the principal defender of freedom in the world.

The theme of this book is that there is till time to avoid a 1984 world in Great Britain if only those who still believe in a free market economy and in the traditional values which once made Britain a model for the world will exert all their efforts to oppose the tide of socialism at home and defeatism abroad.

Professor A.A. Walters, a leading monetarist economist, leads off with a chapter explaining why inflation is not the fault of greedy businessmen or voracious unions or Arab oilmen (as governments would like us to believe) but is, in fact, primarily the fault of the excessive use of the printing press by governments themselves.

Ralph Harris, a former economics don at St Andrews (perhaps the most liberal, in the true sense of the term, of the world's leading universities) went on to direct the respected Institute of Economic Affaris in London. Writing from the standpoint of that bulwark to the market economy, Mr. Harris explains cogently how competition will lead to a more prosperous nation with greater equality of opportunity for all.

Russell Lewis, an economist and journalist (author of *The New Service Society*) exposes the actual results of nationalisation and shows how the trend to state-ownership can be reversed.

Arthur Shenfield, another economist (and barrister) and recent President of the Mont Pelerin Society (the international association of classical liberal scholars) tells us how the trade unions can and should be brought under the rule of law.

Arthur Seldon (the other half of "the double-ax" of Harris and Seldon