GENETIC ENGINEERING: PROSPECTS AND RECOMMENDATIONS

by Bernard D. Davis and H. Tristram Engelhardt, Jr.

Abstract. At the 1983 Summer Conference on the Institute on Religion in an Age of Science, working groups chaired by the co-authors outlined some of the prospects for the use of somatic and germ line genetic engineering and related biological technologies to alleviate disease and to modify human behavior. They then offered a series of recommendations concerning the application of genetic engineering to persons and the monitoring of medical research and therapy.

"What Is and What Makes a Person? Consequences of Current Genetic Research for Scientific and Religious Evaluations of Human Nature" was the theme of the thirtieth Summer Conference of the Institute on Religion in an Age of Science. Held on 30 July-6 August 1983 on Star Island, New Hampshire, the conference surveyed current genetic research and its implications for understanding and making decisions regarding possible modifications of human nature, in order to suggest ways of dealing effectively with ethical issues arising out of the possibilities offered by current and future medical technology.

After discussing presentations on the history of the notion of person, on current genetic research and its possible uses for gene therapy and other applications to alter human beings, and on the philosophical, ethical, and theological issues involved in so acting on persons, the conference was organized into working groups in order to produce a statement for the wider public on the scientific prospects and the social and moral issues related to genetic engineering. Two working groups,

Bernard D. Davis is professor of bacterial physiology, Harvard Medical School, 25 Shattuck Street, Boston, Massachusetts 02115. H. Tristram Engelhardt, Jr., is a professor in the departments of medicine and community medicine and a member of the Center for Ethics, Medicine, and Public Issues, Baylor College of Medicine, Texas Medical Center, Houston, Texas 77030. An earlier version of this paper was developed by working groups, chaired by Davis and Engelhardt, at the Thirtieth Summer Conference ("What Is and What Makes a Person? Consequences of Current Genetic Research for Scientific and Religious Evaluations of Human Nature") of the Institute on Religion in an Age of Science, Star Island, New Hampshire, 30 July-6 August 1983.

[*Zygon*, vol. 19, no. 3 (September 1984).]
 ISSN 0044-5614

chaired by us, drafted the following statements of prospects and recommendations.[1] Although they reflect neither the thinking of everyone present nor the official policy of the Institute on Religion in an Age of Science, they were accepted as an accurate formulation of the general results of the conference and as worthy of being shared with a wider audience.

Statements of the Prospects for Genetic Engineering

1. It is rapidly becoming possible to identify and isolate any human gene, to determine its DNA sequence, and to integrate it into cells. The problem of ensuring activity of that gene in the cell, and of regulating that activity adequately, is less advanced but seems likely to be solved soon.

2. With these techniques, gene therapy (addition or substitution of a normal gene) in patients with defective somatic cells will probably soon be possible for diseases of the blood, because cells taken from the bone marrow (the source of red blood cells, white blood cells, and antibodies) can be genetically modified and then used to recolonize the marrow. For diseases in highly organized organs and tissues (other than the endocrine system) the prospect of such cure does not seem promising.[2]

3. The development of the brain is very much more complex than the single gene mechanisms responsible for most hereditary diseases. Hence predictable, useful modification of behavior by gene insertion, either in somatic cells or in germ line cells, would be very difficult to achieve. Moreover, the possibilities through somatic gene manipulation are particularly limited. Such manipulation might conceivably be used to alter mood, by changing the level of hormones or neurotransmitters in the brain, but it cannot be expected to rewire the circuitry that has been laid down before birth. That circuitry, along with the environment, is surely a major source of our individual differences in behavioral capacities and patterns.

4. Genes incorporated into germ line cells would be replicated in all the cells of the resulting individual and also in succeeding generations; this procedure has already been accomplished in mice. However, no responsible medical investigator would extend it at this time to persons, because genes inserted in a cell are incorporated into chromosomes at random locations and hence may damage an already present, normal gene at the site of insertion. Moreover, a more predictable, less risky way of reaching the same preventive goal is provided by prenatal diagnosis (e.g., by amniocentesis), followed by abortion and a subsequent pregnancy. In addition, the usefulness of prenatal diagnosis is rapidly being extended, since it can now be accomplished earlier in

pregnancy, and, for an increasing variety of defects, by detecting differences in the DNA rather than in the products of cultured cells. Accordingly, a ban on germ line recombinant DNA research, recently demanded by a group of clergymen, seems both unnecessary and misleading.

5. Although human germ line intervention is too risky to undertake now, the main risk might someday be eliminated if the site of DNA insertion into a chromosome could be directed. It would then be important to distinguish between the use of the procedure for preventing diseases versus its use for political purposes. Moreover, while any effort at "improving" our genes now would present excessive social problems, in addition to serious risks of damage to the subject, one can imagine that someday the survival of the species might depend on improving our adaptation to an altered environment.

6. Another conceivable form of genetic engineering, cloning (exact genetic copying), comprises two very different procedures. Cloning from early embryos is already practiced in cattle and could be done in humans. However, it seems to present no unique moral problems and few or no grounds for its use, since it yields genetically unpredictable, identical twins—an event that already occurs naturally and that involves no fundamental change in the mechanism of reshuffling the genes in sexual reproduction. In contrast, cloning from cells of a developed (and presumably adult) person would present serious, novel moral problems. However, this procedure is not possible with nuclei from adult mammals at present, and it may well never be possible, because there are indications that adult differentiated cells differ slightly in their DNA and hence cannot give rise to a viable embryo.

7. The likely dangers from future advances in genetic engineering, as applied to humans, do not require long-range warning or planning, because they could not create a massive or irreversible catastrophe. Instead, they would involve individual actions, which could be controlled as the need arose.

8. In the past ten years fertilization of human eggs in the test tube and embryo transfer from one uterus to another have progressed from a newsworthy curiosity to a practice that will soon be routine. These techniques make it possible to achieve a pregnancy that would otherwise be prevented by tubal blockage, a low sperm count, or conditions in which pregnancy would endanger the mother's health. In addition to this opportunity to satisfy the powerful and valuable urge to have children within a family, these techniques also make the fertilized human egg available for studies that will improve our ability to solve problems of reproduction.

Recommendations

1. Genetic engineering in humans should be directed only to gene therapy: the cure or amelioration of disease. Arguments against tampering with the course of evolution do not provide a rational basis for interfering with such medical advances.

2. Gene therapy should be undertaken only after careful assessment of possible harms and likely benefits. In particular, germ line intervention should be approached with extreme care because of the possible risks to future persons.

3. Regulations should be developed, but they should not impede the development, or delay the availability, of beneficial medical treatments. In addition, the use of these techniques in the laboratory can be of immense value in advancing our knowledge. Such research should therefore not be restricted by fears of undesirable possible applications.

4. Science writers should be encouraged to make information available to the general public regarding advances in gene therapy and concerning regulations bearing on the subject. Science writers should also help to direct public concern toward real problems in the development and the application of science and away from imagined problems.

5. A continuing commission should be established, composed not only of scientists and physicians but also of lawyers, ethicists, and lay persons, to review the moral and public policy issues raised by future advances, or likely advances, in molecular genetics and gene therapy.[3] Since similar problems are encountered in other areas of medical research and therapy, the charge of the commission should include moral issues in all medical research and treatment and should not single out genetic engineering. The commission should ensure that the public is well informed of its deliberations.

Notes

1. A few stylistic changes have been made in the text of the statements to make them clearer.

2. Recent work with Drosophila suggests, however, that gene expression may be tissue specific.

3. This was perhaps the most controversial recommendation formulated at the conference. It is one with which the authors are not in complete agreement. Engelhardt would prefer not to have the commission be a "continuing" commission. Davis thinks that existing local review boards in hospitals could handle the problems likely to come up, leaving a commission with no job to do; however, if major new ethical problems arose, a national commission could be established to formulate policy that could be employed by local boards.