The Experiences and Challenges of Science and Ethics: Proceedings of an American-Iranian Workshop

Committee on the Experiences and Challenges of Science and Ethics in the United States and Iran, In cooperation with the Academy of Sciences and the Academy of Medical Sciences of the Islamic Republic of Iran, National Research Council

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Preface

In April 2002, the U.S. National Academies hosted an interacademy workshop involving participants from the United States and Iran at the Conference Center of the Rockefeller Foundation in Bellagio, Italy, on the topic of Science and Ethics. The American participants were selected by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine of the United States; and the Iranian participants were selected by the Academy of Sciences and the Academy of Medical Sciences of the Islamic Republic of Iran. All attendees participated in their personal capacities, and the documents that were developed prior to and during the workshop express their personal views and not the views of the academies.

This workshop was the first of six interacademy workshops to be organized by the academies in the two countries in accordance with discussions between the leaderships of the academies in Tehran in September 2000.

This report includes documents prepared by four breakout groups that held concurrent meetings between plenary sessions and a statement on priority areas for future interacademy cooperation developed at the final plenary session. Also included are background papers prepared by some of the participants prior to the workshop that had not been previously published and two particularly relevant background documents that had been published. The statements made in the enclosed papers are those of the individual authors and do not necessarily represent positions of the National Academies. The participants recognized that given the state of U.S.-Iran relations, future contacts will be limited, but they never-

theless considered that a broad menu of possible cooperative activities would provide impetus to begin serious cooperation.

The breakout groups were charged with considering the following four issues:

1. Similarities and differences in the United States and Iran in defining and approaching selected issues.
2. Roles of the academies in the United States and Iran in addressing the issues.
3. The global character of the issues.
4. Opportunities for international cooperation: bilaterally between the U.S. and Iranian academies, through the Inter-Academy Panel, on the basis of scientist-to-scientist contacts, and through other channels.

At the final plenary session, each of the breakout groups presented its two highest priority topics for future interacademy collaboration in the field of science and ethics. The groups also suggested how these topics might be incorporated into specific joint projects. All of the participants then cast votes as to which of these topics should be given the highest priority.

Formal criteria for the initial selection and then the ranking of the topics were not adopted, but participants suggested that the following considerations might guide the voting: importance of the topic, the feasibility of obtaining financial support for a project directed to the topic, and past experience and current interest of the academies in addressing the topic. The topics are listed in priority order based on the views of the participants

Kenneth Shine

Acknowledgments

The Iranian Academy of Sciences and the Iranian Academy of Medical Sciences were full partners in organizing and leading the workshop. The insights of their specialists provided an unusual and essential dimension for this NRC report on an important topic.

We also express our appreciation to the Rockefeller Foundation for accommodating us at the Conference Center and for providing financial support. We are particularly indebted to the staff at the Conference Center for their administrative assistance during the duration of the workshop. The W. Alton Jones Foundation and the National Research Council provided additional financial support for the workshop.

The staffs of the Institute of Medicine and the National Research Council organized and took the lead in preparing these proceedings. Glenn Schweitzer, the responsible staff officer, Wilhelmine Miller, and Sara Gray ensured that the arrangements were conducive to valuable discussions among the participants during both the formal sessions and during informal activities.

This proceedings has been reviewed in draft form by individuals chosen for their technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its reports as sound as possible and to ensure that they meet institutional standards for quality. The review comments and draft manuscripts remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of the papers in this proceedings: Thomas Blasingame, Texas A&M University;

George Bugliarello, Polytechnic University; Michael Fischer, Massachusetts Institute of Technology; William Kastenberg, University of California, Berkeley; and Richard McCray, University of Colorado.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the content of the individual papers, nor did they see the final draft of the proceedings before its release. Responsibility for the final content of the papers rests with the individual authors.

Kenneth Shine

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Final Plenary Session: Areas for Future Cooperation

Kenneth Shine

Based on the voting at the Final Plenary Session, the following eight projects for future cooperation were considered to be of highest priority in the order indicated.

1. The academies should encourage the integration of ethical values into kindergarten-grade 12 science curricula with special attention to "hands-on" approaches that encourage pupils to work together and gain an appreciation of how individual values should be reflected in real life situations.

2. The academies should organize a workshop or study on food security, including consideration of the control of food contamination and food-borne diseases as well as the adequacy of and access to the food supply in changing demographic situations. In the project, consideration should also be given to the importance and content of nutritional diets that help prevent obesity and other food-related ailments. The project should involve a review of relevant legislation in both countries to help ensure that the project encompasses the major issues of current concern.

3. The academies should arrange for an exchange of ethics experts who are familiar with science and technology issues. Initially one expert from each country should visit the other country and lead several seminars on science, technology, and ethics while also consulting with local experts in the field of ethics. A second step might include preparation by the two experts of a joint paper on key ethical concerns in developing and carrying out scientific research and related programs.

4. The Iranian Academy of Sciences should review the report of the National Research Council entitled *On Being a Scientist* and determine whether the report or a modified version of the report would be appropriate for distribution in Iran and/or in other Muslim countries. The Iranian academy should also consider preparing a first draft of a companion report that might be entitled *On Being an Engineer.* After review by the U.S. National Academy of Engineering, the report might be published as a joint report of the two academies. Alternatively, each side could prepare its own version of the report.

5. The academies in the two countries should consider organizing an exchange of experts in the field of cancer epidemiology who might compare different approaches to assessing the impact of environmental pollutants on cancer rates including impacts from the petrochemical industry. A second priority field for an exchange of experts should be medical genetics.

6. The academies should consider organizing workshops on environmental education at various levels from kindergarten through university. A unique aspect of the workshops would be to develop modules for appropriate levels that could be presented in films and other animated forms that attract the interest of students.

7. The academies should organize workshops and related activities on the legal and policy frameworks for addressing environmental issues while also encouraging the development of sister city arrangements between municipalities that have been concerned with health, environmental, and other issues involving a host of ethical considerations.

8. The academies should facilitate exchanges of scientists, educators, and students that emphasize the ethical aspects of the education process. One approach would be to enlist the participation of organizations in the two countries that have histories of promoting exchanges that are sensitive to ethical issues.

More than a dozen other suggestions were presented in the reports of the breakout groups. While the participants decided not to expand the priority list to accommodate more of these suggestions, they agreed that these suggestions should not be lost, and included them in the reports of the breakout groups.

Research Integrity

Mehdi Bahadori and George Bugliarello

The breakout group considered many aspects of research integrity, drawing on both Iranian and American publications that were of relevance to the topic. Summarized below are the highlights of the discussions. The other participants in this group were Seyed Mohammad Jafar Marashi-Shoshtari, Glenn Schweitzer, and Kenneth Shine.

SIMILARITIES AND DIFFERENCES IN THE APPROACHES TO RESEARCH INTEGRITY IN THE UNITED STATES AND IRAN

The members of the group observed similarities in approaches on the following issues.

- Scientists, engineers, and health specialists as representatives of learned professions are responsible for addressing both the creation of knowledge and the use of this knowledge for informing policy. They should keep the public informed of activities involving science. They have a trusted role in society and a special role in safeguarding integrity.
- Ethical issues in engineering and health have many characteristics in common with ethical issues in science, but they also have characteristics and scopes of their own and therefore cannot be totally subsumed under the label of ethics of science.
- Research integrity has three interrelated components: integrity of the scientist; integrity of research design; and integrity of scientific data, including the collection, analysis, and interpretation of data.
- There is a difference between misconduct (e.g., fabrication of data,

falsification of data, and plagiarism) and careless science. The latter does not reflect breaches of integrity as such and can often be remedied by improved training and better supervision.

- The environment in which science is carried out is in many ways a part of the scientific process and plays an important role in ensuring integrity. Students working in research laboratories can often provide important perspectives in this regard.
- Research directors must take responsibility for integrity within their teams. To this end, they have special responsibilities for mentoring junior scientists.
- The issue of authorship is frequently linked both to productivity and to integrity. In this regard, the number of publications is not necessarily the best way to judge the productivity of a researcher. The quality of results set forth in papers is probably a better indicator than simply the number of papers. Also, there may be questions concerning multiple authors of papers. A good practice adopted by some journals is to specify the responsibility of each author in footnotes to papers. At the same time, the lead authors must take responsibility for the integrity of the entire paper.
- In a complex paper involving many researchers, individual researchers may not comprehend the scope of the entire paper. Special efforts may be needed to help the entire team understand how individual contributions are interrelated. Such efforts help ensure that breaches of integrity in any part of the process will be recognized by some or all of the participants.

The following observations reflect different perspectives and experiences of the participants from the United States and those from Iran.

- The Iranian members considered ethics to be based on absolutes from which standards of conduct are derived for particular activities. The quality of the "will" of researchers is the basis of all choices. There was no consensus among the Iranians, however, as to what are the absolutes. The Americans noted that baselines for judgments are not precise and therefore they have not adopted this approach.
- In the United States, the higher education system is considered effective in instilling ethical values in students. However, if the students are then employed in laboratories that cut corners, their perspectives on integrity change considerably. In Iran, there has not been a comparable focus on the transition from education to practice.
- The issue of whistleblowers is dealt with more explicitly in the United States than in Iran, which does not have rules concerning whistleblowers.

- In the United States, there are Offices of Research Integrity at the national and institutional levels, including at universities. Universities make their own investigations of alleged misconduct and then take corrective action, reporting to government funding agencies as appropriate. Also, professional societies often assume special responsibilities in the field in helping to define "responsible science." In Iran, the government is dominant as it makes policy and disburses funding. There are professional societies (e.g., the Mechanical Engineering Association) that also have an interest in research integrity, although they are less developed than in the United States.
- In the United States, professional societies sometimes publicly address the issue of careless science but hesitate to delve into integrity. Professional societies in Iran have not explicitly addressed research integrity.
- It is often easier to address how misconduct happened rather than why it happened (e.g., greed, ambition, lack of supervision). In Iran it is believed that addressing the reasons for misconduct is crucial and that ethical values must be nurtured to avoid these root causes. Therefore, they have given greater attention to root causes.

ROLES OF THE ACADEMIES WITHIN THEIR COUNTRIES

- In addition to concern over ethical responsibilities of individual scientists, the academies have multiple ethical responsibilities to anticipate problems, respond to issues, inform policy makers, inform the public, and in general address the ethical aspects of all of their activities.
- A task of the academies is to define standards of ethical behavior, including the important issue of mentoring.
- In the United States, the academies sometimes begin with specific cases or narrowly defined types of cases concerning ethical issues, most frequently in response to requests from government agencies. From analyses of these cases, broader conclusions are reached as to the meaning of misconduct and research integrity. In somewhat oversimplified terms, in the United States, concerns over misconduct tend to flow from the particular case to the general situation, whereas in Iran they flow from the general to the particular. In Iran, the academies have not yet focused on specific types of cases but indirectly have addressed ethical issues in broad areas such as environmental pollution, food security, nutrition practices, prolongation of life, and authorship.
- For studies carried out by the U.S. National Academies, considerable attention is given to the composition of the study committee, with the public given an opportunity to comment on the balance of the committee. This often leads to inclusion on the committees of representatives of nongovernmental organizations (NGOs).

- In Iran, the emphasis in academy studies is on both research priorities and on the policy direction for the entire country, which encompasses issues of equity. In the United States, the academies tend to focus more narrowly on research areas (e.g., astrophysics), although they also address national issues with significant ethical dimensions. In creating research agendas in either country, the ethical implications of these agendas should be given adequate weight.
- The Iranian Academy of Sciences has a section on philosophy and religion which addresses ethical issues on the basis of general principles.

INTERNATIONAL ROLES OF ACADEMIES

The Interacademy Panel and its interactions with governmental and international organizations as well as joint projects between two or more academies are important mechanisms for addressing ethical issues of international and global significance, such as global warming.

OPPORTUNITIES FOR INTERACADEMY COOPERATION

The group identified the following seven opportunities for interacademy cooperation. The first two topics were considered the most feasible for early implementation.

1. The Iranian Academy of Sciences should review the National Research Council (NRC) report *On Being a Scientist* and determine whether and how it should be modified to provide guidance to scientists in Iran. The Iranian Academy should then seek the views of the NRC on the proposed Iranian adaptation of the report. In a related activity, the Iranian Academy of Sciences should prepare the first draft of a new report "On Being an Engineer" and provide the draft to the National Academy of Engineering (NAE) for comments and elaboration as appropriate. The Iranian Academy should consult with industrial engineers during the preparation of the draft. The academies should then decide whether such a report is warranted and, if so, whether each side should prepare its own version or whether the report should be jointly prepared.

2. There should be an exchange of U.S. and Iranian experts—one expert for at least one week in each direction—in the field of science and ethics. These exchange visits should include seminars and consultations with science and technology leaders and with ethicists.

3. Consideration should be given to an analysis by an Iran-U.S. interacademy group of the ethical dimensions of selected global issues. Such a project could be carried out bilaterally or multilaterally. However, action should be deferred until a later date to take into account the findings of

other U.S.-Iran workshops and the results of the Johannesburg international conference on sustainable development.

4. The academies should consider promotion of a network of Centers for Research on the Cultivation of Human Values. As a first step, a new center in Tehran might be linked with a center in the United States that already carries out relevant research projects.

5. The academies should consider joint assessments of the ethical aspects of the development of specific new technologies that are likely to emerge during the next 10 years. As a starting point, the NAE could provide the Iranian Academy of Sciences with its recent reports on emerging technologies.

6. The academies should consider working together to promote models for international development that are culturally appropriate for different societies. Standard development models promoted by the United Nations Development Programme and other well-known organizations do not adequately take into account ethical considerations and therefore can discourage organizations and specialists from enthusiastic participation in these development activities.

7. The academies should jointly consider a sequence of case studies in Iran and the United States that demonstrate the similarities and differences in addressing ethical issues associated with specific problems of national interest. For example, American specialists might take the lead in reviewing the Iranian approaches to controlling air pollution, and Iranian specialists might take the lead in reviewing the U.S. approaches to controlling air pollution from petrochemical plants. These specialists would then jointly consider the ethical issues involved in the two cases.

Environmental Equity

Michael Fischer and Seyed Mostafa Mohaghegh Ahmadabadi

The breakout group on environmental equity considered many aspects of the topic, drawing on both Iranian and American publications that were of relevance. Summarized below are the highlights of the discussions. The other participants in the group were Bernard Goldstein and Abbas Sharifi Tehrani.

SIMILARITIES AND DIFFERENCES IN THE APPROACHES TO ENVIRONMENTAL EQUITY IN THE UNITED STATES AND IRAN

The members of the group discussed the similarities and differences between approaches of the United States and Iran in addressing the following topics.

- Environmental Philosophies.

There is the common complaint that environmental crises come from overexploitation of nature due to one or a combination of the following causes: unlimited growth generated by the capitalist engine; acceptance of a principle embedded in the three Abrahamic religions of Judaism, Christianity, and Islam that nature exists for use by human beings; and the implementation of scientific discoveries without a grounding in spiritual or holistic values. This overexploitation could be called the evolving crisis in positive feedback systems or systems out of control.

Secondly, there are philosophies that are grounded in some of the

environmental movements of the nineteenth and twentieth centuries. These might be called Romanticism. Generally nostalgic ideas are based on an overenthusiasm for "pristine nature."

Finally, other philosophies might be grouped under a notion of "stewardship" (*khalifat*), which incorporates concerns for sustainable development and sustainable ecologies for future generations as well for the present population.

How is stewardship to be evaluated? Can human societies be trusted to be stewards of nature even though they have traditionally, including in the present, embraced economies destructive to the environment? Can a form of "speaking for the earth" in the sense of the Gaia Hypothesis work under the notion of stewardship/*khalifat*? Or is *khalifat* purely an androcentric concept? It was pointed out that the Koran repeatedly asks human beings to return to God an earth as uncorrupted as it was when given to their stewardship.

Both Iranian and American participants agreed that religious beliefs can support responsible environmentalism and that Romanticism is insufficient to balance the needs of growing populations with demands for higher standards of living. The Americans tend to focus on (a) who is responsible for damage done to the environment; (b) how restitution, remediation, and repair is to be achieved; and (c) how incentive systems to avoid damage can be instituted. Both Iranian and American participants agreed that education in schools, in the workplace, through the mass media, through NGOs, with municipalities, with national governments, and as a product of international conventions is a fundamental requirement for responsible stewardship.

- Government Organizations and Regulatory Structures.

At the national level, Iran has a Vice-President in charge of the Department for Environmental Protection, parallel in some degree to the U.S. Environmental Protection Agency (EPA). Parliamentary reports on environmental issues are issued, parallel to U.S. Congressional hearings and research reports. On the municipal level, there are newly elected municipal councils that manage the environmental problems of cities, parallel to state and city governmental agencies in the United States. On the international level, there are conventions, occasional court cases, and diplomatic negotiations over topics such as pollution, fishing, and in the case of Iran, caviar catches in the Caspian Sea. Both countries have university-level departments and programs in environmental sciences, epidemiology, and environmental health problems. Also, they have faculties in both environmental law and international human rights law as applied to the environment.

ROLES OF THE ACADEMIES

- The academies can be important "bully pulpits" for shaping both governmental and nongovernmental discourse on environmental goals.
- The academies can convene workshops and roundtables to compare environmental law and regulatory structures including implementation, enforcement, and incentives; and they can encourage deliberative democracy or local level organization to give feedback about local level problems to higher level environmental planning and protection agencies.
- The academies can convene workshops on creating educational modules for primary, secondary, and university level students, as well as for workers and government employees. These could include exchanges among film and television production units such as those that produce NOVA and Discovery programs in the United States, as well as investigative or community-based environmental journalists.
- The academies could initiate governance and local responsibility programs that support local school programs to map and monitor environmental problems, and perhaps link these by computer to "pen pal" schools. They could promote self-monitoring as a way of changing local practices to cleaning up trash rather than considering public space as someone else's responsibility. Responsible water use and management are important. Involving students in this effort is a way of introducing change from the bottom up that involves the next generation. Moreover, this could be a creative way to teach ecology, link local groups together, provide information loops between neighborhoods and municipal council members, collect data sets, provide empirical data sets for high school and college research projects, and expand the use of information technology connectivity for civic purposes.
- The academies could supervise the design and implementation of educational modules such as those developed for kindergarten-grade 12 by the American Public Health Association.

GLOBAL OR INTERNATIONAL CHARACTER OF THE ISSUES

Pollution, global inequities in energy and resource utilization, deficiencies in environmental education, and inadequate environmental philosophies are all transnational issues. Moreover, remote sensing and mapping technologies, as well as more traditional ecological knowledge, provide powerful tools for environmental monitoring, data collection, modeling, and management on a global scale. These are tools that could be jointly used with the assistance of NASA space technologies. Also, Geographic Information Systems and other systems adapted for use by towns and villages could be disseminated to users throughout the world.

Such an approach could be the basis for flexible customization of new technologies and their melding with on-the-ground knowledge.

OPPORTUNITIES FOR INTERNATIONAL COOPERATION

- The Iranian and U.S. academies could cooperatively mount the approaches suggested above. Modules could be incrementally expanded to other countries. Scientist-to-scientist exchanges could provide the sinews and contact points for mounting workshops and roundtables and ensuring that they are ongoing endeavors and not one-time events.
- Twinning of cities for collaboration on particular types of environmental issues could support local self-governance and care for the environment. For example, Isfahan and Albuquerque have similar issues with water, desert environment, and urban preservation together with industrial development. Ahwaz or Khoranshahr and Houston have similar challenges with regulation of the petrochemical industry—documenting cancer rates, regulating maritime activities in the ports, and reducing pollution. Tehran and Washington have sharp inequalities of wealth and class leading to disparities in the resolution of environmental problems, as well as interference in municipal self-governance by the national government when dealing with environmental issues.

Ethics in Medicine

Enriqueta Bond and Mohammad Reza Zali

The last decade has seen remarkable advances in our capacity to study molecular and cellular biological processes, to conduct stem cell research that leads to developing new medical therapies for debilitating diseases, and to explore fundamental questions of genetics as applied to medicine and even to cloning of selected animals. Technological advances permit screening and testing for an increasing number of genetic diseases. The mapping of the human genome provides new avenues for identifying and characterizing genes that may predispose to disease with the possibility of developing prevention and treatment strategies. However, these advances present society with numerous ethical and resource allocation challenges.

At the same time, the improved health of the citizens of the United States and Iran depends on the ability of these countries to provide health care that is based on the best available scientific knowledge that meets the needs of the population. The changing epidemiology of the disease burden, together with demographic changes such as the aging population in the United States and a growing cohort of youth in Iran, require rethinking investments in health care delivery systems, in organization of such systems, and in related research needs.

Both of these themes—ethical issues of medical genetics and the allocation of health care resources—were priority topics of discussion for the breakout group that also included James Childress, Sara Gray, and Hassan Tajbakhsh.

SIMILARITIES AND DIFFERENCES IN IRAN AND THE UNITED STATES IN DEFINING AND APPROACHING THE ISSUES

The following subtopics were discussed under Ethical Issues in Medical Genetics:

- Criteria for the Requirements and Timing of Genetic Screening and Testing.

There is no single federal regulation to govern screening in the United States, since screening and testing laws and regulations vary from state to state. Some states have mandatory screening, but in general the emphasis is on voluntary screening. Recently, considerable emphasis has been placed on nondirective counseling whereby physicians attempt to give patients facts about medical situations without suggesting one course of action over another.

In the United States the decision to screen relies on at least two norms: (1) Is treatment available for the disease that is being screened? (2) Will the diagnosis provide the basis for reproductive decision making? Recently the ability to test for multifactorial complex diseases has become technically feasible. But such testing is predictive in nature, and the disease may or may not emerge in the future. Also, the disease may be related to both genetics and environmental conditions. There is, therefore, a reluctance to mandate predictive screening.

In Iran screening technology is not as advanced, and there are fewer tests in use for genetic screening. Those that are available include Thalessemia and RHneg tests. Karyotyping is available on a limited basis for Downs syndrome or other chromosome abnormalities, and testing for Duchenne and for cystic fibrosis is also possible. As the number of tests available to Iranians increases, an important question is how to approach the cost/benefit analysis of deploying tests for diseases of limited burden or of low frequency. Similar to the situation in the United States, screening in Iran is done on a voluntary basis. The decisions to screen rely heavily upon the patient/physician relationship. Professional societies are beginning to develop guidelines for screening, especially the pediatric and obstetrician-gynecological societies. One important aspect related to genetic screening in Iran is that a woman may have an abortion if the fetus has congenital malformation and she is able to obtain permission from her doctor and from a judge.

- Education of Health Professionals and How They, in Turn, Educate the Public.

The American participants reported that it is often the medical societies and volunteer associations that have taken the lead to educate the

public. There is also some relevant instruction in the kindergarten-grade 12 system.

Iran also relies on the kindergarten-grade 12 system in addressing health issues, but it has a much stronger governmental presence in public education, as the Ministry of Health is responsible for public education. The ministry funds the universities and research centers and therefore is well positioned to lead in medical ethics education. The role of educational technology in this effort is not yet well developed.

- Regulation of Laboratory Diagnostic Tests.

In the United States much stress is placed on the regulation of specificity and sensitivity of laboratory tests. The issue of testing for carrier status of a gene in infancy raises concerns. For example, a patient with the sickle trait may not have the disease but may be labeled as "sick" by the test. The Iranian participants stressed the basic need of deployment and access to laboratory tests and suggested an exchange with the United States of scientific information on best practices.

- Privacy and Confidentiality Issues of Data Repositories Including Appropriate Consent Both for Research and During Clinical Trials.

The issue of data or tissue repositories for study and perhaps eventual use in clinical trials brought to light some interesting differences between Iran and the United States. For the United States, the concept of privacy is very important. In this regard, the legal bounds of consent are being tested for research on stored tissue. Often the ability to do research with repositories depends on the anonymity of the subjects. When dealing with samples in the United States, the scientist must also be aware of possible property rights of the sample's originator. In contrast, in Iran the samples are generally viewed as the property of the investigators, and the consent given by a patient in Iran is usually more encompassing than the consent a patient gives in the United States.

- Social Responses to Medical Genetics Ethical Issues Such as Sex Selection, In vitro Fertilization, and the Relevance of Religion and Philosophy.

Looking at societal approaches on sex selection, neither Iran nor the United States has evidence that this regularly occurs. The United States does not prohibit abortion for sex selection, yet sex selection is not apparent except for sex-linked genetic conditions. Underlying factors include the opposition of professional and religious societies to sex selection and the espousal of a commitment to gender equality.

Sex selection is not regularly practiced in Iran, due partially to the fact that abortion is not allowed under most circumstances. While in vitro fertilization is allowed, the Iranian participants have seen no evidence of this being used to select sex. In Iran the cultural importance placed on having children and having a large family opposes the idea of discarding a child of one sex. Iran would most likely have the framework to regulate or

ban sex selection if it were to come into practice, given the example of the Iranian parliament's current discussion on donor sperm and eggs.

The final topics concerned cloning and gene therapy. Due to the history in the United States of freedom of choice regarding reproductive technologies, the U.S. federal government is finding it difficult to ban new technologies, even those regarded as harmful. There are some regulations regarding gene therapy and stem cell research, but at this point only a few states have banned cloning. Professional societies on the whole are opposed to reproductive cloning. Iran has not yet developed the technical capability for reproductive cloning; however, Iran seems better equipped than the United States to deal with the technology when it is available since Iran already has investigated related issues.

Regarding allocation of health care resources, the group made the following observations.

- The Changing Burden of Disease, Epidemiology of Diseases, and Priorities for Health Care.

Some of the problems Iran and the United States share are changing demographics, a change in morbidity from communicable diseases to noncommunicable diseases, new and re-emerging diseases, and multidrug resistance in diseases. Iran and the United States also face similar challenges in providing health services to growing immigrant or refugee populations. Finally, the Iranians stressed that obesity was a burgeoning health problem as it is in the United States.

Iran differs from the United States in the technology area. It just now realizes the importance of high-tech and expensive procedures for health protection and is seeking direction on the best way to deploy advanced technologies. Iran's human capital, technology, and financial resources are limited compared to those of the United States. Meanwhile, the impact of urbanization on health (changing diets, pollution, and stress) is seen as a large problem.

On the positive side, Iran has historically had a responsive national health care system as exemplified by its primary health care system. This system needs guidance from scientists, however, in responding to the changing epidemiology of the disease burden. Another issue is the disease burden related to Iran's high population growth. The government in Iran supports population control through birth control. Family support for aging family members remains intact, but mores are changing and portend the need to develop new approaches to care in the future. Injuries and accidents are the greatest causes of death and injury, likely due to the large youth populations.

• The Need to Shift the Health Care Paradigm From Treatment of Disease to Prevention of Disease.

Promotion of health is of great importance in both countries. The role of the individual is critical in disease prevention, thus shifting the locus of decision making from the physician to the individual.

• Evidence-Based Medicine and Use of Best Practices to Improve the Quality and Safety of Health Care.

Both countries lack an overall system of health priorities, and there is weakness in the public health systems. Oregon is the only state in the United States that has established medical priorities, and it has done so only in reference to the Medicaid program. Also, the anthrax incidents in the United States have brought to light weaknesses in the public health infrastructure.

• Quality of Care and Direction of Resources to Health Care Priorities.

There are incentives and payment policies in both countries that foster continued inequality in access to health care and an excessive emphasis on acute care rather than care for chronic diseases. Another resource issue is the problem of ensuring access to basic services while at the same time rationing investments in expensive services and tertiary care in ways that maximize the use of resources to best ensure a healthy population.

OPPORTUNITIES FOR INTERNATIONAL COOPERATION

The group offered recommendations for possible collaboration between the academies in the two countries.

• Providing U.S. Reports on an Ongoing Basis to Counterpart Academies in Iran, Especially Online.

Many reports produced in the United States could be useful in supporting Iranian science and technology transfer activities.

• Facilitating Access to Journals and to the National Library of Medicine's Resources.

Iranian scientists and medical professionals would benefit from free access to journals and other relevant literature.

• Development of a Special Website to Facilitate Exchange of Information.

A website is currently under development at the U.S. National Academies for the Internet Message Access Protocol that could have a section specifically dedicated to interacademy collaboration.

• Promotion and Implementation of a Variety of U.S.-Iran Exchanges.

As a first step, the Iranian side could identify centers of excellence and topics for possible collaboration. A "sister" or "twinning" approach could

match universities, hospitals, professional societies, cities, or government agencies. The Centers for Disease Control and Prevention, for example, have an international fellowship program that might be of particular interest.

- Iranian Participation on Committees of the U.S. National Academies.
- A Frontiers of Science Program that Convenes Young Scientists from Different Fields to Consider Cutting-Edge Research.

A first step for the U.S. National Academies is to invite an Iranian observer to a Frontiers program to explore the feasibility of a more formal interaction.

- Iranian Use of the Institute of Medicine's Reports on Injury Prevention and Iranian Sharing of Data Collected on Accidents in Iran.

The increase in death from accidents and injuries suggests a possible role for the Iranian academy to undertake an injury prevention study in which it could make recommendations to the government agencies such as the Ministry of Health or Ministry of Transportation and Roads. This would be similar to a study of the Institute of Medicine that influenced the founding of an injury prevention branch of the Centers for Disease Control and Prevention.

- Meetings to Explore Approaches to the Transfer of Medical Science and Technology of Interest in Iran.
- Interacademy Collaboration Using Global Surveillance Techniques for Monitoring Infectious Diseases and Emerging Infections.
- Research Devoted to the Changing Demographic Descriptors and Epidemiology of Disease, with Possible Associations to the World Health Organization (WHO).

WHO has studied the epidemiological shift to chronic disease and is in the process of updating a major study on health burden in different countries. While heart disease has received considerable attention from WHO, with special study groups in different countries, less attention has been given to cancer.

- A Workshop or Project on Food-Borne Diseases and Food Safety.
- An Interacademy Cross Cultural Study on Obesity Examining the Differences and Similarities of the Two Countries and Cultures.

Areas of interest include eating patterns; exercise; dietary components; genetics; disease patterns; and societal issues.

Finally, the breakout group selected the proposed workshop on food-borne diseases and food safety as a natural next step in collaboration. Not only are there concerns about microbiological contamination of food but there are issues related to feeding hormones and antibiotics to animals. Also, the introduction of genetically modified food has raised controversy in some international venues. Iran has considerable expertise in zoonosis

and emerging concerns about the use of hormones and antibiotics in animals as well as genetically modified foods. The United States has become more aware of food safety issues in the context of bioterrorism. The project might address epidemiology, surveillance, and monitoring; burden of disease; approaches to prevention; a future research agenda; and a case study regarding animal health and zoonosis.

Ethics and Education

Hassan Zohoor and Wilhelmine Miller

Summarized below are the highlights of the discussions concerning ethics in education, drawing on both Iranian and American background materials that were of relevance to the topic. The other participants in the group were David Challoner, Gholamhossein Ebrahimidinani, Fatemeh Faghihi Ghazvini, Ali Mohammad Kardan, and Mary Claire King.

SIMILARITIES AND DIFFERENCES IN APPROACHES TO ETHICS AND EDUCATION IN THE UNITED STATES AND IRAN

The group discussed the similarities and differences between approaches in the United States and Iran in addressing the following issues.

- Structure of the Education System

Iran has a centralized system of education for primary and secondary schools. Most teachers are employed by the Ministry of Education, and all textbooks for use by public and private schools are authorized by the Ministry. Iranian science textbooks are written by Iranian authors, based in part on similar texts used in France, Canada, the United States, and Germany.

Primary school comprises grades 1-5; middle school grades 6-8; and high school grades 9-11. Vocational studies are conducted at the secondary school level. For university applicants, there is one additional year of pre-university coursework. While vocational students account for less than 30 percent of all students, they are increasing as a proportion of all students. High school students take national examinations in some sub-

jects before graduation; but not all subjects involve tests according to a national standard examination every year.

Annually, about 1.4 million high school graduates take the public university entrance examination, and 10-12 percent from public schools are accepted into public universities. Private universities, which are operated by nonprofit organizations, serve about an equal number of university entrants. All high school graduates can enroll in the first semester of the public distance-education system. If they pass the first semester, they can continue their higher education.

Many public schools have active parent councils that work with the school administrators to address some of the near-term school policies. Public schools are geographically distributed and/or neighborhood-based.

Private schools in Iran provide education for less than 10 percent of primary and secondary students, and they are for the most part limited to economically and socially elite groups. Private schools must also follow the Ministry of Education's curriculum guidelines.

The salient features of the American education system that were discussed were that primary and secondary public schools are institutions of local governments or of local school systems, with curriculum and examination policies established at the state level. The proportion of students in private schools varies substantially among states and geographic regions, with less than 10 percent of students in private schools in the Midwest and West, and over 10 percent in many states in the East. Private schools are of two kinds: elite private schools, primarily for wealthier families, and religious schools, predominantly Catholic schools, with enrollment of a broader section of students.

Primary and secondary schools extend through 12 grades in the United States, with the majority of graduating students enrolling in some type of post-secondary school, usually a two-year community college or a four-year college or university. As in Iran, vocational students are less than 30 percent of high school students. Few vocational high school programs are thought to be technologically up-to-date and effective as preparation for immediate employment.

- Religious Education and Explicit Ethical Content in School Curricula.

In Iranian schools, students take mandatory religion classes throughout primary and secondary school in one of four state-recognized religions, depending on their professed belief and background—Islam, Judaism, Christianity, or Zoroastrianism. Examinations are given in each of these four curricula, as appropriate to the student. Prayers are conducted in schools for Muslim children. Children of other faiths are exempt.

The U.S. constitutional provision for the separation of church and state limits the extent and content of ethics education in public schools to virtues and principles important for functioning within and participating in a democratic society—citizenship education. However, at different times, the extent of citizenship education has varied, depending on the social understanding of the boundaries of private and public (civic) morality. Religious education classes in the United States are devoted mostly to elective comparative religion classes (religion as culture, history, and sociology) of one or two semesters maximum at the high school level. Philosophy or other ethics-related classes such as peace studies may also be offered at the high school level, but they are not commonplace.

- Ethical Values Implicitly Taught in Science Education.

The group agreed that ethical values and behavior that are cross-culturally accepted, such as virtues of honesty, benevolence, and mutual respect among persons, should be implicit in science education. For ethical training to be implicit in science education, teachers must be trained to teach science as a practice—not by rote. If teachers do not understand, communicate, and model the practice of science for their students, there is nothing within which to incorporate ethical practices and behavior as a scientist.

- Conveyance of a Universally Valid Set of Ethical Principles.

In addition to translating current explicit curricula in ethics and values education into practice, scientists and educators in both countries should find ways to convey to students a universally valid set of ethical principles and practices that do not depend only on nationality or belief systems.

- Content of Science Teacher Training.

This topic is a matter of concern to practicing scientists in both countries.

- Low Status and Wages of Teachers.

The status of primary and secondary school teachers and teacher wage scales are viewed by scientists and professionals in both countries as too low to attract enough talented, well-trained, and exemplary teachers into the workforce.

- Centralization of Education.

As previously noted, an important difference in the educational systems of Iran and the United States is the centralization of Iranian primary and secondary educational policy within a central Ministry of Education and guided by an appointed High Council on Education. In the United States, in contrast, state governments and, even more importantly, local school districts control curricula, textbooks, testing policies, and employment of teachers. This basic difference makes the locus of action different in each country and affects the role that national academies can play in each system.

- Religion as a Required Subject.

A major substantive difference between the Iranian and American systems of public education is that religion is a required subject in Iranian schools while U.S. public schools are prohibited from teaching religion as a belief system. In Iran, studies in ethics and values education are not adequately developed in either religious education or in studies of other subject matter. In American public schools, values education is similarly underdeveloped and inadequate within current curricula.

- Need for Values Education.

Ethics and values education need to become a greater part of the education of children. In Iran this means that education in ethics should be integrated more fully into both religious education and other subject areas. In the United States, ethics and values education should be incorporated into the current curricular areas. The introduction of values education in public school curricula should be independent of and apart from any religious education.

- Identification of a Common Set of Ethical Values.

A common universal set of ethical values can be identified for introduction within kindergarten-grade 12 curricula. A shared set of ethical principles and values to guide the conduct of scientific research could command the endorsement of the scientific communities in both countries. A definition of ethics or values education is as follows: ethics or values education aims to develop good character in students throughout primary and secondary school in developmentally appropriate and effective ways. Good character can be defined as "knowing, caring about, and acting on core ethical values such as fairness, honesty, compassion, responsibility, and respect for oneself and others."[1] Such core ethical values are not specific to particular cultures or traditions.

Scientifically oriented and technologically developed societies all rely on and benefit from inculcation of values and character traits that support responsible individual behavior, concern for others, and awareness that people everywhere belong to an increasingly interdependent global community. These values affirm human dignity, promote individual and social good, and protect human rights.

- Differing Deficiencies in Learning.

Iranian and American educators perceive somewhat different deficiencies in the learning environments in the two countries. In Iran, educators believe that the strong emphasis on training in the sciences and technical professions provides too little time for education in the humanities

[1] Schaeffer, Esther F. "Implementing Character Education." *Education in the United States: The Pre-University Years*. Vol. 5 (no. 2), June 2002.

and in humanistic values. In the United States, educators are concerned that most students do not receive adequate education in science. The group agreed that education in both the humanities and science are critical for children and that ethics or values education in public schools should not be limited to science subjects only.

OPPORTUNITIES FOR COOPERATION BETWEEN THE AMERICAN AND IRANIAN ACADEMIES

There are many commonalities in the understanding of the challenges facing the educational systems in both countries with respect to values education. The next step is to move beyond the consensus on characterizing the issues of concern to identifying opportunities for collaboration between the academies that involves educators and students.

- Hands-on Science Curriculum.

The hands-on science education curriculum sponsored jointly by the National Academies, the Smithsonian Institution, and the National Science Foundation is one model that is of particular interest to Iranian educators. It conveys values as well as an understanding of the practice of science to students. The Iranian participants were interested in featuring this project at subsequent interacademy meetings.

- Educator-to-Educator and Scientist-to-Scientist Exchanges.

The academies should arrange for educator-to-educator and scientist-to-scientist exchanges to observe model practices and foster appreciation of limitations within specific cultural, economic, and educational environments. Such exchanges should be project-focused to allow the counterparts to share in the experience of practicing science and devising integrative ethics-related curricular materials appropriate in each country's setting.

- Student-to-Student or Class-to-Class Communications.

At the student level, the academies should promote student-to-student or class-to-class communications, primarily by the Internet, but also through other media. This strategy could promote mutual student understanding of each other as members of a single global community and could help counter negative views and stereotypes among American and Iranian youth about each other's nations.

In conclusion, the participants agreed that science is best learned through projects, that is, through the practice of science, and joint projects between Iranian and American scientists, educators, and students should be encouraged. Projects in many areas of scientific investigation can contribute to national development as well as bring specialists from the two countries closer together.

APPENDIXES

Appendix A

Workshop Agenda

SCIENCE AND ETHICS: EXPERIENCES AND CHALLENGES IN THE UNITED STATES AND IRAN

Bellagio, Italy, April 22-26, 2002

Agenda

Tuesday, April 23—Day 1

Morning Plenary Session:

Overview of current issues in science and ethics in the two countries; recent research reports of relevance to the conference; roles of academies and related institutions of science, engineering, and health in addressing science and ethics; international dimensions of issues.

Afternoon Four Break-out Sessions: Presentations of Topics

1. Research Integrity
   - Definition and scope
   - Establishing an ethical environment for research
   - Education of young researchers in ethical behavior
2. Environmental Equity
   - Definition and scope
   - Relationships between environmental impacts and socio-economic status
   - Interventions to help reduce inequalities

3. Genetics and Ethics
   - Genetic screening and therapy
   - Genetic privacy
   - Genetic therapy in human subject experiments
4. Resource Allocation for Health Care
   - Distribution of limited resources
   - Role of local communities in allocation of resources
   - Determination of most effective interventions

Wednesday, April 24—Day 2

Morning: Plenary Session

Reports on progress in break-out sessions; identification and discussion of overlapping issues; suggestions for focus in each break-out session

Afternoon: Break-out Sessions: Discussion of Issues Using Case Studies

Thursday, April 25—Day 3

Morning: Break-out Sessions

Discussion of issues; preparation of report to plenary session including priorities and mechanisms for future collaboration among U.S. and Iranian specialists

Afternoon: Plenary Session (end at 3:30 P.M.)

Critique of reports from break-out sessions; areas for further discussion; research needs; discussions of future cooperation—priorities, mechanisms, roles of academies. Open discussion of next steps.

Appendix B

Workshop Participants List

PARTICIPANTS LIST

Mehdi Bahadori, *Cochair*, Vice-President for Research, Iranian Academy of Sciences
Kenneth Shine, *Cochair*, President, Institute of Medicine
Enriqueta C. Bond, President, Burroughs Wellcome Fund
George Bugliarello, Chancellor, Polytechnic University
David R. Challoner, Foreign Secretary, Institute of Medicine
James Childress, Edwin B. Kyle Professor of Religious Studies, University of Virginia
Gholamhossein Ebrahimidinani, Fellow, Iranian Academy of Sciences
Fatemeh Faghihi-Ghazvini, Research Institute for Education
Michael Fischer, Professor of Anthropology and Science and Technology Studies, Massachusetts Institute of Technology
Bernard Goldstein, Dean, University of Pittsburgh Graduate School of Public Health
Mirza Ali Mohammad Kardan, Fellow, Iranian Academy of Sciences
Mary Claire King, Professor, University of Washington
Seyed Mohammad Jafar Marashi-Shoshtari, Chairman, Cultural Research Institute for Social Development
Seyed Mostafa Mohaghegh Ahmadabadi, Head of Department of Islamic Studies, Iranian Academy of Sciences
Abbas Sharifi Tehrani, Professor, Plant Pathology, Iranian Academy of Sciences

Hassan Tajbakhsh, Professor, Veterinary Science, Microbiology & History of Science, Iranian Academy of Sciences
Mohammad Reza Zali, Deputy Director, Office of Research, Iranian Academy of Medical Sciences
Hassan Zohoor, Secretary, Iranian Academy of Sciences

STAFF

Glenn Schweitzer, Project Director
Wilhelmine Miller, Senior Program Officer
Sara Gray, Program Associate

Appendix C

Science and Ethics

Reza Davari Ardakani

How is science related to ethics? It seems that science and ethics have two completely separate domains so that they are in no way related to each other. In the case of science following its methods, it is necessary to concede the validity and appropriateness of research; there is no need to consider ethics at all. However, if one says that the researcher should honestly follow the rules of the scientific method, which is an ethical constraint per se, and then conclude that it is impossible to have science without ethics, the original argument is somehow misleading.

It is clear that any possible universe is based on its own principles without which it would be impossible for it to exist. The principles form the foundation of a universe so that rejection of the principles leads to the destruction of the universe. Modern science was created after certain principles were adopted and followed. Should not this be considered an ethical deed? The term "ethics" may have different meanings for different people. People who obey social disciplines and general principles are respectable, yet their behaviors and deeds may not be characterized as ethical.

A driver who observes the driving rules and regulations is more respectable than the one who ignores them, but these rules and regulations are not necessarily ethical and someone who does not follow them is not an immoral person. Similarly, a scientist's observance of scientific principles is not a moral deed. In other words, there is a system in every universe that people adapt themselves to mostly out of habit. Should we consider habitual deeds moral? Ethical codes are so general and universal that their implementation varies in different situations. That is, a moral person does a moral deed only in particular situations when she/he is

aware of his/her commitments, and then decides accordingly. Therefore, a moral deed calls for the recognition of a moral commitment and taking measures for its implementation. But realizing a commitment does not necessarily imply positive or negative consequences. If the implementer of an action is aware of the outcome of his deed and the reason why he does it, he is then out of the domain of ethics and freedom.

It seems as if science and ethics cannot unite, or it is better to say that ethics begins where science ends. Yet how is it possible to make a decision in the darkness of ignorance? Decision making based on certainty is impossible in ethics. One should choose a way, and this option may begin with deciding if it is moral. How is it possible to make a decision when one is uncertain? At least in our age, morality appears as a paradox where one must make a decision when decision making is impossible. And such decision making is a negative deed. That is, one does not make a moral decision. One does not choose one of the existing options. Rather one avoids certain options and may confront a deadlock, or one may find the one option that has been left for her/ him. In such conditions ethics is not founded on science but its domain is beyond that of science.

With respect to this introductory part, discussions about science and ethics as two independent realms will not be fruitful. It may be appropriate to look at a problem from a different view and raise these questions: What status do science and ethics have in the modern world? Is there any match between science and ethics in the world of modernity?

One cannot think of the modern world without technological science. In this world, science and technology are present everywhere, and almost everything and everybody depends on them. In this world neither science nor politics depends on ethics, and each has its own origins and fundamentals. But this is not the end of the story. Science and politics do not need ethics, and in today's technical-political system, there is usually no need for making moral decisions, simply because decision making is required to correspond to the universal system.

Until recent decades, the values of the modern world were considered absolute. It is believed that as people gradually enter the modern scientific and intellectual system, they will accept and realize its values universally. Still, while most people of the world, including those of the under-developed nations, have the same opinion, it seems that this universal perspective has gradually dimmed. When economy, commerce, living traditions, and production and consumption patterns are globalized, the fulfillment of those universalistic values is less probable, and even their validity is doubted.

This skepticism is also manifest in practice and politics. Such manifestation may be considered undesirable, particularly when it contrasts with western values. In some cases, it may turn out to be violent, inde-

cent, unpleasant, and indefensible. Until 50 years ago such manifestation did not exist. Now as we study the past, even anti-colonization movements are considered efforts in adopting the values of the modern world.

Now, however, the situation is somewhat different. There are signs of hopelessness about the future, and efforts made in westernization and modernization have not achieved their stated aims. The West strives to fulfill its values at any cost, and does not tolerate any resistance and objection. The West concedes that the objections are no longer to the policies and oppressiveness, but contends they are for the denial and destruction of the basis of Western civilization and policies. In this dispute technological science is versatile, and ethics has yet to find a place in it.

In a sense, it is acceptable to say that defending human values is ethics, but it is noteworthy that common beliefs and moral habits should not be mistaken for the true ethical rules. Common beliefs and ethical habits are important, but as soon as these values are to be defended by immoral means, their moral force vanishes. The West has established political and technical systems by moral force. If there is now a demand for defending these moral principles and traditions by policies and technology, there must be deficiencies in those principles and traditions.

Ethics calls for patience and confidence. The moral characteristics modeled by the pioneers of knowledge (wisdom, bravery, self-control, and justice) were ethics, not their outcome. These may not be created or maintained by immoral means. Ethics in its true sense precedes science, technique, and people's relations. The ethics that was to be formulated in Kant's thinking was founded on the basis of the West's science, technology, and politics.

If ethics has lost its power and influence, one cannot revive it by external means. Certainly, peace and freedom may not be achieved by war and violence, nor do revenge and enmity result in kindness and friendship. Is it possible to get along with avengers by kindness? No, they dislike unanimity and companionship. Yet they have not deprived the world of unanimity, rather they belong to the world in which everybody must obey something that is dictated. They have no language for communicating with others, nor are they prepared to listen to what others say.

Freedom is a great value; it requires not only the ability to speak, but also tolerance to hear. Ethics necessitates the acceptance of the other's existence. The words of Jean Paul Sartre, who wrote the play *Hell* and called "the other" hell, had Kafkaian implications. That is, he was also worried about situations in which man had no privacy. He may have absolutely denied "the other's" existence by being aware of knowing "the other," and as a consequence, dismissed ethics altogether.

Raising the problem of "I" without "the other" does not make sense. From the beginning, the West has made for itself "the other." This "other"

is unsuitable for dialog and unanimity unless it becomes aware of its condition and exits from its artificial identity and begins unanimity. Freedom makes sense if "the other" is realized, and with the acceptance and tolerating of "the other," it is stabilized and preserved. Violence, wherever it is, from whatever side it emanates, and with whatever justification, destroys freedom and justice and demolishes ethics. Marquis De Sade and Denis Diderot, the two great French authors, were right to say that whenever wisdom and science are separated from ethics and ethical ends they act against themselves and turn to violence and savagery. Wisdom, science, and truth must be saved. This is the most genuine ethical principle in the present world.

Appendix D

Cultivation of Human Values for Progress in Science, Eradication of Miseries, and the Attainment of Happiness

Mehdi Bahadori

Cultivation of human values is of paramount importance for developed countries in order to eradicate human miseries, heal environmental wounds, and secure true happiness for people. It is also of great significance for developing countries to progress in science and technology and solve their economic and social problems.

Human values, the embodiment or possession of which is believed to bring progress in science and technology in a society and happiness to people, are listed in the following paragraphs. The author would like to begin with the supposition that we are born to be happy, and securing true happiness should be the goal of all of our activities. Progress in science and technology should be considered simply a means to reach this goal and not the goal itself.

On top of the list of human values is unconditional love and service, rendered to people irrespective of their race, religion, or nationality. These qualities of love and service may be considered as the two wings of a bird, attempting to ascend spiritually, and to secure true peace of mind and happiness.

All events in our lives can be considered opportunities to cultivate human values. Progress in science and technology can be viewed as one of the most effective means of rendering unconditional service.

The progress in science and technology in the past 100 years has brought a better health care, higher life span, mass and higher education, a higher standard of living, and more comfort and conveniences in life. This progress has not been without costs; costs of more environmental pollution, of faster depletion of natural resources, and of a wider gap be-

tween people and nations enjoying conveniences and those that do not. The misuse of scientific knowledge has inflicted pain on both the environment and people. To heal these pains, concerned scientists throughout the world have started looking at the ethics in the use of scientific knowledge and technology, trying to balance scientific progress without causing environmental and social damages.

WHY SCIENCE AND ETHICS?

We are born with inquisitive minds and enjoy learning about ourselves and our surroundings. We are also born with certain needs and a desire to be physically comfortable. But more than the physical comfort, we thrive to have peace of mind and happiness. But, can science and technology alone bring us happiness? It is this writer's belief that it is only through the ethical use of scientific knowledge that we can secure happiness. Let me elaborate more on this.

We need advances in science and technology in order to eradicate hunger, malnutrition, diseases, ignorance, homelessness, and other human miseries throughout the world. At the same time, we need to possess human values in order to perform this task, or render this service, with love, and without any expectations. We should do it only as a duty and as a means of expressing our gratitude to the Universe for all that we have. It is through the combination of science and ethics that we can secure happiness. With this attitude, the scientifically advanced nations would take pride in their healing abilities, and not in their killing powers.

THE ROLE OF SCIENCE AND ETHICS IN SOLVING PRESENT NATIONAL AND INTERNATIONAL PROBLEMS

While enjoying a higher standard of living and a high degree of material and physical comfort and conveniences, the industrialized and wealthy countries are suffering from a great number of social problems to the extent that the majority of their people are not truly happy. Developing or poorer countries have their own social and economic problems. These nations are clamoring to advance in science and technology in order to solve their economic problems. While it is necessary to do so, we have to realize that science alone cannot solve the present problems and cannot eradicate human miseries; science together with ethics can. Instead of investing time and efforts to just advance in science and technology, we now need to shift our attention and resource allocations more toward cultivating human values and placing more emphasize on ethics. This is of paramount importance, both in the developed and developing countries. While science and technology can bring us conveniences and

material and physical comfort, it is the possession and the embodiment of human values that can bring us true and sustainable happiness. After all, we are born to be happy, and this can only be accomplished by possession of human and moral values, and not necessarily through wealth, fame, and power. The developed countries should invest in cultivating human values in order to eradicate their social problems and simply be happy. And, the developing countries should emphasize moral and human values in order to advance in science and technology to attain a higher standard of living and at the same time reach a higher degree of happiness. After all, in many developing countries what is lacking is not just the scientific know-how, but more importantly, the possession of human values.

CONDITIONS FOR PROGRESS IN SCIENCE AND TECHNOLOGY

The conditions prevailing in a society and the human values that are the embodiment of the people and that will bring about progress in science and technology are:

1. Freedom
2. Justice
3. Security
4. Order
5. Righteousness
6. True desire of the society to progress in science and technology
7. The belief and the self-confidence of the society that it can progress and reach its goals
8. Willingness to work hard to accomplish what is desired, but with:
    a. sincerity, integrity, and honesty at work and in relations with other people
    b. diligence, devotion, courage, tolerance, dedication, persistence, and enthusiasm
    c. hope, optimism, love for people, well-wishfullness, patience, and willingness to serve unconditionally
    d. respect for law and order and other people's rights
    e. belief in science and the scientific approach to deal with problems
    f. respect and reverence for nature, and conservation of natural resources.[1]

[1] Bahadori, Mehdi, N. *Love to Be Happy—Secrets Toward Sustainable Joy,* Blue Dolphin Publishing, Inc. Nevada City, CA, 1994. Bahadori, Mehdi, N. *Ama para ser Feliz, El Secreto de la Alegria de Vivir*, EDAF/Nueva Era, Madrid, Spain, 1995.

It is interesting to note that the more a person and a nation possess the above human values, the easier life becomes for them, the more natural resources become abundant for them, and the easier nature's secrets are revealed to them. This is the way the Universe operates.

A VISION OF THE WORLD WHERE ETHICS PREVAIL.

With the ethical use of scientific knowledge by all people and all nations, we can visualize living ultimately in a world with the following features:[2,3]

1. There is a complete lack of crime and violence.
2. There are no weapons or ammunition of any kind, and no military forces.
3. No borders separate countries from each other.
4. The population has complete freedom to move about from one place to another without any fear or restriction.
5. Science and technology are at their highest state of development throughout the planet, but are still being advanced for the well-being of humankind and Earth.
6. Desirable goods are abundant and plentiful.
7. Greed to have and acquire more than is needed, or more than others have, is notably lacking.
8. People everywhere have modest living standards and are conscientious not to waste anything.
9. Nothing is wasted, and everything is reused or recycled.
10. People need to work only 20 to 25 hours a week.
11. People spend their time outside work pursuing art, music, cultural events, and spiritual disciplines or studies.
12. People volunteer considerable time and effort in giving love to one another, particularly to children and the elderly.
13. People take time to enjoy nature, trees, flowers, birds, and life in general.
14. The environment is pure and clean.

Is it at all possible that some day this vision will come true? Is it possible for humankind to drop all its arrogance and finally realize who we

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[2] *Ibid.*

[3] Bahadori, Mehdi, N. *The University of Life*, Blue Dolphin Publishing, Inc, Nevada City, CA, First Edition, 1988, Second Edition, 1993. Bahadori, Mehdi, N. *La Universidad de la Vida*, Errepar S. A., Buenos Aires, Argentina 1997.

truly are, to live in peace and harmony with one another and with nature? Is it possible that our planet, so badly wounded by the abuses of humankind, can some day be healed and restored to its original purity and beauty?

Is it possible that some day humanity will drop its caste systems and all its ideas of separateness and the superiority of one race, religion, natural origin, or place of birth and residence over the others? Is it possible that some day the only victors that prevail in the world will be peace, harmony, love, respect, and reverence toward nature and all living beings on Earth? What will it take to make this vision come true?

The answers depend on our attitude in life and on how we use our scientific knowledge. They also depend on the method through which we try to secure happiness.

THE ROLE OF HUMAN VALUES TO SECURE HAPPINESS

We are born to be happy, and it is our right to pursue happiness. Scientific and technological progress and accomplishments are just means to reach this end, and not the goals.

It is interesting to note that nearly all of our efforts are to gain more happiness. But a great number of people tend to seek this important quality of life through wealth, fame, and power. We know that while these may bring more comfort and conveniences, they may not necessarily bring any happiness. If these do not bring happiness, what factors could? The author can answer this question through presenting an equation called The Happiness Equation.[4] This equation is

$$H = J - F - E, \qquad (1)$$

where H represents happiness, J all the values (such as all the human values mentioned above) which directly contribute to happiness, F the physical misery elements (such as pain, hunger, or malnutrition) which detract from happiness, and E the emotional miseries, the embodiment or possession of which detracts from happiness.[5]

It is worth mentioning that the progress made in the past 100 years in science and technology has helped to reduce the physical misery elements included in F, thus contributing to people's happiness. Now there is a

[4] Bahadori, Mehdi, N. *Love to Be Happy—Secrets Toward Sustainable Joy,* Blue Dolphin Publishing, Inc, Nevada City, CA, 1994. Bahadori, Mehdi, N. *Ama para ser Feliz, El Secreto de la Alegria de Vivir*, EDAF/Nueva Era, Madrid, Spain, 1995.

[5] *Ibid.*

challenge for science to increase J and reduce E. But, can science and technology bring more peace of mind to us? The answer depends on how we use our scientific knowledge to bring about more happiness, not only to ourselves but also to the people throughout the world, or the ethical use of our scientific knowledge. We should use our know-how to:

1. Heal the wounds and pains that we have inflicted on people, animals, and the environment in general
2. Use fewer natural resources for our needs
3. Cause no damages to people and the environment
4. Help others, without any expectations, to pursue and secure happiness.

NATIONAL INDEX OF HAPPINESS (NIH), A CRITERIA FOR APPRAISING THE PERFORMANCE OF VARIOUS NATIONS

If we could somehow quantify our happiness, for example, through using the Happiness Equation (1), we could then find out how we are doing happiness-wise every day, month, or year.[6]

If all the happiness values determined by the citizens of a country could be calculated, for every day, week, month, or year, a value could be determined as to how the nation as a whole has been doing, happiness-wise. We could then determine a National Index of Happiness, or NIH, every year. This index is the algebraic sum of all the positive values (showing happiness) and negative values (showing misery) of H, determined by every citizen of the country every day, summed up to determine the annual value, then divided by the total number of people reporting their happiness values. This National Index of Happiness could then be plotted for various years to determine the happier times of a nation.

The author strongly believes that governments should make every effort to maximize the National Index of Happiness, or NIH. This approach is quite different from the present economic planning methods, which are aimed at increasing individual income and maximizing the so-called gross domestic product, or GDP. If such action is taken by governments, we will see priorities shift, with more emphasis placed on the eradication of hunger, malnutrition, homelessness, joblessness, and suffering due to AIDS, cancer, and other diseases. The presence of these problems in a society contributes to the negative values of H, as reported by all the people who suffer from them.

Governments would surely need to place a great deal more emphasis on education—not simply to teach a vocation, as is done currently, but

[6] *Ibid.*

more importantly, to teach human values such as integrity, courage, hope, truth, righteousness, enthusiasm, love, peace, respect for all beings, nonviolence, and the desire to serve others unconditionally. Such education is absolutely necessary in order to increase the positive values in the Happiness Equation and to reduce all the negative elements of happiness.

I believe that the quality of life of a nation in truth depends on its National Index of Happiness, or NIH. I also believe that this is a more realistic way of comparing the quality of life of different nations than by comparing their GDP's, or how much energy or material resources they use per person per year.

As you know, it is now common to consider a nation's GDP as the measure of its progress, standard of living, and prosperity. This is hugely flawed. For example, if in one country the crime rate is higher than in other countries, it may be that all the expenditures in manufacturing and handling of guns, protection against crime, capturing and convicting of criminals, and paying for their incarcerations add up and increase the GDP in that nation. For another country, whose crime rates are lower, with every other economic activity being equal to those of the first country, this country may show a lower GDP, and may be considered less developed. The same thing is true about food and nutrition. If the people of one society are used to consuming more processed food, this consumption may contribute to a higher GDP when compared to another society that consumes more natural foods (assuming that everything else is the same). The presence of many chemicals used during the food processing and the absence of fiber and many other elements found in natural foods contributes to many illnesses. All the costs of food processing and health care also contribute to a higher value of GDP.

CONCLUSIONS

Science alone is not capable of solving all the problems that humankind is facing today.

It is only through the ethical use of scientific knowledge that we will be able to progress in science and technology, to eradicate human and environmental miseries throughout the world, and to secure true and sustainable happiness for people.

Education in human values should be emphasized along with conventional education. It is also suggested that an international center be established, with branches in each country, to do research on how human values can be best cultivated in people. This center for Research In Cultivation of Human values (or *center for RICH values)* can operate under the United Nations or through bilateral or multilateral agreements among nations.

Appendix E

Bioengineering Ethics: The Ethics of the Linkage Between Engineering and Biology[1]

George Bugliarello

INTRODUCTION

Bailey's dictionary, the forerunner in 1730 of Samuel Johnson's famous dictionary, defines ethics as "a science which skews those rules and measures of human actions which lead to true happiness; and that acquaints us with the means to practice them."[2] Webster's unabridged dictionary defines ethics as the discipline dealing with what is good and bad or right and wrong and with moral duty and obligation.[3] Indeed, in the most fundamental sense, ethics has to do with the distinction between right and wrong, between good and bad. A guide for action that may have operationally the semblance of an ethic instinct is encountered in some animal species. It is an instinct that makes the animals that possess it willing to sacrifice their lives for their offspring, or for members of their social group. However, it is only humans, and perhaps some higher animals closer to our species, that have a conscious ethics—a reasoned ethics.

Conscious ethics—or, ethics for short—was originally the domain of religion. But in the West, under the pressure of philosophy, starting with Greek philosophy, ethics became the domain of philosophical inquiry. In turn, science, with its discoveries, pushed religion and helped shape views

[1] Based on the Keynote Speech at the First International Conference on Ethical Issues in Biomedical Engineering, Clemson University, September 29, 1997.

[2] Bailey, N., *Dictionarium Britannicum*. Cox: London, 1730.

[3] Webster's *Third New International Dictionary of the English Languages, Unabridged.* Merriam: Springfield, MA: 1968.

of the world on which ethics considerations are based. And now engineering also is putting pressure on science, philosophy and religion in terms of ethics.

ENGINEERING, SCIENCE, AND MEDICINE

In the broadest sense, engineering can be defined as an activity directed toward the modification of nature, from altering genes to the construction of bridges, from space flights to the fighting of disease—all processes or artifacts that did not exist in nature. This modification of nature is in effect a continuation of biology by other means, so that engineering—whether traditional engineering or genetic engineering or medicine—is a metabiological activity. Science, on the other hand, has the goal of understanding nature. The questions of science are *why?* and *how?* Those of engineering, in all of its thrusts, are *how can we?* Engineering achieves its goals through the design and operation of machines (artifacts), be they tangible, such as a bridge or the modification of a gene or a hip replacement, or intangible, such as a computer program or a therapeutic protocol. (I prefer the term 'machine' to artifact or device because in its Greek etymology—*mechané*—it also has a slightly pejorative connotation that fits our ambivalence about some impacts of technology.)

In the traditional sense of the word—used henceforth in this paper unless otherwise noted—engineering is a specific method for designing machines. There are complex interactions among engineering, the physical inanimate world, and the biological world that need to be identified as they are relevant to an understanding of where bioengineering and the ethical problems of bioengineering fit in the picture (Figure 1). Engineering, as an agent modifying nature, interacts with the physical inanimate world, and as an agent to extend biology, it interacts with the biological world. The specific interaction of engineering with the biological world thus far has been recognized primarily as the domain of bioengineering, although it is clear that all of engineering is centrally involved, whether it recognizes it or not, in the modification of the biological world (for example, a highway, by bisecting a habitat, changes the biology of that habitat). It is also clear that any significant engineering development has an impact on society, just as any significant societal development ultimately is likely to lead to engineering developments. We may want to note at this point that not only the artifacts—the machines—that are created by engineering, but also society are metabiological activities. Both machines and society extend biology by other means as they interact with biological organisms and with each other.

Traditionally, engineering has been focused on the outward extension of biological organisms, that is, on extensions that are external to the

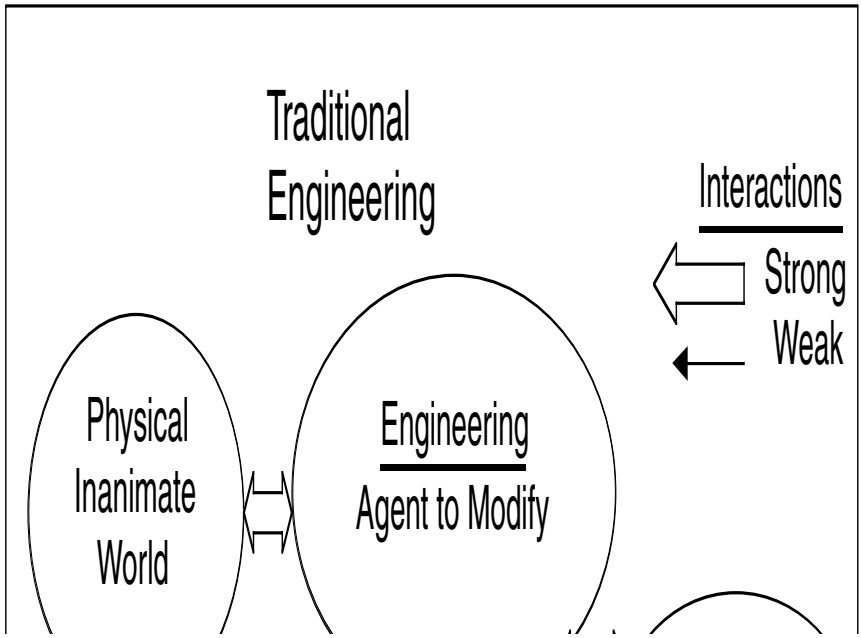

FIGURE 1 The physical inanimate world, the biological world, engineering, and society—The complex interactions.

organism—from buildings to space ships. Bioengineering, instead, has been concerned with the inward applications of engineering, that is, applications focused on processes inside the biological organism. In the future, however, more and more the activities of engineering will blur the distinction between inward and outward processes. For example, biomimesis, with its goal of designing machines by drawing inspiration from biological processes and designs, is an extension from the organism outward. Simple examples of biomimesis are today's artificial organs, as well as bio-electrical sensors, that is, biological sensors implanted on an electronic platform, or *vice versa.* Another future interaction between biological organisms and engineering, the creation of bio-machines bringing together in intimate combination a biological organism and a machine, will further blur the separation between inward and outward thrusts of engineering with respect to biological organisms.

Thus, bioengineering has multiple roles. It brings engineering to bear on medicine and on biological organisms. It brings a knowledge of biology to bear on engineering designs (biotechnology and biomimesis are the result of this direction). It creates a bio-machine synthesis. And, most importantly, it helps develop a metabiological view of engineering—a

new and powerfully productive way of assessing the meaning of engineering as the extender of biology.

Engineering, historically and still today, is primarily an emanation of the physical sciences with which it constantly and closely interacts. More recently, starting primarily in the second half of the 20th century, engineering has been brought to bear on the biological sciences, spawning the field of bioengineering. Bioengineering thus sits astride engineering, biology and medicine. In our endeavor to understand the nature and role of bioengineering, we need, furthermore, to take into account the physical sciences because of their close association with engineering. (Of course, the physical sciences also have directly intervened in the biological sciences, as in the case of biophysics and biochemistry.) An understanding of all these relationships becomes essential if we are to develop a clear picture of the challenges and meaning of ethics in bioengineering.

Physics in particular, engineering, biology and medicine have both differences and commonalities with respect to the goals, domains, key challenges, instruments, and key philosophical and ethical issues that they address (Table 1). The *goal* of physics as a science is that of understanding nature, and so is that of biology, in the context of biological nature. On the other hand, the goal of engineering is to modify nature and that of medicine, like engineering, is also to modify nature, limitedly to biological nature—to heal disease, which is by and large a natural phenomenon. The nature of the goal of engineering and medicine is teleological, while that of physics and biology is not. The *domain* of physics is universal; that of biology is limited, of course, to biological organisms; that of medicine is limited primarily to humans and, in veterinary medicine, to higher animals, while the domain of engineering is the potentially limitless one of machines and alterations of nature, from nanomachines to macroenvironmental machines or processes such as dams, highways and weather modification.

The *key challenges* today in physics are cosmogony and the development of a unified theory. In biology they are the origin of life, the evolution of life forms, and complexity, including behavior and consciousness. The key challenge of engineering is the enhancement of humans through materials, energy, information and systems, as in biomimesis, but also, as in aeronautical engineering, the imitation of the capabilities of some life forms, like flight. The key challenge of medicine, of course, is understanding the origins of disease and the prevention and cure of disease.

The *key instruments* of both physics and biology are theory; those of medicine are diagnosis and therapy, which in turn is based on theories. The key instrument of engineering is design, which has a byproduct, theory.

The *key philosophical issues* of physics are *how do we know and how do we verify that knowledge*—the matter-mind problem of what is knowledge in

TABLE 1 Some Characteristics of Physics, Engineering, Biology and Medicine

	Physics	Engineering	Biology	Medicine
Goal	Understand nature	Modify nature	Understand nature (biological)	Modify biological nature (heal)
Nature of Goal	Nonteological	Teleological	Nonteological	Teleological
Domain	Universal	Machines (from nano to macroenvironmental)	Biological organisms	Primarily humans and higher animals
Key Challenges	• Cosmogony • Unifying theory	• Enhancement of humans through o Materials o Energy o Information o Systems • Imitation of life attributes	• Origins of life • Evolution of life forms (including behavior) • Complexity (including consciousness)	Prevention and treatment of disease
Instruments	Theories	Design (byproduct: theories)	Theories	• Diagnosis • Therapy (based on theories)
Key Philosophical Issues	• How do we know? • Matter-mind problem	• What is a machine? • Why machines? • How far with machines?	• What is life? • Body-mind problem	Nature of disease
Key Ethical Issues	• Purpose of research • Impacts of research • Limits of research	• Purpose of machines • Impacts of machines (biosocial-environmental) • Limits to machines • Safety	• Purpose of research • Impacts of research • Limits of research	• Limits of therapy • Informed consent • Individual *versus* societal benefit • Risk and benefit

our mind and what is objectively outside knowledge. In biology, the key issues are the nature of life, and the body-mind problem of consciousness, which parallels the matter-mind problem of physics. In medicine, the key philosophical issue is the nature of disease, whereas in engineering, the issues are *what is the machine? why do we have machines?* and *how far can we go with machines?*—all issues very seldom discussed by engineers. The associated *key ethical issues* are shaped primarily, as is, in general, the case for all of ethics, by conflicts among contrasting views, needs, or actions. In physics and biology, these key issues are the purpose of research, and the impacts and limits of research as exemplified by the controversies about cloning and nuclear energy. In engineering, the key ethical issues have to do with the benefits—*cui bonum?*—of the machine, the biosocial and environmental impacts of the machines and with safety and permissible risk. In medicine, the issues concern the limits of therapy, again safety and risk, the Hippocratic imperatives, informed consent, and the role of the patient, as well as the dilemma of individual *versus* societal benefit.

ETHICS IN BIOENGINEERING

This very simplified overview of the fields that flow together to form the basis of bioengineering helps us identify some of the fundamental ethical issues in bioengineering. These are issues that concern, again, the domain and focus of bioengineering, the views of nature that govern the activities of bioengineering, the impacts of bioengineering, its limits, risks and safety factors, the question of activism, and that of intellectual responsibility. Starting with *the domain*, a first issue is whether the ethical responsibility of bioengineering should be exclusively human-centric or could be extended to a broader bio-centric domain. The issue of animal experimentation, for instance, evolves around this question. Should bioengineers be concerned exclusively with the health of humans, or should they have a broader responsibility over all life forms?

In terms of *focus*, a key ethical issue is prevention *versus* therapy. The escalation of medical costs makes it increasingly necessary to focus on prevention, yet historically most of the medically oriented activities of bioengineering have been focused on therapy, and on very costly devices. Another focus issue with ethical implications is medical *versus* industrial. Both medical and industrial activities are important to society, but when they are carried out side by side in a research laboratory, they sharply bring in focus the issue of disinterest versus vested interest—the disinterest that should govern medical-oriented activity *versus* the vested interest which characterizes industrial activity and is a prime mover of industrial success. A third issue, in terms of focus, is that of the individual *versus*

society. This is the dilemma, for medicine and bioengineering alike, that is at the core of today's debate about health care—whether the focus should be exclusively on an individual or whether, or to what extent, the question of costs to society should also be taken into account.

In terms of *views of nature*, how complex the ethical issues confronting bioengineering are can be underscored by the multitude of basic and often conflicting values involved.[4] These values range from utilitarian (emphasis on the way in which humans derive benefits from nature) to the naturalistic (the satisfaction that people obtain from the direct experience of nature), from the ecological (the integrative nature of ecology) to the scientific (the relation of structure and processes), from the aesthetic (the aesthetic influence of nature and living diversity on humans) to the symbolic (the use of nature for communication of thought), to the doministic (the domination of nature), from the atavistic (the fear and aversion to the dangers of the natural world) to the humanistic (nature as a means to give people an avenue for attachment and bonding) and the moralistic (the basic component of nature as a source of spirituality and guidance for humans). Each of these values involves ethical dilemmas for bioengineering, starting with basic biology *versus* engineering dilemma of whether to accept nature as is, or to modify it, as medicine and engineering do. The dilemma leads to different ethics—the ethics of discovery *versus* that of design—and to today's debates about genetic engineering.

In terms of *impact*, the technicalization of health care and the depersonalization today increasingly associated with it, particularly in advanced economies, should also be areas of ethical concern for the bioengineer, and so should the change of human outlook brought about by the possibility of artificial organs or genetic engineering.

In terms of *limits*, a most important ethical issue for bioengineering is the positioning of the bio-machine interface. Where should the biological organism end and the machine begin? Where should the development of machines be positioned in that polarity between biological organisms and machines? Issues related to these are the limits of biomimesis, that is, how far should the bioengineer—and, more generally, the engineer—go with the imitation of biology in creating devices? As to bio-machines, should they still retain the essential characteristics of biological organisms or should they possess more those of machines?

In terms of *risk and safety factors*, the ethical issues have to do with acceptable risks and appropriate safety factors. In bioengineering, these

[4] Kellerp, Stephen R., *The Value of Life: Biological Diversity in Human Society.* Island Press: Washington, DC, 1996.

issues are an intriguing and difficult meeting point of the ethics of medicine, engineering, and biology.

In terms of *activism*, the issue that all engineers encounter in our society is the extent to which, rather than merely executing the wishes of society, they should lead society in acquiring an understanding of future possibilities and in moving in new directions. There are two different models. By and large, engineers have tended to see their role more as a purely technical one, while biologists and health professionals have been less timid in an independent leadership role. Which model should bioengineers adopt? Closely related to the question of activism is the ethical issue of the *intellectual responsibility* of the bioengineer, that is, whether and to what extent the bioengineer should intervene in the philosophical dialogue about the modification of nature and about the future of humans and their responsibility for other species.

It is clear even from a cursory view of issues such as these, that the ethical questions involved in bioengineering are very broad and very fundamental, and it is equally clear that, as of now, barely the surface of many of these questions has been addressed.

ETHICAL TENETS FOR BIOENGINEERS

In reviewing the immense challenges in the development of bioengineering ethics, it is tempting to suggest—very subjectively—some initial tenets for the bioengineer that may, if nothing else, open up a much needed dialogue on the issues:

- the *finality tenet*: to expand the capabilities of biological organisms, individually and collectively.
- the *approval tenet*: to understand and approve the goal of the medical or industrial processes in which the bioengineer is involved. In other words, the engineers should not participate in a medical procedure or in the development of an industrial bioengineering process of which he or she does not approve, technically challenging as those processes or procedures may be. The bioengineer must exert his or her judgment.
- the *knowledge tenet*: to base a design on a knowledge of nature and engineering as vast as possible. For instance, the knowledge on which bioengineering draws cannot be based only on a stereotyped view of human nature as purely a rational one. It must take into account, as all engineering should, the emotional component of human nature. Neglect of that component has contributed to the cold impersonality of many health care institutions.
- the *value added tenet*: to strive to add value to and through an object, a process, or a modification of nature.

- the *harm avoidance tenet* (essentially a restatement of the Hippocratic belief): to avoid harming individuals, to minimize the side effects of a design, and not to design something that the bioengineer would not use on him or herself if necessary.
- the *risk tenet*: to explicitly weigh risks to human society and environment of a bioengineering device or process.
- the *effectiveness tenet*: to make cost and risk of a design or intervention commensurate with expected benefits. At times, the effort expended and the risks of a solution do not yield sufficient benefits to justify its development, yet the development is pursued, for a variety of reasons.
- the *simplicity tenet* (an extension to bioengineering of Ockham's razor): to achieve a goal with means that are as simple as possible, so as to avoid excessively complicated and costly designs.
- the *conflict of interest tenet*: not to advocate an unsafe, ineffective, or inferior design because of a vested interest in it.
- the *responsibility tenet*: to assume the responsibility to follow up the performance of a design or process and communicate the results, positive or negative; to assume the responsibility for advocating the introduction of a beneficial design or process and the elimination of a dangerous one.
- the *professional tenet*: to act as an independent-minded professional, regardless of whatever pressure may be put on a bioengineer by the environment (the hospital, the research laboratory, the factory) and to intervene in professional and public discussions about engineering, medical, biological, and societal issues. Much too often, bioengineers are silent on these issues.

CONCLUSION

The ethics of bioengineering is one of the most complex and challenging of all ethics, as it must blend the ethics of engineering, biology, medicine, and the physical sciences. To the extent that it can do so, it brings bioengineering to the forefront of human endeavors, as an activity that synthesizes the two most exquisitely human activities—how to understand nature and how to modify it for an ever better future of our species.

Appendix F

Evolutionary Organizing of Science

Seyed Mohammad Jafar Marashi-Shoshtari

The dynamics of civilization and the development of civil life in human societies are primarily due to the structures and evolution of paradigms, models, software, and technologies that change over time. The historical process of the birth and decline of civilizations attests to the fact that the success of long-lasting civilizations is contingent upon the creation and development of scientific, cultural, and artistic structures that are capable of generating suitable socially sensitive technology.

Were we to evaluate civilizations and cultures on the basis of a metaparadigm, it would seem that the secret to the survival and success of civilizations lies in the growth and development of a triumvirate of systems:

1. The ethical system (that gives orientation)
2. The subjective system (that shapes thought)
3. The objective system (that generates power)

Against the above backdrop, topics such as ethics, science, and technology will inter-relate as follows:

- Ethics (primary)
- Science (secondary)
- Technology (dependent)

Egocentrism, hedonism, and materialism, among others, are manifestations of life in today's world. We are in need of a "new culture," not based on scientism and the creed of technology.

Transcendental culture through the implementation of a "consensus strategy" can attain genuine development. This strategy is in direct confrontation with the prevailing global order spearheaded by materialism. The engineering of such a system is a *sine qua non* for all intellectuals who invest their future in fostering social agreement.

Throughout the ages and eras, myriads of civilizations were born in various corners of the world. Today's world encompasses seven or eight different types of civilizations.[1] Western, Confucian, Japanese, Islamic (in the traditional sense of the word), Hindu, Slavonic Orthodox, Latin American, and African are some of the civilizations. Various ethical, national, regional, and religious (in the traditional connotation) differences separate this variety of civilizations. In the past century, enhanced communication and the exchange of goods and information have blurred ancient dividing lines. The increasing permeability of geographical borders and the emergence of the so-called "global village" are challenging this fairly recent transfiguration anew.

Both the maturing of these civilizations and the way this process is tied to the shaping of human existence demand attention. It appears that the key to the perseverance of civilization lies in the evolution and transcendence of three interwoven systems:

1. The ethical system
2. The system of thought
3. The system of material objectivism

If we define "civilization" within the context of the aforementioned triadic systems, it will then resemble a living organism evolving in congruence with the evolutionary stages of human society. The tangible and objective outcomes and manifestations of the existing civilizations, notwithstanding their past divergence and differences, reveal their gradual assimilation in the world's secular mainstream.

AN AWAKENED SOCIETY

An outstanding characteristic of every society, stretching far beyond time and space, lies in ethical values. "Ethics" constitutes one of the pillars of every society. The dimensions of anomie besetting societies signal the rupturing of this pillar on various levels, an issue that must be immediately addressed. The philosophy undergirding the Divine Prophets'

[1] Huntington, Samuel P. "The Clash of Civilizations?" *Foreign Affairs*, Summer 1993.

(peace be upon them) "prophetic mission" points out that they were chosen to perfect ethical and moral blessings.

"Ethics" has been expounded and defined in a variety of religious, educational, sociological, and psychological sources. A comprehensive definition has yet to emerge. "Ethics" can be construed as the "structure of social inclinations" reflecting the moral code governing the society. As such, "individual ethics" intertwines with "social ethics" and in principle, we do not make any distinction between the two.

When defining law we place at the fore a set of principles, the violation of which can entail social disorder, punishment, and corrective measures. Since moral concepts rest on ethical considerations, they can be socially processed within a legal framework. In a nutshell, we can divide ethical concepts into two categories:

- Ethical behavior that can be regulated or governed by law—Hard Ethics
- Ethical behavior that cannot be regulated (i.e., being on-time, risk-taking, patience)—Soft Ethics.

EVOLUTION OF ETHICS: FOUNDATIONS

The evolutionary foundations of ethics can be delineated as follows:

- Show of Interest

Having interest in a subject, thought, or object is the beginning of the evolution of ethics. A person first becomes interested in something and develops a certain ethical stance with regard to the phenomenon. The interest displayed by the individual is a function of his/her potential and abilities, and the development of this potential is commensurate with the evolution of the individual's ethics.

- Evasion and Lack of Interest

The phenomenon the individual becomes interested in is the focus of his/her ethical evolution; as such the person evades the opposite pole, in which he/she is not interested. This evasion underlies the individual's ethical growth and evolution.

- Sacrifice

After the stage of evasion, the individual must be prepared to sacrifice for the object or subject in which he/she has displayed interest. In this stage, the individual is acting on the basis of his/her convictions, and ethics are materialized in terms of actions. Should the individual not be convinced about the subject of his/her interest, then he/she will not be willing to sacrifice. In this stage ethical grounds become solidified.

THE EVOLUTIONARY STAGES OF ETHICS

The main factors of change are set forth below. The principal, secondary, and dependent factors of change in society are placed at the forefront:

- The Decision-Making Stage

This is the first and most important stage in the structure of ethics. Here the individual or the society decides how to proceed. In a social context, the leaders decide on which actions to take or what characteristics ought to be developed in the populace. Therefore, it can be asserted that "decision making" is the main ingredient of ethical evolution and decisions must encompass the foundations of evolution, that is, the show of interest, evasion, and sacrifice.

- Regulation

After initial decisions on the direction of ethical concepts are taken, ethics will be institutionalized through regulatory measures. At this stage, ethical concepts are protected by sanctions, and violators will be penalized.

Punishment can emerge in two ways: (1) cultural punishment involves the rejection, confrontation, opposition, or anger by other members of society, and (2) legal punishment regulates the behavior of the populace on the basis of moral codes and ethics, and violators will be penalized in accordance with the severity of their crimes.

- Stage of Action

In this stage of the structure of ethical concepts, individuals start acting on the basis of ethical convictions. Ethics have taken the form of concrete decisions and laws, and they emerge in the form of actions. Acting on the basis of ethical principles strengthens ethical concepts and facilitates the administration of society.

- Effects

The effects reflecting how the status of ethics are looked upon: Resort to the Immaculate Immas: According to Islamic values, resort to the Immaculate Immas inevitably entails the evolution of social ethics. The transcendental evolution of ethics in society first rests on resort to the immaculate men of God. Behaving as such continuously purges a society that draws on Divine and Islamic values, and the society is given a chance to solidify itself.

- Interest in Organization

Organized and transcendental motivations feed interest in national institutions (government, municipal, or workplace); thus, social ethics start flowing into organizations leading to the regulation of society.

- Exertion of Will and Family Orientation

Here, social ethics find a context for materialization and will be implemented in the basic core of the society, that is, the family. The family will

be the primordial absorber of social norms and ethics. Family members will be acquainted with the society's values and norms, basing their actions thereupon.

CLASSIFICATION OF SCIENCE

Human science and knowledge, applied or otherwise, can be divided into two groups: (1) reductionist, or (2) holistic.

In the first category scientific disciplines are defined separately without being systematically linked. In the second category they are viewed as "orderly" subsystems that are integrated and coordinated within the framework of an umbrella system. In this latter case, each subsystem acts in concert with other subsystems, and their inter-relationship has an exponential and cumulative character.

The various disciplines and spheres of any school of thought are inter-related in one way or another. Some might be classified within theoretical and/or applied groupings. Information might be gathered in "mathematical" or "economic" classifications. What is fairly obvious is that all schools of thought that embody information classifications can submit themselves to "orderly arrangement."

A viewpoint that is widely accepted considers human knowledge from three broad perspectives;

- Knowledge/information based on revelation.
- Knowledge/information based on logical analysis.
- Knowledge/information based on sense experience.

Various fields of knowledge and scientific disciplines distinguish themselves in three aspects: (1) topic, (2) objective, and (3) methodology.

In philosophy, for instance, in the section dealing with "topic and subject," the question might be raised as to what is the subject to be studied. In the section relating to the objective one might ask about the ultimate objective of theoretical logos or philosophy. The objective is to ensure that we are convinced of the fact that "truths" and "realities" surround us, but we are also convinced that in identifying these "truths" and "realities" we make mistakes, taking "perceptions" for "reality." The proper distinction between "perceptions" and "realities" is what drives philosophy. In this methodology section, when discussing "a being whose existence is necessary," we do not resort to the empirical method for deduction or logical reasoning.

Philosophy seeks to separate truths from illusions. It creates the necessary context for man's beliefs. Science, on the other hand, seeks to analyze the various aspects of the social arenas so as to best direct the society.

Hence, science and philosophy focus on different areas. For instance, a person might have both philosophical and scientific insight; nonetheless, the unity of his person will not functionally unify or integrate these two distinct spheres. The person will adopt a scientific approach when dealing with scientific issues; and when tackling philosophical problems, he will be bound to adopt a philosophical perspective. The practical consequence of this thinking is the separation of the faculties of experience and function.

It is widely known that the science of management uses various methods to administer organizations (notwithstanding philosophical issues and without considering philosophical principles). It is contended that these methods ought to be separated from philosophical principles and are in no way related to philosophical questions.

Philosophers, on the other hand, contend that the role of philosophy is to eliminate illusions. They do not interfere in such arenas as man's sphere of action and performance in the society. The net result of this is that our beliefs and action would be delinked: we act in one way and believe in something else.

It so seems that the secular system of thought has reached its saturation point, for it lacks that innovative spark of guidance toward "sensible life." But it is still engaged in paradigm building so as to encourage consumption. The denial of "soul and spirit" is a link to the other world and a transcendental life, bringing about the acceptance of objectivism as the source of cognition and life. In reality, material objectivism is elative and subject to change in time. The new effort toward defining ethics[2] will also go astray since the root of ethics cannot be traced back to the material world. If one does not believe in the afterworld, he or she will certainly not put faith in constant and eternal values as shown in today's situation.

Therefore, it can be maintained that the definition of a new civilization lies in the transformation of all elements of society's value and thought system and the emergence of constructive inter-relationships between these elements. Secular civilization that bases itself on profit maximization is dying, whereas the spiritual civilization that is nurturing due to its proximity to the Lord, is coming to the forefront.

We are on the verge of creating a new phenomenon in this world. Having learned from the past, man has become mature enough to reappraise his condition, institutionalize justice, and reflect divine guardianship and values in his social interactions. Material evolution fails to coa-

[2] Piper, Thomas R., Mary C. Genlile, and Sharon D. Parks. *Can Ethics Be Taught?* Harvard Business School Press, Cambridge, MA: 1993.

lesce divergent social aspirations. Social evolution can be attained on the basis of divine guardianship around the axis of worship.

The realization of social evolution is in need of a new "culture" not based on scientism and the creed of technology. In the new "culture," ethics, science, and technology will interrelate as follows:

- Ethics (primary)
- Science (secondary)
- Technology (dependent)

The transcendental culture through the implementation of a "consensus strategy" can attain genuine development. The realization of this aim is contingent upon the creation of a network of all intellectuals who invest their future in fostering social agreement.

The "network" has the following objectives, (1) idea generation, (2) idea selection, and (3) harmonization and linkage of ideas. The network will be based on a new conceptual system. Even science will assume a novel meaning in the context of this system. From this viewpoint, the historical and social systems shape the ethical grounds of sciences. *Weltanshauug* (world view) and the "why" of things will be based on "proaction" that sets the rational ground for the development of observation in the "applied" realm. In this sphere, a "relational" philosophy will emerge as a new basis for mathematics and will be in total harmony with the proposed intellectual system. In the categories of knowledge, social science will assume a higher standing. In other words, social sciences will be a catalyst to the development of human and applied sciences.

Appendix G

Ethics in the Protection of the Environment

Seyed Mostafa Mohaghegh Ahmadabadi

Ensuring the soundness and protection of the natural environment constitutes one of the most fundamental teachings in the history of religions. The faithful believe that on the eve of creation the Lord commanded humans not to bring corruption and ruin to the earth for which he had forsaken the Heaven. Man was sworn not to betray this trust, that is, a pristine and pure earth. He was forewarned sufficiently against the dire repercussions of not upholding this command. Yet, the fact is that human inattention to this matter and the insidious calamity that has befallen it seems to be an entirely modern issue. The natural environment crisis is one of the main issues that preoccupy contemporary humanity. The ferocious and cruel approach towards nature in recent centuries that stemmed from expansionist motives and has led to relentless exploitation of raw materials—sea pollution by oil spills, jungle slashing and burning, global warming, and depletion of the ozone layer—has finally roused man from the stupor of dereliction. The innocent crying of the birds because of hunting, the extinction of forests, and the death of beautiful, colorful fish and whales have opened the eyes and ears of human beings so much that many are dedicating themselves to environmental protection. It has moved man's hard heart and made him consider solutions to the repercussions of this untenable style of living. He seeks alternatives to the consequences of this dominating and monopolistic way of life that seemingly considers any other life form on the face of the earth insignificant.

Many people have passed in human history. The call of divine messengers and religious leaders fell on the deaf ears of aggressive and domineering human beings. They failed to turn squandering eyes, or tame

their cruel hearts, while they continued to satiate their instincts like animals, seeking pleasures, joys, and exploitations. Just as the Holy Koran draws the picture of humanity at the time of Its Revelation: "…They have hearts wherewith they understand not, eyes wherewith they see not, and ears wherewith they hear not. They are like cattle…"[1]

Man finally was caught in the painful infliction resulting from his own misdeeds; the horrible perversion that he fomented himself had made his life miserable. "Corruption has appeared in the land and the sea on account of that which man's hands have wrought…"[2]

Now it seems as if humanity is going through the first moments of awakening at the dawn of consciousness, rubbing drowsy eyes, the very eyes that had been closed in the deep slumber of heedlessness in the darkness of centuries.

Fortunately today, environmental scientists and experts are not the only ones to recognize the enormity of the situation. There is a kind of rising public reaction and popular protest in all inhabited parts of the planet earth. This is a promising trend; for I believe that until this important issue is understood by all, and the jeopardy threatening humanity is publicly discernible, the cries of handfuls of people in "Green" parties will not result in the ultimate solution; a popular mobilization of humanity. Without public understanding, the issue shall remain buried within conference proceedings and academic papers. Having the masses of humanity understand the problem is of paramount importance, and is the basis upon which everything else depends. Then all that remains is to find the root causes that conform and comply with the sound, natural, and pure disposition of human beings so that a proper solution and a logical strategy can be devised.

Our time is replete with cautionary saviors in the form of individuals or groups. Green parties have a significant presence everywhere. Thousands of articles and books are being written, and numerous screenplays and films are being made. Yet the sheer enormity and gravity of the situation is such that it is as if all these efforts have no efficacy, and they serve only as placebo for an illness. What is the mystery behind this?

It seems that the riddle of the failure lies in ignoring the causes and pursuing the results. Should we not confront the issue in a fundamental way, and reach its roots? Every effort is like giving placebo to a patient suffering from a festering infectious cyst within him. An unknown Iranian poet best illustrates his condition:

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[1] Al A'raf, verse 179 (Translator's note: Al A'raf in Arabic means the elevated places. It is the seventh chapter in the Bounteous Koran.)

[2] Al-Rum, verse 41 (Translator's note: Al-Rum means the Romans. It is the thirtieth chapter in the Holy Koran.)

"*Alaji Nama Kaz Delam Khoon Nayayad, Sereshk az rokham pak kardan Che Hasel*?"

[Find me a cure; for no blood comes forth from my heart, what is the use of cleaning tears from my face?]

A major portion of the efforts exerted by environmental activists is merely in the form of environmental engineering. Instead of solving the problem, they are erasing the statement of the problem. One group claims that if we could completely transform our means of transportation and eliminate fossil fuel as a source of energy, the problem would be totally solved. Another group also states that there are parts of the earth that are still untouched and man must abandon the polluted areas and move into virgin and sound areas to be free of corruption and pollution.

While we appreciate all the efforts exerted toward better care of the inhabited earth using more rational means of production, transportation, and similar matters, and while we acknowledge the fact that there should be a constant drive toward achieving more appropriate forms of technology, we believe that these accomplishments alone do not hold the key to the final solution to the problem and release from the crisis. The question that still remains is why has the habitat of humanity become so unsightly and unpleasant? Why has the situation reached a point that a group of men, now that they have polluted a part of planet earth, wish to leave that place and go somewhere else so that they can once again afflict that place with the same adversity? What is the primary solution? Could an alternative be conceived that could reconcile man with his natural environment, so that he would refrain from merciless exploitation and infringement and live peacefully embracing nature? Could there be clean, pure air? Could we listen to the refreshing murmurs of doves and fish?

The reality is that the root cause of the crisis in the modern time should be sought in man's view and interpretation of his natural environment. In other words, the main problem is in man's epistemology and worldview.

We hold the view that fanatical scientism, or a rigid and inflexible scientific view lacking any spiritual support and interpretation and description of the world through the narrow portal of empirical science that itself is the major gift and achievement of industrial development in recent centuries, is the main factor of destruction, pollution, and ruin of humanity's natural environment. In the modern lexicon, science has replaced "faith."

It was the French scientist Auguste Comte who first stated that the course of human knowledge has three stages: (1) divine or godly, (2) philosophical or dialectic, and (3) scientific. At the divine stage, human beings attributed all affairs to the will of God and the supernatural. At the philo-

sophical stage, the human mind became capable of experimentation and abstraction and thus attributed natural affairs to the powers that were unseen but whose effects were visible. At this stage, man sought an actual cause or final cause for natural events. In the third stage or the scientific or investigative stage, imagination and rationality become functions of observation and experience. Something is valid when it can be sensed and observed.

Comte believed that humanity had passed through the first two stages and had now reached the third stage. No longer would man fruitlessly clamor for things that are of no use to him, and he would only deal with matters that would benefit life and would be of use. In the later days of his life, Auguste Comte yearned for tenderness, and upon the basis of his philosophical convictions established a creed called *Religion de l'Humanite*,[3] and he built a house of worship and established a series of rites of worship. He maintained that no creed would be acceptable and followed unless the scientists of the age accepted it. Since scientists have passed through the divine and metaphysical stage, any creed that they could accept on the basis of conviction and faith inevitably must agree with empirical science. In another words, science is the future religion of human beings. Comte then added that modern science could only accept and worship a unified being. That being is a humanity that is above all things and persons, with all individuals, both past and future, being members and having sought progress and prosperity of the human kind. This entity must be worshiped. Auguste Comte called it *Le Grand Etre*[4] and he appointed himself as *Le Grande Pretre*[5] of this creed. Of course under this religion of humanity, supplication does not mean worship; rather it means nurturing and nursing.[6]

Comte stated decisively that the future religion of human beings should adapt itself to science. His prediction was not far off the mark, for in recent centuries, science has become the great icon and the absolute object of veneration for human beings. No, not even an object of veneration, but an exclusionist god that was intolerant of any rival or partner. A lifeless, soulless icon that, without hearing any conceptions of meaning, spirituality, and soul, cut down that which did not bow before it in utter submission.

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[3] Religion of Humanity.

[4] The Great Entity.

[5] The Great Preacher.

[6] See *Encyclopedia of Philosophy*, Paul Edward editor-in-chief. New York: Macmillan, 1976, c1967. See also *Sair-e Hekmat dar Europa (Course of Philosophy in Europe),* Mohammad Ali Forooghi, p. 113, Tehran, Safi Alishah Publications, 1927.

Spirituality, ethics, and philosophy, whether natural or metaphysical, have no place unless they are given the seal of approval by science.

Modern science is not a peculiar method of knowledge about nature, but rather a thorough and encompassing philosophy that reduces all realities to the material level of functions and phenomena, and under no condition is it willing to acknowledge the existence of "unscientific" viewpoints. Other views derived from seasoned doctrines do not deny the legitimacy of science as a limited matter confined and encompassed by the material dimension of realities, but maintain constantly the existence of a web of inner relationships that links the material nature to the realm of the divine, and the outward appearances of visible objects to an inner reality. Exclusive confinement of the realities of the universe to their material scope by modern scholars, especially in the West, is to ignore the inner causes and means of the environmental crisis.

Humanity sought refuge in science in order to escape from hardships and to attain a more comfortable life, but the very science that came to interpret the world surrounding man, devoid of life, spirit, and meaning, led man to make his world more constrictive and painful under the shadow of ignorance and neglect of inner and spiritual concepts of the natural world. Science that was supposed to be man's companion and sympathizer, became his nemesis and according to Saadi, a poet from Shiraz:

> *"Shod Gholami ke Ab-e Jouy Arad; Ab-e Jouy Amad o Gholam Bebord."*
>
> [A servant went to fetch water from the stream. The water of the stream took the servant away.]

For the urban man, modern science has made the realm of nature into an object devoid of meaning. It has secularized the cosmos and made it asunder from Divine splendor. It is not a mirror whose beauties reflect the beauty of righteousness. Moreover, the natural cosmos lacks any kind of unity and oneness with human beings. Man considers himself apart from nature and is estranged from it, a stranger that lacks any kind of sanctity. If there is any sanctity, the modern man maintains it solely for himself. Thus modern man does not look compassionately on nature. He simply has a material, exploitative, and applied view. *Nature* is not his beloved, nor does he love it. It is not seen as his life companion to whom he feels responsible while enjoying its company. Rather to the modern man, *Nature* has become like a lady of the night being there merely to be taken advantage of, to whom he does not feel any responsibility or duty. The outcome of such notion was that of a woman of the night; nature has gradually fallen into decay, as if spending its final days. It has become so old and impaired that it has fallen from man's grace and can no longer be of service in his dominion.

It should be noted here that through its interpretation of nature, modern science has helped to unlock the secrets and the mystery buried within the nature and character of man. By nature, human beings are an entity determined to dominate and control all that is outside them. Accordingly, he wants to dominate and transgress upon nature. Many Western philosophers, and even a few Islamic philosophers, are of the opinion that man is unlike the ancient Greeks' idea that Human is civilized by nature; rather, man is an aggressor and exploiter by nature.

The seventeenth-century English philosopher Hobbes[7] was convinced that man is by nature always at war and that he maintains the right of preservation only for his own.[8]

He said: "By nature man is selfish and egotistical. He is motivated by selfish desires that need to be satiated and fulfilled. In its natural state, man's life is ugly, horrid, cruel, savage, and short."

Among present day Islamic philosophers, Allameh Seyyed Muhammad Hussein Tabatabaie believes: "Man has a relationship with his own faculties and parts. This relationship was brought into existence and is real. Hands, feet, eyes, and other parts of his body are undeniably controlled and used by him. Man has the very same relationship with nature outside his being; essentially considering all external objects and even other human beings for his own. He considers them as his tools. He looks at all external matters, whether inanimate, animals and even plants, with a view towards their use." Allameh believes that man is by nature created as an aggressor and exploiter, and that ethics is a secondary tenet for him. In other words, man is not civilized by nature, rather he is civilized by consequence and exhibition. The Aristotle quotation that man is by nature civilized, really means that civilized is secondary nature and not primary nature.

Briefly, human beings are naturally disposed to engage nature and overcome it as much as it is within their power and to employ it toward their goals and enjoyment. Modern science has totally theorized this concept for him by desanctifying nature. There remains no longer any meaning for man within the high mountain ranges, boundless oceans, and the heavens. It seems rather that their majesty and grandeur annoys his dominating and arrogant disposition. By scaling and conquering them, he wanted to deprive them of their natural majesty and make them lie prostrate at his feet. No longer is the spiritual experience of flight toward the kingdom of heavens as illustrated in Dante's "Divine Comedy" for

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[7] Thomas Hobbes (1588-1679).

[8] McDonald, M. "Natural Rights." pp. 21-40, *Theories on Rights*, Ed. J. Waldron, Oxford University Press, Oxford: 1984.

Christianity and nightly flights to heaven as in the Ascent of the Holy Prophet of Islam, the aspiration of modern man. Conquering of the mountain peaks, flying in spacecraft, and traveling to the planets in the solar system have made him proud. He sang the hymn of victory over nature and celebrated over the destroyed ruins. So successful was modern science in its attempt at desanctifying nature that regrettably even the religious persons lost their divine and sublime feeling toward nature and its importance.

Eliade wrote:

> The cosmic praise and the mystery of nature's participation as in Christian drama has become unattainable for the Christians living in a modern city. Religious experience is no longer available to existence. In the final analysis, this experience is totally private and personal. Salvation is an issue concerning only man and his god. At most, man might recognize that he is responsible not only in relation to God, but also before history. However, in this man-God-history association there remains no place for the universe and the creatures within. From this perspective, even to a true Christian, it appears that the world is no longer felt as the work of God.[9]

We must confess the fact that there is a striking neglect observed among custodians of religions in general, including Christian philosophers, especially Protestants. The majority of important trends in philosophy of religion in recent centuries had dealt with the subject of man and history and had focused on the issue of salvation and emancipation of man as a separate and single entity. For instance what is seen in the works of the famous contemporary theologian P. Tilich is merely apprehension about human beings as individuals, separate and disconnected from the world before God. Works by Barth and Bruner suggest an Iron Curtain has been laid around the natural world. They believe that nature cannot teach man anything about God, and therefore nature offers no theosophical or spiritual gain. R. Bultman's works have generally ignored the importance of the spiritual and divine dimension of nature, and they have brought it to the level of a synthesized construct introduced for sustained life of progressive man.

Unfortunately, Western churches, religious institutes, and the Islamic seminaries in Muslim countries have not shown much reaction until recently. In spite of the existing resources originating from the depth of Christianity and Islam, they did not embark on compiling separate books

[9] Eliade, M. *The Sacred and the Profane: The Nature of Religion,* Harvest/HBJ, New York: 1959, p. 179.

entitled Environmental Divinity or theology to direct man toward the spiritual aspect of the natural world around him.

Due to a silence of religious centers and lack of serious scholarly works, the learning and teachings of divine religions, instead of demanding, have assumed the debtor status and are being reprimanded as an accused party. Some of the scholars who are preoccupied with the environmental crisis have produced works in which it seems as if unitarian religions shoulder a major portion of the culpability for the ruin of nature instead of pinning it on the internal developments within Western civilization that began during medieval ages, and continued through the Renaissance and seventeenth century.

For instance, Arnold Toynbee, the great English historian and philosopher of the twentieth century, expressed unique and controversial hypotheses about the philosophy of history and about the periodic rise and fall of civilizations. He believed that the unitarian religions have unwarrantedly spoiled man more than he deserves. They taught humans that God created the world for them, that everything belongs to them, that all the mountains, seas, and plains were created for humans' life and use, and that they can do whatever they desire. This way of thought led humans to unbridled exploitation.[10]

Such thinkers ignore the fact that the unitary religion of Islam, which belongs to the very same succession of the unitary, Abrahamic religions of Christianity and Judaism, has never lost its mindfulness toward the sacred character of nature. This paper will later point out how Koranic quotations express the sanctity of nature. It will show how Christianity and Judaism in the East, unlike what we see in the West, have neither taught nor promulgated the attitude of dominating nature and laying it to waste. The teachings of unitary religions are not the cause of this crisis, but rather they are the only solution for the dilemma that has come to grip modern man.

In the later decades of the twentieth century, amid the rapture of conquering and commanding nature, man awakened from the intoxication of victory over nature. He recognized what was devastated as the value of victory—humanity. Fortunately, the majority of today's thinkers believe that the very essence of man's existence is threatened. Instead of deciding that the merit of science and technology overcomes that of nature, man's own constructs have been transformed to recognize it is now time for him to revise the general view of the world. According to Schoen: "Is it no

[10] Mohaghegh Damad, Seyyed Mostafa. *A Discourse on Nature and Environment from an Islamic Perspective*, Department of Environment, Tehran, Iran: 2000.

longer human reason that determines what is man? What is reason? What is Truth? Rather it is the machine that determines these subjects using physics, chemistry, and biology. Under these conditions, man's mind and thoughts are more than ever dependent upon the 'space' that has been created and established by his knowledge. From then on it is science and machines that create man."[11]

Yet, in spite of the mindfulness of the world's scientific centers, the note of protest does not go beyond the confines of environmental supporters and authorities who have understood the depth of tragedy. The general conscience of human community has not been alerted. The ultimate solution requires unanimous efforts and dedication of humanity. The environmental crisis will not subside as long as the feeling of kindness and compassion toward the outer world has not replaced the sense of domination in every corner of the hearts of all humans.

In our opinion, the true alternative at this juncture is to return to the perception of religions. More than the in past, today's man has much readiness to accept teachings of religions. Inasmuch as man's understanding and intelligence has grown, he better understands and accepts religious concepts. This is especially so given that modern man has experienced the bitter outcomes of atheistic perceptions and removal of spirituality from his natural environment. Contemporary man has become repentant of sin and penitent before the Lord and has sought forgiveness for past transgressions. This is a critical and invaluable opportunity for religious institutions and clerics to have religion presented in a way appropriate to the march of time, so as to embrace with kindness the modern man who has confessed to his sin. Certainly, if man were to look at the world around him through religious beliefs, no such ravage would take place.

What we mean by religion in its widest and most universal sense includes all the beliefs and worldviews that have been studied and investigated under this subject. Thus, our view here is not solely confined to religion defined as "submission of man before a superior force" that would inevitably lead to the Lord and the unitary religions. Official religion is a collection of principle precepts and deeds that are undertaken with an aim of linking man to a sublime power particular to a society or a community. Our intent in the present discussion, however, is linked to all tenets, words, and deeds that are directly or indirectly effective with respect to the preservation of the environment. Religion in this context applies to any system of beliefs that imparts meaning to the world, trans-

[11] Schoun, Frithjof. *Understanding Islam.* Translated by D.M. Matheson. Mandala Books, London: 1967, pp. 32-33.

forms one's view, and calls for application of conscience and ethics. It is an inner strength and a manner of the physical way of life based on enjoining good and abstaining from evil. A worldview coupled with spirituality and uprightness is the original core of all beliefs that we mean by religion.

The proof is that all religions play this role in this general sense; this is not something particular only to Abrahamic religions. When we look up the Hindu tradition, we meet a metaphysical belief about nature. It is thus that we see the growth and blossoming of many sciences within the embrace of Hinduism, some of which have come to influence the West through Islam. In the Hindu tradition, our attention is drawn to the Vedantic belief of Atman or Maya, a belief where existence is considered not an absolute reality, but rather a veil that covers the transcendental self.[12] This view is very similar to the theory of Names and Attributes in the Islamic gnosticism. In Islamic gnosticism, the world and whatever it holds are manifestation of the Names and Attributes of the Righteous, which we will come to later.

In Eastern Religions, especially in Taoism and in Confucian doctrine, we observe a form of devotion toward nature and an understanding of its metaphysical significance, which is of utmost importance. This respectful attitude towards nature, coupled with a strong sense of symbolism and an awareness of the clarity and focus of the universe and its transparency from the standpoint of metaphysical truths, can also be found in Japan. Shintoism strongly reinforces this perception. In Far Eastern art, most notably in Taoist and Zen traditions, drawings of natural landscapes are true portraits of nature. They do not cause a sensual delight in the spectator, but rather convey benefaction, compassion, and beauty, and serve as the means of union with transcendental truth.[13] This is the very essence that a Muslim gnostic Saadi Shirazi expresses:

> *"Tang Cheshman Nazar be miveh konnand; Ma Tamashagar Bostanim."*
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> [Narrow-sighted niggards look at the fruit, [while] we behold the orchard.]

Within divine religions, if we examined the history of Christianity in the light of Eastern metaphysical and cosmological principle, we would

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[12] Guenon, Rene. *Introduction to the Study of the Hindu Doctrines.* Translated by Marco Pallis. Vedams, New Delhi: 2000. Also see his other book, *Man and His Becoming to Vedanta.* Translated by Reynolds Nicholson, Vedams, New Delhi: 1999.

[13] Matgioni, *La Voie Metaphysic,* Paris: 1956.

succeed in discovering a tradition for studying nature that could serve as a record for evaluating Christianity's new theosophy toward nature.

In the Old Testament, there are certain references made to nature's participation in the context of a religious view of life. In the Book of Joshua, there is mention of the Lord's vow to maintain peace with animals and plants. Noah is commanded to preserve all animals, whether hallowed or not, regardless of their benefit to human beings.[14] In the same manner, the untouched nature or desert is visualized as a place of trial and punishment, as a refuge for contemplation, or even as a reflection of paradise. This very tradition of contemplative view of nature lives later on in Judaism in the "Kabala" and "Hasidim" schools of thought.

In the New Testament, the death and assignation of Jesus is accompanied by the wilting and blossoming of nature that bespeak Jesus's cosmic quality. Saint Paul, too, believes that all creation partakes in the redemption of sin.

In the West, due to the concern about polytheism and idolatry and in reaction to them, the original church gradually distanced itself from the surrounding world until it was severed from it. Even words such as paradise and desert, in their positive sense, were recognized by the Church and later monasteries as separate and distinct institutions.[15] In the Eastern Church, in contrast, reflection in nature was still accepted and became more pivotal. Nature was included as a support for spiritual life. The belief was formed that all nature partakes in deliverance and salvation and that the world would be revived and restored with the second coming of Jesus.

For the author, Origen[16] and Irnaus, the early fathers of the Greek Orthodox Church who created "Divinity of Nature," are very important. They did not restrict the term Logos, or the Word or Expression of Allah,

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[14] Williams, George Huntston. *Wilderness and Paradise in Christian Thought; the Biblical Experience of the Desert in the History of Christianity & the Paradise Theme in the Theological Idea of the University.* [1st ed.] New York, Harper [1962]. Prologue, p. 10.

[15] *Ibid.*

[16] *Translator's Note: Oregenes Adamantius,* or Origen the most important theologian and biblical scholar of the early Greek church. His greatest work is the *Hexapla,* which is a synopsis of six versions of the Old Testament. Born *c.* 185, probably Alexandria, Egypt, died *c.* 254, Tyre, Phoenicia [now *Sur,* Lebanon].

[17] *Hexaemeron* or *Hexaëmeron* ("Six Days"), nine Lenten sermons on the days of creation, signify a term of six days, or, technically, the history of the six days' work of creation, as contained in the first chapter of Genesis.

[18] Born AD 329, Caesarea Mazaca, Cappadocia; died January 1, 379, Caesarea; was Latin *Basilius* early Church Father who defended the orthodox faith against the heretical Arians. As bishop of Caesarea, he wrote several works on monasticism, theology, and canon law.

to man and religion only, but they have also used it for the whole of nature and all creatures.

In his book, *Hexaemeron*,[17] Saint Basil,[18] a follower of Origen, wrote: "When you think about grass or a herb-yielding seed…that seed is the word that would come to occupy your whole mind."[19]

This view completely complies with the Islamic perception. In the Majestic Koran, the whole universe and its every component are Kalimatullah [Word of Allah], just as Jesus and the Koran that was revealed to the Prophet are the Word of Allah.

"And if all the trees in the earth were pens and the sea with seven more seas added to it were inks, the word of Allah would not be exhausted. Surely Allah is mighty and wise."[20]

"Then the angels said: O Mary, surely Allah gives good news of one whose name is Messiah, Jesus, son of Mary."[21]

Gradually as Christianity expanded into Eastern Europe, new groups embraced it. These groups had a deep insight about the spiritual value of nature devoid of any signs of Mediterranean polytheism. A perfect example of this was the Celts who had a strong cognizance and awareness about the balance and harmony of man and nature. The Celtic monks were always seeking Divine epiphany, and they went on quests hoping to discover the harmony of the Lord's Creation.[22] They sought the Lord in the mysterious cosmos. Pilgrimage, quest, and visiting creation have been repeatedly mentioned in Koranic monotheism. Please take note of the following verses:

"Say O Messenger: Travel in the earth and see how He makes the first creation…"[23]

"And we made between them and the towns which we had blessed,

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[19] Raven, Charles E. *Natural Religion and ChristianTheology*. Cambridge University Press, Cambridge, England: 1953.

[20] Luqman, verse 27 [Translator's note: Luqman is the 31st chapter of the Holy Koran. The title of the chapter is taken from that of a sage to whose story it refers].

[21] Al-Amran, verse 44 [Translator's note: *Al-Imran* or Family of Amran is the 3rd chapter of Holy Koran].

[22] Williams, George Huntston, *Wilderness and Paradise in Christian Thought; the Biblical Experience of the Desert in the History of Christianity & the Paradise Theme in the Theological Idea of the University*. [1st ed.] New York, Harper [1962], p. 46.

[23] Ankabut, verse 20. [Translator's note: *Ankabut* or Spider is the 29th Chapter of Holy Koran.]

[24] Saba, verse 18. [Translator's note: *Al-Saba* or Saba is the 34th Chapter of Holy Koran. The title of this chapter is taken from that of the city of the same name, i.e., Saba or Shaba, which was situated in Yaman and was destroyed by flood.]

[25] John Scotus Eriugena; An Irish teacher, theologian, philosopher, and poet, who lived in the ninth century.

other towns easy to be seen, and we apportioned the journey therein. Travel through them night and day, secure."[24]

In the ninth century, an Irish thinker named Johannes Scotus Eriugena[25] wrote a commentary on the Holy Bible in which he tried to establish an intimate link between the Lord, the Cosmos, and human beings. In this respect, he strongly defied some of the theologians and philosophers who, due to lack of precise understanding of metaphysical and cosmological concepts of nature, were inclined to classify any such speculation as pantheism, naturalism, and polytheism. Eriugena thus stated, "The Cosmos has a transcendental origin, and all creatures are from the Lord, but created through Jesus."[26]

Finally in the person of Saint Francis of Assisi[27] we behold the most fantastic, respective attitude towards nature within the framework of a Christian saintly life. His life among the birds and animals is a firm example of this Christian conviction that human beings cannot relate to nature through consecration. In his Canticle of the Sun and his many other canticles, he displays a deep, penetrating insight free of any human gainfulness. In his conversation with animals, he displays the sincerity that a saint attains by connecting with the divine essence that has breathed into nature.[28] Dante's Divine Comedy teaches that human beings must trek throughout the universe so that they would recognize that the force that surrounds all beings is, "love and kindness that moves the sun and stars."[29] While this way of observing nature based on post-medieval teachings was confronted with fluctuations and challenges, it continued until the end of the nineteenth century. People like John Ray still searched nature for signs and indications of the Lord. In his work, *Unsere Farbenlehre*, Goethe[30] dealt with the existing symmetry in nature and called people to recover a perception of this pure and eternal nature.

Following Christianity and Judaism are Islamic teachings. The Majestic Koran has a very interesting and penetrating view of nature. It does not allow man to lay prostrate before nature as his lord because of its

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[26] Bett, Henry. *Johannes Scotus Eriugena. A Study in Mediaeval Philosophy*. pp. 204. University Press: Cambridge, 1925.

[27] Founder of the Franciscan Order, born at Assisi in Umbria, in 1181 or 1182 — the exact year is uncertain; died there, 3 October, 1226.

[28] Williams, George Huntston, *Wilderness and Paradise in Christian Thought; the Biblical Experience of the Desert in the History of Christianity & the Paradise Theme in the Theological Idea of the University*. [1st ed.] New York, Harper [1962], p. 42.

[29] The New Encyclopedia Britannica, v. 16, pp. 971-976, 15th Edition, 1989.

[30] German poet, novelist, playwright, and natural philospoher, the greatest figure of the German Romantic period and of German literature as a whole. The New Encyclopedia Britannica, v. 20, pp. 133-140, 15th Edition, 1989.

greatness and magnificence, nor does it consider nature as an entity without any sanctity, meaning, or essence. The Koran presents natural manifestations as the Lord's creations, and directs man that instead of worshiping these manifestations to worship their Creator: "And of His signs are the night and the day and the sun and the moon. Adore neither the sun nor the moon, but adore Allah who created them."[31]

Although the Lord creates the living beings in nature, in the Koran's view, nature itself is not a soulless and lifeless entity. It is living. Human beings could become intimate with nature, talk with it, and express love for it. Due to their manner of relationship to the Lord, the Koran views the beings in nature as sacred. Their sanctity and essence are inseparable.

From the Koran's viewpoint, all parts of nature always are glorifying the truth. They all pray before god and conduct supplication: "Whatever is in the heavens and whatever is in the earth glorifies Allah, the Ruler, the Holy, the Mighty, the Wise. "[32]

It is interesting to note that according to the Koran, the glorification of the Lord by creatures could be understood, perceived, and recognized by human beings. In a verse revealed to a Messenger of Allah, it announces: "Seest thou not that Allah is He, Whom does glorify all those who are in the heavens and the earth and the birds with wings outspread? Each one knows its prayer and its glorification. And Allah is Knower of what they do."[33]

As you notice, the above verse expects human beings to discern the glorification and invocations made by all the beings of the world, even the birds in the sky.

In the lives of Muslim sages, it is a simple feat to hear the sound of invocations of nature. Saadi says:

> "Last night a bird was singing a dirge that robbed me of reason, patience, stamina and conscious;
> Unless hearing my chant, one of my true friends said:
> I could not believe that the sound of a bird could make one so senseless,
> I answered: I would have not been human to remain silent while the bird glorified the Lord."

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[31] Fussilat, verse 37. [Translator's note: *Fussilat* means a thing made plain. It is the 41st Chapter of the Holy Koran.]

[32] Jummu'ah, verse 1. [Translator's note: *Jummu'ah* receives its name from the exhortation to gather together on the day of *Congregation,* or Friday. It is the 62nd chapter of the Holy Koran.]

[33] Al-Nur, verse 41. [Translator's note: *Al-Nur* means The Light. It is the 24th chapter of the Holy Koran.]

According to Sadrul-Motu'alehin Shirazi, every being is understanding to the extent of its essence, thus all beings in nature have understanding and awareness inasmuch as they are entitled to: "All beings, even the solids, while seemingly inanimate, are in reality alive, aware and glorify the truth. They gaze upon the majesty and magnificence of truth; having total awareness about their Creator and Maker." The magnificent Koran points to the very same thing when it says that "…And there is not a single thing but glorifies Him with His praise, but you do not understand their glorification."[34]

Sadra has not interpreted the passage "you do not understand" in an active form, rather he considered it passive, suggesting that the beings themselves are not aware of their glorification although they are consciously glorifying. To provide further reasoning, he adds: "Meaning that because this manner of knowledge, that is knowledge about knowledge, which the Islamic philosophy calls compound knowledge, is particular to beings that are purely abstract who transcend the physical state."[35]

According to the Koran, all parts of nature share salvation and deliverance with human beings. Therefore, just like them, entities in nature, whether animate or inanimate, would gather in the Day of Gathering, or Day of Resurrection. About animals, the Koran says: "And when the wild animals are gathered together, the earthly beings gather along with humans, and everything is eloquent and articulate."[36]

"When the earth is shaken, and the earth brings forth her burdens, and man says: 'What has befallen her?' On that day she will tell her news, as if the Lord had revealed it to her."[37]

In Islamic teachings, the link between man and nature in deliverance and salvation, as well as in corruption and annihilation, is so strong that a human being's devotion or negligence toward God, observance, or violation of divine precepts directly affects nature. As a part of the manifestation of truth, nature is kind and compassionate toward upright and devout human beings, but it is contemptuous and uncompromising against wrongdoing and cruel human beings. The glorious Koran says: "And if

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[34] Bani Isra'il, verse 44. [Translator's note: *Bani Isra'il* or the Israelites is the 17th chapter in the Holy Koran.]

[35] Sadr-e-din Muhammad Shirazi (Mollah Sadra), *Al Asfar Al Arba'a, fel Hekmatul Mote'aliya [The Four Unveiling on Transcendental Philosophy],* vol. 6, Chapter 12, Tehran.

[36] Al Takwir, verse 5. [Translator's note: *Al Takwir* or folding up derives its name from the mention of the folding up of the sun in the first verse. It is the 81st chapter in the Holy Koran.]

[37] Al Zilzal, verses 1-4 [Translator's note: *Al-Zilzal* means the shaking. It is the 99th chapter in the Holy Koran.]

people of the town had believed and kept their duty, we would certainly have opened for them blessings from the heavens and the earth."[38]

In another verse, it quotes Noah appealing to those who sin: "…Ask forgiveness of your Lord; surely He is ever forgiving. He will send down upon you rain, pouring in abundance."[39]

In the Hadith or accounts dealing with religious leaders, the wrath of nature has been recognized as the very wrath of the Lord against the deeds and actions of human beings.

"When the rulers tell lies to people, no rain shall fall."[40]

The glorious Koran presents an account of a past group of people, who because they committed sin and transgressed against divine precepts, were subjected to divine punishment through the wrath of nature. The people of Noah (Aad) and people of Lot (Thumud),[41] each had been annihilated through natural punishments.

In Islamic teachings, all beings in the world are signs and indications of the Lord. Within Islamic mysticism, they are all the names and attributes of the Lord. What is meant here by names and attributes is that the Lord is manifest in natural entities, and all nature is a demonstration of truth. Wherever human beings look, they will see the Lord. The Koran says: "And Allah's is the East and the West, so whither you turn thither is Allah's purpose."[42]

A portent-based view of nature would bestow it such sanctity that would make it totally immune against any transgression committed in the course of scientific explorations.

Along with this perception, there is the conception of Divine Vice-Regency that has been quoted in the Koran. It is explicit in presenting human beings as Vice-Regents of the Lord: "And when thy Lord said to the angels, I am going to place a ruler in the earth."[43]

In the conversation between the Lord and the Angel in the beginning of the genesis, the angels were worried about the annihilation and defilement of earth, and discussed this with the Lord. But the Lord indicated knowledge when responding to them.

"The angels said: Wilt Thou place in it such as make mischief in it…?"[44]

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[38] Al Araf, verse 96.

[39] Nuh, verses 10-11. [Translator's note: Nuh or Noah is the 71st Chapter in the Holy Koran.]

[40] Bahar, V. 73, p. 373 ; see also V. 96 p. 14.

[41] Translator's note: Refers also to the people of Sodom.

[42] Al Baqarah, verse 115 [Translator's note: *Al-Baqarah* means the Cow and is the 2nd Chapter in Holy Koran.]

[43] Al Baqarah, verse 30.

[44] *Ibid.*

In reply to them, the Lord said: "Surely I know what you know not."[45]

That is, you shall discover the secret of this later. The Lord announces: "And He taught Adam all the names, then presented them to the angels. He said: 'Tell Me the names of those if you are right.' They said: 'Glory be to Thee! We have no knowledge but that which thou hast taught us. Surely Thou are the Knowing, the Wise.' He said: 'O Adam, inform them of their names.' So when he informed them of their names, He said: 'Did I not say to you that I know what is unseen in the heavens and the earth? And I know what you manifest and what you hide.'"[46]

From this conversation it appears that upon seeing the knowledge and science of Adam, the angels were convinced that such a being merits divine Vice-Regency and as a sign of humbleness they bowed to him. What kind of science is this knowledge? Could the very science that has in recent centuries devastated the environment and ruined the earth be the demonstration of the knowledge taught by the Lord? Indeed not. The science taught by the Lord is a sacred knowledge that sees the world as a revelation of the Lord and a reflection of the essence of truth. The best rendition of this is in the Koran where it mentions that He had taught man His names and attributes—the world. To know the world is to know the Lord, and to transgress upon the world, is to transgress and violate the truth. Attar, a Persian poet, says:

"When we sent out Adam, We bequeathed our splendor on the desert."

A devout human being will use the gifts of nature toward evolvement and development, for the Lord has announced:

"The Lord created you from the earth and called for you to prosper on it."

A devout person would not take any step other than thriving on the earth, otherwise they would be known as a profligate. According to the Koran, Satan suggests squandering and profligacy; and those who execute such deeds, are Satan's brethren: "Surely the squanderers are the devil's brethren. And the devil is ever ungrateful to his Lord."[47]

CONCLUSION AND RECOMMENDATION

In past centuries, by distancing itself from the spiritual perception of nature, modern science had given man insight that has led to a dominating and transgressing ego in humans. This ego has brought about ruin and crisis while it confronted nature to satiate its inner desires. Unfortu-

[45] *Ibid.*
[46] Al Baqarah verses 31-33.
[47] Bani Isra'il, verse 27.

nately, the theologians and philosophers are most often responsible for, and have even contributed to, the secularization of nature. By not focusing and making efforts toward writing in the field of environmental theology and presenting it to the literary scene of their time, they left the field open for the total secularization of nature by the industrial revolution and by endless application of modern science. Many theologians and religious thinkers completely laid aside the issue of nature and pursued man's salvation, with utter disregard to the rest of the Lord's creation. Due to this hard-hearted indifference to the right of nature and other living beings, the continued existence of human beings on planet earth has become a hazard.

The time has now come for all those who are truly concerned with the human condition and seek an alternative solution to this crisis to once again recourse to the long and historical traditions of religions. There is a need to teach the study and exploration of nature using religious texts and sources within metaphysical teachings, to attest that it is only through the revival of a spiritual and divine conception and cognition of nature that humanity can neutralize the ruination of nature caused by application of modern science. It is through such revival that we might be assured that future humanity would make the earth prosperous and flourishing instead of mercilessly exploiting nature's blessings and defiling the earth.

Not only the religious values, but also the cultural beliefs of people could be generally used as rules and guidelines, as they are grown from within people following careful study, modification, reform, and extension. Such rules could be better accepted. They could lead to practical answers in environmental preservation and in achieving a sustainable development not only in one region or country, but throughout the world.

As one of the practical and tangible strategies in the dialogue of civilizations, the universalization of religious values and teaching and expansion of cultural beliefs could be used as practical blueprints toward the protection and development of the environment throughout this diverse world.

The existing practical methods in religious convictions and cultural beliefs include the knowledge that one could contemplate the beliefs that have been expanded and proven in the course of history, to preserve the environment and finally achieve sustainable development. It is thus possible to draft solutions and act on them so that along with other methodologies, these could, without being imposed by an outside agency or any governing body, reach their destined goals. By their nature, these solu-

tions would become the hallmark of existing practical methods, especially in developing societies that have an ancient culture and history that are more dependent on religious culture and principles.

Thus the author wishes to make the following suggestions to the present scholars.

Now that human thinkers are concerned about the depth of the catastrophe that has befallen the human environment, are worried about the future life of humanity, and confess to the role of public beliefs and convictions in resolving this crisis, the cultural figures and religious clergy shoulder a heavy responsibility. It is now time for this group of people to seriously and sincerely concentrate on this issue, and reintroduce genuine cultures, teachings, and traditions of religions towards educating the public in dealing with nature. Resolving the environmental crisis demands general mobilization of humanity. The only way to achieve this sacred goal is to follow the guidelines offered by men of culture and religious authorities.

I propose that an association of scholars and authorities of various religions of the world as its members be formed for protecting the environment. Its secretariat should constantly work for coordination in convening scientific conferences and meetings.

The manner of introducing the traditions of religions to the present generation for an immaculate and spiritually better life calls for a relatively deep study, since using the old methods could not answer the present era and would be ineffective. There should be an exchange of experience among religious figures in order to update the methods and tools suitable for the new situation. The proposed association could attain this goal through bilateral talks and discussions.

Appendix H

Current Situation of Bioethics in Genetic Research in Iran

Mohammad Reza Zali and Saeed Shahraz

There are a limited number of centers for genetic studies in Iran, although the number has rapidly increased in recent years. The most important of these research centers are now under the supervision of a research network.

Considering the growing trend toward genetic research, health care officials strongly sensed the need to draw up detailed guidelines on ethical issues related to such research. Recently, the Iranian Ministry of Health established a national ethics committee to develop regulations in the field of bioethics, and the committee issued a document with 27 clauses. A few provisions are directly related to genetic studies. In this regard, the Research Center for Gastroenterology and Liver Disease in Tehran is now preparing the first draft of a guideline that addresses the most challenging ethical implications in the field of genetic studies including informed consent, confidentiality, genetic counseling, and the potential for social harm or psychological distress imposed by disclosure of an individual's genetic information.

Shiite, a branch of Islam and the official religion of Iran, embraces a number of rules and concepts about important issues of bioethics that are not in accordance with those of Western countries. In addition, gnostic concepts that are integrated in Persian literature and are firmly respected by the Iranian population present a different view of some aspects of bioethical issues. This paper addresses the current situation concerning the bioethical aspects of genetic studies and a logical way to prepare simple, applicable, and effective guidelines in this area.

BRIEF HISTORY OF DEVELOPING BIOETHICAL GUIDELINES

The German "Guidelines on Human Experimentation" (1931) is thought to be the first guideline for therapeutic and scientific research on human subjects. It remained in force until 1945, but it had no discussion of genetic research. The Nuremberg Code (1947), which considered general guidelines for experiments on human subjects, also had no discussion regarding genetic research.

The World Medical Association issued the first historical predecessor of the Declaration of Helsinki in 1954. Since then, the Declaration has been issued and revised five times. Although the most important aspects of ethical issues concerning research on human subjects were discussed in the last version of the Declaration, special ethical considerations in the field of genetic research such as gene therapy, privacy of genetic information, sex selection, cloning, eugenics, and patent and licensing have not been included.

Respect for persons, beneficence, justice, informed consent, disclosure of information, and volunteerism are some topics that were debated in the Belmont Report, issued by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research in 1979. The U.S. Department of Health and Human Services issued Regulations for the Protection of Human Subjects in 1991. In addition to more detailed explanations regarding some critical bioethical terminology currently in use, this important document addressed the role of Institutional Review Boards (IRB) in addressing human subjects in biomedical research, requirements for and documentation of informed consent, and mother-fetus rights during pregnancy.

The Summary Report of the International Summit Conference on Bioethics toward an International Ethic for Research involving Human Subjects of 1987 is a brief document that addresses international cooperation on both the elaboration of principles and on the implementation of ethics review processes involving human subjects. The Council for International Organizations of Medical Sciences, in collaboration with the World Health Organization, issued a series of guidelines for biomedical research involving human subjects in 1993. No particular bioethical consideration in the area of genetic research can be seen in this document. In short, discussions of current topics of ethical problems of genetic research should be included in new versions of international bioethical guidelines.[1]

[1] Reich, W.T., ed. *Encyclopedia of Bioethics*. Wiley Interscience, Georgetown: 1995.

IMPORTANT BIOETHICAL ISSUES IN THE FIELD OF GENETIC RESEARCH

Gene Therapy

Innovations in recombinant DNA research in the early 1970s and fertilization outside the human body in the 1980s brought closer the prospect of genetically manipulating human eggs, spermatozoa, and embryos. Various ethics committees have been set up in developing countries to weigh ethical issues associated with embryo research, reproductive technologies, and genetic manipulations. There are two kinds of gene therapy: somatic cell gene therapy and germ-line gene therapy. Considering the ethical aspect, it is apparent that the latter type is more important than the former. National and international governmental and nongovernmental organizations have reached a range of conclusions about the ethical acceptability of germ-line gene therapy.[2,3,4]

Privacy of Genetic Information

In a strict sense, genetic data are information about the genetic code (DNA, RNA, and protein sequences) of the human chromosomes present in the nucleus and mitochondria of the cells of an individual, and about the number and state of the chromosomes. Such data determine the individual's genetic identity.

In the legal context the term "privacy" implies the following: 1) access to information about persons, 2) subsequent disclosure of this information to third parties, 3) third–party interference with personal choices, especially in intimate spheres such as procreation, and 4) ownership of materials and information derived from persons.[5] The highly personal nature of the information contained in DNA can be illustrated by thinking of DNA as containing an individual's "future diary."

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[2] Juengst, E.T., "Can Enhancement Be Distinguished from Prevention in Genetic Medicine?" *Journal of Medicine and Philosophy.* April 1997, Vol. 22(2), pp. 125-142.

[3] Wivel, Nelson A., and LeRoy Walters. "Germ-Line Gene Modification and Disease Prevention: Some Medical and Ethical Perspectives." *Science.* 22 October 1993; Vol. 262 (5133), pp. 533-538.

[4] Minister of Government Service of Canada, Royal Commission on New Reproductive Technologies. *Proceed With Care* (final report), Ottawa: 1993.

[5] Anderlilk M.R., in Murray T.H., Mehlman M.J., editors. *Encyclopedia of Ethical, Legal, and Policy Issues in Biotechnology.* Vol. 1, John Wiley and Sons, Inc., New York: 2000.

DNA databanks can be assumed to be entities that collect, store, analyze, and control DNA samples and information derived from DNA samples. The term could also include entities that either only store DNA samples or only store information derived from genetic analysis. Therefore, to effectively protect genetic privacy, unauthorized collection and analysis of individually identifiable DNA must be prohibited unless the concerned individual specifically authorizes the collection of DNA.

Sex Selection

There are several different attitudes toward sex selection before birth. Liberals, and particularly liberal feminists, tend to support the pre-selection of the sex of a future child as morally acceptable as is the use of contraception for family planning. Others condemn any type of sex selection. Families themselves have different aspirations to have sons or daughters. However, the dominant trend to have one sex within families may lead to sex-ratio changes. New methods of pre-selecting sex will probably be introduced over a period of several decades. Thus, there will be time to improve our understanding of the consequences of small sex-ratio changes.

Cloning

The world of science and the public at large were both shocked and fascinated by the work of Ian Wilmut and his colleagues on the successful cloning of a sheep from a single cell of an adult.[6] But it appears that the global sentiment is against cloning.[7] The U.S. National Bioethics Advisory Commission is reviewing the troubling ethical and legal implications of cloning in the United States. The Director General of the World Health Organization characterized human cloning as "ethically unacceptable as it would violate some of the basic principles which govern medically assisted reproduction. These include respect for the dignity of human beings and the protection of the security of human genetic material."[8] As in the United States, one cannot see a firm acceptance of cloning.[9] Despite

[6] Wilmut, I., and Schnieke, A.E., "Viable Offspring Derived from Fetal and Adult Mammalian Cells." *Nature*. 27 Feb. 1997, Vol. 385 (6619) pp. 810-813.

[7] Brock, D.W., et al in Murray, T.H., Mehlman, M.J., editors. *Encyclopedia of Ethical, Legal, and Policy Issues in Biotechnology.* Vol. 1, Wiley Interscience, New York: 2000.

[8] World Health Organization Press Office, Geneva, Switzerland, March 11, 1997.

[9] Anderlilk, M.R., in Murray, T.H., Mehlman, M.J., editors. *Encyclopedia of Ethical, Legal, and Policy Issues in Biotechnology.* Vol. 1, John Wiley and Sons, Inc., New York: 2000.

this negative atmosphere, all biotechnologists potentially understand the individual and social benefits of cloning such as allowing women who have no ova or men who have no sperm to produce an offspring that is biologically related to them.[10]

Eugenics

According to Francis Galton, eugenics is the science of improving the human genome over time.[11] Sterilization is the main topic discussed in the field of eugenics. Despite major opposition to sterilization laws from the side of some Catholic churches and Islamic fundamentalists and some other religions, sterilization has broad acceptance among people and legislators worldwide.

Patents and Licensing

The collection, treatment, storage, and use of genetic data are other issues troubling ethicists around the world. Tens of thousands of applications for patents on human genes, living cells, plants, and animals have been made in recent years, especially in the United States and Japan. Hundreds of them have been granted.

Should it be legal to patent genes and traditional knowledge? This is a very important question that should be answered by authorized organizations. Somehow the source of genetic data indicates the status of property. If the material obtained were from a non-human source, the law generally considers it as property. However, if the material is obtained from a human source, the law generally fails to recognize it as property. It has been recognized that a living organism not found in nature and created by the intervention of humans is a product of invention and not a product of nature.[12] Now in the United States, artificial living organisms are qualified as patentable subject matter under the U.S. patent law.[13]

A tremendous bulk of information has been obtained from large projects such as the Human Genome Project, and considering studies of the human body, body parts, and biological materials all over the world, we believe that all governments should clarify their patent laws concerning such activities.

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[10] Robertson, J.A. *Children of Choice: Freedom and the New Reproductive Technologies*. Princeton University Press, Princeton NJ: 1994.

[11] Gehrke, L.M., in Murray, T.H., and Mehlman, M.J., editors. *Encyclopedia of Ethical, Legal, and Policy Issues in Biotechnology*. Vol. 1, John Wiley and Sons, Inc., New York: 2000.

[12] Kelves, D. *In the Name of Eugenics.* University of California Press, Berkeley: 1985.

[13] Chakarabarty, D.V., 444 U.S. patent 397: 1980.

ORGANIZATIONS IN IRAN CONCERNED WITH BIOETHICS

The Ministry of Health and Medical Education, Office for Study for Humanistic and Islamic Science in Medicine and Medical Ethics

This Office started its activity a few years ago and has drafted the previously mentioned 27-clause act entitled, "The Protection Code for Human Subjects in Medical Research." The most important ethical considerations include: informed consent, human rights during research, certifying research projects according to risks and benefits, privacy of information, paying compensation for harm imposed by research on human subjects, cultural and religious implications of research, rights of prisoners and individuals with mental retardation and of psychotic patients, and research on the fetus. The Act has been customized according to the Code of Religious Laws in Shia and cultural issues peculiar to the Iranian population. An informed consent document in the form of a questionnaire has been attached to the Act.[14]

Recently, the Ministry of Health and Medical Education has required all universities and biomedical research centers to develop bioethics committees based on a uniform guideline. The Office of the Deputy for Research, Ministry of Health and Medical Education, has prepared the guideline.

Iranian National Commission for UNESCO

This organization is drafting a sixteen-clause guideline to establish a national bioethics committee that will discuss important issues. They include priorities for national bioethical studies; coordination of activities of ministries, organizations, universities, and research centers that are involved in bioethical issues; lack of higher education in the field of bioethics; establishment of a basis for international scientific negotiations; and financial resources for research projects on bioethics. The committee will include representation of the Ministry of Science, Research, and Technology; the Ministry of Health and Medical Education; the Organization for Protection of the Biological Environment; the Ministry of Agricultural Jihad; the Legal Medicine Organization of Iran; the Hozeh Elmieh of Qom (Qom Seminary); the Iranian Academic Center for Education, Culture, and Research (ACECR); and the Medical Council of Iran (as an NGO). Other permanent members will be two specialists in the philosophy of ethics, two lawyers, two biotechnologists, two biologists, and one specialist from

[14] *Protection Code of Human Subjects in Medical Research.* Iran's Ministry of Health and Medical Education: 1999.

each of the fields of immunology, genetics, pharmacology, biochemistry, psychology, and epidemiology.[15]

Research Centers

Local ethics committees have been established in over 85 research centers involved in research in biotechnology, molecular and cellular biology, and related fields. The number of such committees is increasing. Some centers such as the Research Center for Gastroenterology and Liver Disease and the Avecina Research Center have developed documentation for certifying proposals for genetic research.

Meanwhile, the Molecular Medicine Network is a new organization that aims to coordinate and supervise the research centers involved in molecular and genetic research throughout the country. The current trend is to write a uniform guideline for the ethics committees of these centers.

POTENTIAL SOURCES OF BIOETHICAL LAWS IN ISLAM AND SHIA

Islam

The modification and improvement of living organisms and the creation of microorganisms through biotechnology challenge all religions—including Islam—to refine their doctrines and expand their ethical imagination. In Islam, making bioethical decisions is based on ethical teachings of the Koran, the tradition of the Prophet Muhammad, and interpretation of Islamic law. Islamic bioethics is an extension of Shariah (Islamic law), which is itself based on two foundations—the Koran and the Sunna (the aspects of Islamic law based on the Prophet Muhammad's words or acts. Consensus (ijmaa) and analogy (qiyas) might be considered as two other sources of Islamic law. Also, consideration is given to maslaha (public interest) and urf (local customary precedent) when appropriate. The Shia branch of Islam has in some cases developed its own interpretations, methodology, and authority systems; but on the whole its bioethical rulings do not differ fundamentally from the Sunni positions.[16,17,18]

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[15] Draft of "Guideline for Establishing a National Bioethics Committee." Iranian National Commission for UNESCO: 2001.

[16] Daar Abdallah, S., Al Khitamy, and A. Binsumeit. "Bioethics for Clinicians: 21 Islamic Ethics." *Canadian Medical Association Journal*, 9 January 2001; Vol. 164(1) pp. 60-63. See also the Holy Koran 5:32.

[17] Rahman, F. *Legacy and Prospects in Islam*. University of Chicago Press, Chicago: 1979.

[18] Kamali, M.H. *Urf (Custom) in Principles of Islamic Jurisprudence*. Islamic Texts Society, Cambridge: 1991.

Overall, Islam places no limitations on the pursuit of scientific knowledge, including genetics. According to Hassan Hathout and B. Andrew Lusting, there is a consensus among Islamic scholars that a governmental rule that refers to "changing God's creation" does not support a ban on genetic engineering. The scholars have concluded that genetic engineering is permissible.[19] However, Gamal Serour restricts the justifiability of gene therapy to its therapeutic uses since using biotechnology in genetic research for eugenic purposes would involve changes in the creations of God and has the potential of inducing imbalance into the universe or into humanity.[20]

Shia

As mentioned above, *Shia* is a branch of Islam. While approximately one-fifth of the Iranian population belong to the Sunni branch of Islam, *Shia* has been the historical religion of the Iranian population for nine to ten centuries. *Aql* (the process of reasoning) and *urf* (custom) are two other important sources from which to draw Islamic law.

However, in spite of the fact that *Shia* jurists have formally recognized *aql* as an independent source of the Islamic law and have examined it in detail within the framework of the methodology of the jurisprudence system, they are very cautious in practice. The role of community practice (custom) as a supplementary tool in the process of inferring from Islamic law *is*, in principle, undeniable. In two cases the jurists commonly rely on custom. Historically, *aql* (literally, the act of withholding or restraining and in terminology of the jurists, "human intellect," and "reason") is a source for inferring that current Islamic laws come from the early centuries of the development of Islamic law.[21]

CONCLUSION

Today, all human beings should be able to benefit from the positive and valuable results of science. Hence, with the cooperation of the international community, Iran should adopt principles and regulations to guar-

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[19] Hathout, H., in Lusting, B.A., et al., editors. *Bioethics Yearbook,* Vol. 3 pp. 133-148. Kluwer Academics, Dordrecht, The Netherlands: 1993.

[20] Serour, G.I., in Lusting, B.A., et al., editors. *Bioethics Yearbook,* Vol. 5, pp. 171-188. Kluwer Academics, Dordrecht, The Netherlands: 1997.

[21] Jafarzadeh, M., *A Comparative Study under English Law, the Convention on Contracts for the International Sale of Goods 1980, Iranian and Shia Law.* Shahid Beheshti University, Tehran, Iran: March 2001.

antee freedom of research and scientific progress and at the same time to safeguard the rights and dignity of human beings.

Iran has an ancient past that history has not adequately documented. Iran has played host to various ethnic groups who, while retaining their own cultural identities, comprises the nation of Iran. They have been afforded equal rights. While preserving their own special culture, social, architectural, linguistic, and civilization characteristics, all have contributed to the process of dialogue among civilizations.[22]

Similarly to other parts of the world, a great majority of intellectuals in Iran do not accept the role of Islamic legislation in making bioethical decisions. Nonetheless, one cannot deny the deep religious nature of attitudes and beliefs of the majority in the country. Considering that the source of Islamic law can be according to formal and pluralistic ideas, we believe that the results of international conventions and conferences might be accepted with little modification from the Iranian government and the religious legislators of the country.

Fortunately, among the many controversial bioethical issues, only abortion has been banned in Iran. In exceptional situations, abortion can be authorized. Allograft transplantation is a legal action at present, and the legal issues of sperm transfer from a donor are under intensive investigation.

We are looking forward to join with international bioethical communities in the development of modern bioethical committees and legislation.

ACKNOWLEDGMENT

The authors would like to thank Dr. Mirghasem Jafar Zadeh and Ms. Arefnia for their assistance in preparing this report.

[22] Round Table of Ministers of Science on "Bioethics: International Implications." Paris, 22-23 October 2001. Presentation by Mostafa Moin, Minister of Science, Research and Technology, Islamic Republic of Iran.

Appendix I

Medical Ethics in the Life and Works of the Great Iranian Scholars

Hassan Tajbakhsh

Great Iranian physicians and scholars paid attention to ethics in their life, especially in their professional works. As a general rule, renowned physicians treated the rich while the poor and needy had no access to first-class physicians. Rare were such physicians as Rhazes or Mahmoud ibn Elias who treated the needy free of charge in their own houses, supplied drugs to their patients whenever needed, and even gave patients money to live. If there was a hospital in a city, the needy, the travelers, and the homeless received medical services free of charge. Iranian hospitals offered similar services to Christians, Jews, and followers of other religions.

Haly Abbas, who died in 994, strongly recommended the constant presence of medical students in the hospital, that they might follow their supervisor's instructions, visit patients, and show them kindness. The medical recommendations of Haly Abbas to the contemporary physicians were taken from Hippocrates and other previous physicians. However, he reproduces them in a pleasing manner, highlighting the ethics of medicine.

Nadjm al Din Mahmoud ibn Elias, who died 1325 A.D., was a great scientist and belonged to the noble physicians' family of Shiraz. He was skilled in jurisprudence and in other sciences, but especially excelled in medicine. Mo'in al Din Djoneyd ibn Mahmoud (d. 1397), the author of *Shad al-Ezar*, records the following: "He treated patients in his office and helped the old patients, generous people, and the needy. Not only did he not accept honorarium from the poor, but also sent someone with them to purchase their drugs. Therefore, it is crystal clear that he spoke wisely and treated the patients with knowledge."[1]

Excerpts from *Methods* by the philosopher Rhazes, who died in 925 are as follows:

> In summary, to date; I have written over 200 books and articles on various branches of philosophy, ranging from Divine sciences to wisdom…I have never joined an army nor have I been a government agent. Rather, if I have been in one's company, it was merely for medical purposes, and my companion did not go beyond friendship while performing my medical duties…Those who have observed my eating, drinking, and bad habits know well that I have never tended to extremes…However, with regard to my interest in science, those who know me from my youth are well aware that I have devoted all my life to this subject. My patience and exertion in studying science was so great that I have written over 20,000 pages in small letters on a certain branch of science. I have worked hard during day and night for 15 years of my life to write Al Havi, and I have lost my eyesight in this endeavor. My hand muscles have grown weak, and all this has deprived me of reading and writing. However, I have not stopped my research and studies. I read and write with the assistance of my companions. I forgive my enemies and I confess to my faults, but I do not know what they will say in the scientific fields. If they see faults, why do not they come to me to make sure they are right, because I will make them understand that they are wrong. However, if they are critical of my way of life and my practical methods, I wish they would enjoy my knowledge and overlook my way of life.[2]

BASIS OF MEDICAL ETHICS

Hippocrates first introduced medical ethics to the world of science. Since then, these ethics have influenced the way of life of all physicians in the history of humanity.

Hippocrates was born in 460 B.C. on the island of Kos, Greece, and passed away in 375 B.C. He is regarded as the father of medicine. According to W. Durant, Hippocrates's masterwork was saving medicine from the boundaries of philosophy and metaphysics although he himself in his "Food Legislation" says chanting spells is sometimes useful. Hippocrates insisted that diseases had a natural cause, and he rooted his work in medical records and observations. [3]

Hippocrates wrote an oath, (know as the Hippocratic Oath) and the physicians took the oath after graduation. He also wrote the "Medical

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[1] Djoneyd Issa ibn, N. Vessal, ed. *Shad al-Ezar: Moin al-Din Djoneyd Shirazi* (Arabic Language)/Persian Translation titled *Hezar Mazar (A Thousand Tombs).* Ahmadi Press, Shiraz: 1985.

[2] Al-razi, *K. al-Hawi fi 'l-tibb.*

[3] *The Story of Civilization,* Vol. 2: p. 383; Tarikh-e-Dampezeshki va Pezeshki, Vol. 1: p. 259.

Principle" or "Medical Law" for students of medicine and compiled "Medical Manner" or the recommendation for the physicians mentioned by Ibn Abi Osaybia in his *Oyoun al-Anba*.[4]

Ibn Ekvah writes:

"Physicians must swear using the Hippocratic Oath with the Mohtasseb (Censor)."[5]

THE HIPPOCRATIC OATH

"I swear by Apollo the Physician, Asclepius, Hygieia, Panaceia, and all the gods and goddesses, making them my witnesses, that I will fulfill according to my ability and judgment this oath and this covenant:

"To hold him who has taught me this art as equal to my parents and to live my life in partnership with him, and if he is in need of money, to give him a share of mine, and to regard his offspring as equal to my brothers in male lineage and to teach them this art— if they desire to learn it— without fee and covenant; to give a share of precepts and oral instruction and all the other learning to my sons and to the sons of him who has instructed me and to pupils who have signed the covenant and have taken an oath according to the medical law, but no one else.

"I will apply dietetic measures for the benefit of the sick according to my ability and judgment. I will keep them from harm and injustice.

"I will neither give a deadly drug to anybody who asked for it, nor will I make a suggestion to this effect. Similarly I will not give to a woman an abortive remedy. In purity and holiness I will guard my life and my art.

"I will not use the knife, not even on sufferers from stone, but will withdraw in favor of such men as are engaged in this work.

"Whatever houses I may visit, I will come for the benefit of the sick, remaining free of all intentional injustice, of all mischief and in particular of sexual relations with both female and male persons, be they free or slaves.

"What I may see or hear in the course of the treatment or even outside treatment in regard to the life of men, which on no account one must spread abroad, I will keep to myself, holding such things shameful to be spoken about.

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[4] Osaybia, Ibn Abi (Arabic Language), Emr-ul-Qays ibn al-Tahan, ed. *Oyun al-Anba fi Tabaqat al- Atebba (The Sources of News on the Classification of the Physicians)*, Vol. 2. Al Vahabia Press, 1881. Vol. 1, Persian Translation by S. J. Ghazban and M. Najmabadi; Tehran University Press, Tehran: 1971.

[5] Qarshi, Ibn (Ibn Ekhvah), and Zia al-Din Muhammad (Arabic Language)/ Persian Translation by J. Shoar. *Maalem al-Qorba fi Ahkam al-Hasseba (The Manner of Municipality on the Supervisional Judgment)* p. 171. The Foundation for Iranian Culture, Tehran: 1969.

"If I fulfill this oath and do not violate it, may it be granted to me to enjoy life and art, being honored with fame among all men for all time to come. If I transgress it and swear falsely, may the opposite of all this be my lot."[6]

HIPPOCRATES'S MEDICAL PRINCIPLE

"Medicine is the holiest of all professions. It may not be understood well by those whose deeds may cause public distrust. There is no fault with medicine in any cities except the ignorance of those living because of it but not understanding it. These people are like puppets played by actors for public amusement and as such puppets are only faces and not real. He who wants to learn medicine must have good deed and creed and must have the greed to learn and the inborn interest in what is needed for this profession. A student of medicine must yield good fruits as the results of the seeds sown on earth. Medicine is like soil and teaching is planting. Education is like the seeds sown on cultivable earth. Upon graduation the students must settle in a city to be practical and professional physicians, not physicians in words only. The science of medicine is an exquisite treasure for those who want to learn it. A learned physician is always pleased internally and externally. Ignorance of this science for him who has made it his job leads to a cursed profession that brings no happiness, no satisfaction to him. Such a person is suffering all the time and is impatient and rash. Impatience is a sign of weakness and his rashness comes out of misinformation and shallow experience."[7]

HIPPOCRATES'S MEDICAL MANNER

"It serves him who is in the position of learning medicine to be temperamentally of good nature and mold. He must be young, of average height, and well bodied. He must be quick to understand, conversable, and of good judgment in consultation. He must be chaste and brave but not a lover of material gain. He must be able to calm down in anger and prevent rage. He must not be slow to learn or lazy. A physician must show sympathy to the afflicted and sick and be kind to them. He must keep all secrets about diseases and patients to himself because the majority of the patients reveal everything about their disease to the physician, but do not want physicians to speak about it elsewhere. The physician

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[6] Edelstein, Ludwig, trans. From *The Hippocratic Oath: Text, Translation, and Interpretation.* Johns Hopkins Press, Baltimore: 1943.

[7] *Ibid.*

must be tolerant of curses because some persons suffering from pleurisy, obsession, and melancholia talk harshly, but we know that those curses do not come from them, rather they come from the diseases. A physician must keep his hair tidy. He must not shave his head nor grow it bushy. He must trim his nails, but not deeply nor should he grow long nails. His garments should be white and clean, and he must not hurry when walking because walking hastily is a sign of rashness and walking too slowly is sign of indifference and laziness. He must sit cross-legged if he has been asked about a disease, slowly and patiently. There should be no hurriedness or embarrassment in his words. In my view, this form of life and behavior is better than the other forms."[8,9]

HALY ABBAS'S LETTER OF EXHORTATION TO PHYSICIANS

Ali ibn Abbas Majussi, know as Haly Abbas to the Europeans, in his *Kamel al-Sanaat al-Tibbia* has included exhortations based on testaments of Hippocrates, other physicians, and some of his own views for physicians and students of medicine. The text is as follows:

> "I should say that he who wants to be a highly learned physician must act upon the testaments Hippocrates wrote in his time for the future physicians. Then the first testament is this: Be pious and fear and obey God. Respect and serve and appreciate those who have taught you. Regard them as you regard your father and share with them what you possess. As your fathers were the cause of your coming to this world, your teachers are the cause of your reputation, good deeds, and creed. Yes, man should regard his teachers as his father. Give a share of precepts, oral instruction, and all the other learning to his children without any fee, condition, or reward and teach them like your children. Beware not to impart medical education to inappropriate, incapable, or wicked persons.
>
> "Also, the physician must try to cure the patient with food and medication with no intention of accumulating wealth, but meaning spiritual rewards and charity. He must not give deadly medicine to anyone and must not talk about these drugs. He must not give to a woman an abortive drug, nor explain about it with others. The physician must keep everything on the disease and patient to himself, not talking about it

[8] Osaybia, Ibn Abi (Arabic Language), Emr-ul-Qays ibn al-Tahan, ed. *Oyun al-Anba fi Tabaqat al-Atebba (The Sources of News on the Classification of the Physicians)*, Vol. 2. Al Vahabia Press, 1881. pp. 58-61. Vol. 1, Persian Translation by S. J. Ghazban and M. Najmabadi; Tehran University Press, Tehran: 1971.

[9] Bimarestanhay, Tarikh-e. *Iran: The History of the Iranian Hospitals from Ancient Times to the Present Era.* pp. 331-334. Persian Translation by Hassan Tadjbakhsh. Institute of Human Culture, Tehran: 2000.

with relatives, because many patients hide their disease from their families and relatives but tell it to the physician, such as metrodynia and hemorrhoids. Thus the physician must try to keep the secrets of the patients confidential even more than the patients themselves.

"The physician must conform his deed and creed to what Hippocrates has said. He must be popular, doing his best to cure needy patients. He must not seek material gain from his medical practice, and pay for the drugs himself if the patient does not have money to pay. He is requested to prescribe and explain about drugs. If the patient has an acute disease, the doctor must visit him day and night to help him recover health, because acute diseases change conditions quickly.

"A physician must keep himself from lust and material gain, and from being involved in menial and useless jobs. He must not drink excessive wine because it is harmful to brain, adds excretion, and destroys the mind. The daily amusement of a physician should be studying books, and pondering them, specifically upon medical texts. He must not become tired of reading. He must memorize whatever he has learned and review material even when walking in order to learn whatever aspect of science and deed he needs. He must learn and grow scientifically so that he does not need to refer to the books, because his books may be lost, then his mind will help him. He ought to memorize materials when he is young, because learning when one is young is better than learning when one is old.

"A student of medicine should be always at the service of skilled masters of medicine in the hospitals and clinics to serve patients, to be compassionate to them, and to compare what clinical signs and complications of sickness he sees with those he has read in books, and to come to know about benign and malignant diseases.

"Then, it is that he who acts upon the above will make best use of the medical profession and he who wants to be an able physician should act upon this recommendation and enrich his learning with whatever ethical materials we wrote about and not understate this recommendation. If he does so he will treat people well, and they will trust and gather around him, and he will enjoy all goodness and friendship, and benefit from these people. And God is the wisest."[10]

[10] Ali ibn Abbas Majussi (Haly Abbas). *Kamel al-Sanaat al-Tibbia (The Perfect Art of Medicine)*; Vol. I pp. 8-9, (Arabic Language). Al-Dassuqi, Ed. Saadat Press, Cairo: 1877.

Appendix K

The Conditions of Moral Education

Mirza Ali Mohammad Kardan

At the present time, ethical or moral issues are as important as scientific and technological activities and progress. Science and technology provide us with the capacity to possess systematic knowledge of natural and human realities and to improve the conditions of our material life. Ethics helps us to identify moral values whose application improves our internal existence and balances our individual and social lives. Science and ethics are two necessary components man uses to enjoy a good life and well being, to realize his own essence, and to work toward perfection. Ethics involves the study of values in the domain of human conduct.

While science is essentially universal, as scholars believe it to be, and is less influenced by social and cultural patterns, ethical values vary according to the culture or society in which they are derived. The ethical conduct of individuals depends on several elements, the most important being value systems, education systems, and an individual's native constitution. The priority given to these three elements depends on the psychological, sociological, or philosophical approaches used to determine priorities. Value systems are not absolute but relative to time and space. The individual's need to adapt behavior to new value systems is inspired by various factors. And if the individual is not prepared for this perpetual adaptation, he will lose his mental equilibrium and identity. Through this we observe the importance of moral education and seek conditions for its appropriate application.

NECESSITY OF MORAL EDUCATION

In the past, both in the West and the East, religion determined the rules of moral behavior. All followers of a specific religion obey almost identical values. Since the beginning of the modern era, especially in the West, religion has gradually lost its spiritual authority. Today in some advanced western countries people consult clinical psychologists instead of priests to resolve their mental problems. In societies that have not given science absolute power, people face numerous moral and psychic contradictions due to the influence of new value systems. These people are wandering between their ancestral tradition and the new value system, and they feel what sociologists call "anomy." This bewilderment and disorientation can be observed in all aspects of their life, particularly in the realm of morality.

In the West, people are able to meet their material, and to some extent, their social needs through the use of science and technology. But they realize that these achievements have not been able to relieve their anxieties arising from higher competition, constant changes, and loneliness. Furthermore, they cannot prevent violence or ensure tranquility, friendship, and security—all necessary conditions for self-realization.

The 1789 French Revolution's ideals—equality, fraternity, and freedom—have not been fully realized in the world. Despite the vertiginous development of science and technology, humanity witnessed two ruinous world wars resulting in millions of deaths. International agreements and treaties, including the establishment of the League of Nations, which was later to be transformed into the United Nations, as well as the ratification of the Human Rights Charter have not succeeded in ending wars. Current ideologies like liberalism, socialism, and other "isms" prevalent in the twentieth century neither brought about worldwide peace and security nor provided stable and reliable internal tranquility for individuals.

Humanity is asking itself how it is possible to replace war, violence, and anxiety with peace and security in social and individual environments.

The ratification by the United Nations General Assembly of the principle proposed by the President of the Islamic Republic of Iran regarding "Dialogue among Civilizations" instead of "Conflict among Civilizations" could be proof that we have begun to ask this question. However, one wonders whether this socio-political guideline can be realized without the moral education of citizens of human societies, be it in the West, East, North, or South.

What has been mentioned thus far proves the real demand for moral education. What remains is to generate a moral attitude that will ensure peace and security in the world and the principles and conditions to succeed in moral education.

The author does not pretend to be able to answer such important questions in this brief presentation. However, by raising these questions, he is inviting members of the academies to rethink old principles and set forth new proposals.

THEORIES ON MORAL EDUCATION

Various theories exist concerning the possibility of moral education. Whatever the criterion for good conduct and thoughts, we must find out to what extent human nature is prepared for moral education. The great religions first, followed by the famous intellectuals of the world, have all tried to discover the answer.

The result of these efforts may be summarized in three theories:

1. Man is by nature bad, selfish, and an oppressor.
2. Man is innately good and has empathy and compassion toward others.
3. The nature of man is neither good nor bad. It becomes good or bad by experience and environmental influence.

MAN IS BY NATURE BAD

The source of this theory is the belief in original sin committed by man, and it is held by some renowned Christian intellectuals such as Saint Augustine. Thomas Hobbes, the British thinker, and Sigmund Freud, the father of psychoanalysis, were both supporters of this theory. According to Freud, the sign of morality is the feeling of guilt, and this is expressed by super ego (conscience), gradually formed in man from birth until the age of five or six. Hence, further education has not much effect on changing the super ego. The only way to change it is the fear of punishment.

MAN WITH A GOOD NATURE

This theory can be found in many of the divine religions. In modern times, the most famous supporter of it is Jean-Jacques Rousseau. In the beginning of his book "Emile," Rousseau writes, "Everything is good when it comes out of the hand of the creator of nature, and degrades when manipulated by men."

Jean Piaget, the Swiss epistemologist and psychologist and his American follower Lawrence Kohlberg, both believe in the theory of growth and cognition and support this view. According to Piaget, mental growth is a precondition for moral and social education, and its factors include group play and cooperation. Morality consists of conscious judgment re-

garding good and bad deeds, and has close ties with mental growth.[1] He believes that there are two stages for the growth of moral judgment:

1. The subordination or "heteronomy" stage goes together with realism, moral objectivity, and a belief in immanent justice.

2. In the autonomy stage the child values the incentives of the acts more than their apparent consequences and expects in compensatory chastisement rather than the penal punishment mentioned in the first stage. At this stage the child understands gradually that rules and norms can be violated. And while playing games, he and the other children can set and implement rules.

Kohlberg believes in moral growth as well. However, unlike his teacher, he raises the end of moral growth from the age of 12 to 25. He considers that this growth consists of six stages starting with pre-moral or pre-conventional stage. After going through the conventional stage, he reaches the sixth or final stage, which is the autonomy stage, or as Kant says, "the stage of discovery of universal principles of morality."

MAN WITH NEITHER A BAD NOR GOOD NATURE

The third theory is termed "Tabula Rasa" by John Locke, the British philosopher. It states that there are no innate tendencies or moral background in man at the start of life. According to this theory, moral behaviors are approved by society, and morality in man is the consequence of experience, learning, and the influence of the surrounding environment. The precondition for moralization of the individual is the coordination between his family and institutional education and the value system of society. Then, an individual's morality may be altered by changes in social position or educational programs and methods. Therefore, an individual can be considered being moral if he shows resistance to internal temptations in order to follow the social values. In other words, this theory considers that moral behavior implies freedom in human choice and action.[2] The supporters of social learning theory, such as the American social psychologist Bandura, share this view.

Further discussion about the strengths and weaknesses of these three theories is not possible in such a brief presentation. It suffices to say that today's scholars of human sciences are more in favor of social learning

[1] Piaget, Jean. *Moral Judgment of the Child.* Harcourt, New York: 1932.
[2] Reboul, O. *Les valeurs de l'éducation.* p. 49. Presses Universitaires de France, Paris: 1992.

theory without denying the role of inheritance in moral behaviors. The first problem an educator may face is the nature of the child. Educators can observe that similar to the uniqueness of physical traits, each child has innate emotional characteristics which can weaken the effect of education.

In fact, education is able only to realize the potential disposition of the child and cannot completely alter his nature. As the French educationist and psychologist Maurice Debesse says: "Education—including moral education—does not create the child but helps him to create himself."[3]

Finally, in the present world, human societies are confronted constantly with various and contradictory value systems. Thus, it is necessary to ensure that people become familiar with new cultures in order to keep their national identities and avoid moral instability.

One of the tasks of the Iranian Academy of Sciences, particularly the human science branch, is to review and to study the issues caused by interference among several cultures. They have to highlight moral principles that help people bring about cultural agreement between various nations and preserve their individual and social identities. These moral principles could be the following:

- Respect human beings regardless of gender, race, ethnicity, and ideology. According to this principle, it is necessary to combat the related prejudices using solutions stemming from social psychological research or at least to reduce their moral impacts.
- Respect diversity and differences between various cultures. This requires that cultures of other nations or ethnic groups are first valued and then presented to a younger generation. The youth in different countries should be persuaded that the only way to ensure sustainable prosperity, security, and peace is to gain justice and welfare for the whole world and not just for their own social class or countries.

It is necessary to bring about the following preliminary actions in order to apply the above principles:

- Provide a moral atmosphere in the environment where the individual lives. As is proven in social psychology, in an environment where the majority observes ethical values and mutual respect, an individual is

[3] Debesse, M. *The Steps of Education.* (Persian Translation), 8th ed. p. 208. Tehran University Press, Tehran: 1989.

obliged to adapt himself to the accepted social norms in order not to be expelled from the social group.

- Move from social education toward human education by acquainting the younger generation with absolute values such as goodness, justice, truth, peace, and respect for human dignity.
- Familiarize the younger generation with the culture and the social mores and traditions of other nations through teaching them subjects such as general geography and world history, or by facilitating their travel to other countries.
- Establish coordination between several educational organizations, especially between the family, school, and the mass media, regarding principles and methods of moral education.
- Confront the younger generation with moral antagonisms and different value systems in their own or other societies, and encourage them to compare their observations in order to distinguish between good and bad behaviors. This will lead the young generation to stable and dependable moral criteria.

These actions will result in a sustainable effect, provided the society prepares the necessary conditions to value moral virtues and to respect those who posses these virtues.

Appendix L

Science and Technology Without Ethics Can Do Nothing for the Prosperity of Human Beings

Gholamhossein Ebrahimidinani

Science and technology are the results of the slowly evolving activities of the human mind throughout history. Man is the only creature that can experience life and take advantage of his old and new experiences to make a better life for himself. Man takes lessons from his old experiences through his memory and tries to improve his life constantly. This drive originates from his sense of hope.

Let us not forget that wisdom is the factor that links man's hope and his memory and gives him the ability to take advantage of this link toward building a better life and making new discoveries. Wisdom works on the basis of old experiences and hope for the future. In this way, it gradually moves toward discovering facts. Nowadays, we observe several discoveries that have been made by experiments combined with wisdom. Such discoveries have been effective in the improvement of man's life.

Here the question is whether science and technology by themselves guarantee man's prosperity forever. It is not easy to answer this question, and it seems that we should think about it more deeply.

Undoubtedly, science and technology have empowered man as he has faced problems, and many obstacles and difficulties of human life have been solved. Yet, we cannot ignore that science and technology can be harmful and destructive as much as they can be beneficial. There are many cases that show the destructive aspects of science and technology, but there is not space to mention them here.

One of the features of science and technology is that they do not lead to decisions by themselves. Therefore, science serves man. Human will

determines the direction of science and technology. It is obvious that human will cannot determine faith nor the ethical direction of science and technology using science and technology alone. Therefore, humans need other factors in addition to the experimental sciences.

The important factor is practical wisdom in Islamic education. It means "being aware of what man's behavior or non-obligatory acts should be." Practical wisdom is the opposite of theoretical wisdom. Theoretical wisdom talks about "to be and not to be." In practical wisdom, the center of the study is "must and must not." There are four main characteristics of practical wisdom:

1. It describes only human beings.
2. It works only on non-obligatory acts of man.
3. It deals only with "must and must not" in the non-obligatory area.
4. It addresses only absolute subjects.

We should not forget that the "must and must not" that comprise moral values are not considered observational, or things that can be proved through logical comparison. The source of "must and must not" is man's nature. As this nature is absolute, so are the moral values. There is no difference between the essence and the nature of the original and the modern man, and there is no evidence showing that such a difference could occur in the future. Therefore, science and technology cannot make a prosperous future for man without consideration of ethics.

Appendix M

Extract from Report *On Being a Scientist*

THE SCIENTIST IN SOCIETY[1]

This booklet has concentrated on the responsibilities of scientists for the advancement of science, but scientists have additional responsibilities to society. Even scientists conducting the most fundamental research need to be aware that their work can ultimately have a great impact on society. Construction of the atomic bomb and the development of recombinant DNA—events that grew out of basic research on the nucleus of the atom and investigations of certain bacterial enzymes, respectively—are two examples of how seemingly arcane areas of science can have tremendous societal consequences.

The occurrence and consequences of discoveries in basic research are virtually impossible to foresee. Nevertheless, the scientific community must recognize the potential for such discoveries and be prepared to address the questions that they raise. If scientists do find that their discoveries have implications for some important aspect of public affairs, they have a responsibility to call attention to the public issues involved. They might set up a suitable public forum involving experts with different perspectives on the issues at hand. They could then seek to develop a consensus of informed judgment that can be disseminated to the public. A good example is the response of biologists to the development of recombinant DNA technologies—first calling for a temporary moratorium on

[1] This text is extracted from *On Being a Scientist*, (pp. 20-21), by the Committee on Science, Engineering, and Public Policy, 1995, Washington, D.C.: National Academy Press.

the research and then helping to set up a regulatory mechanism to ensure its safety.

This document cannot describe the many responsibilities incumbent upon researchers because of science's function in modern society. The bibliography lists several volumes that examine the social roles of scientists in detail. The important point is that science and technology have become such integral parts of society that scientists can no longer isolate themselves from societal concerns. Nearly half of the bills that come before Congress have a significant scientific or technological component. Scientists are increasingly called upon to contribute to public policy and to the public understanding of science. They play an important role in educating non-scientists about the content and processes of science.

In fulfilling these responsibilities scientists must take the time to relate scientific knowledge to society in such a way that members of the public can make an informed decision about the relevance of research. Sometimes researchers reserve this right to themselves, considering nonexperts unqualified to make such judgments. But science offers only one window on human experience. While upholding the honor of their profession, scientists must seek to avoid putting scientific knowledge on a pedestal above knowledge obtained through other means.

Many scientists enjoy working with the public. Others see this obligation as a distraction from the work they would like to be doing. But concern and involvement with the broader uses of scientific knowledge are essential if scientists are to retain the public's trust.

The research enterprise has itself been changing as science has become increasingly integrated into everyday life. But the core values on which the enterprise is based—honesty, skepticism, fairness, collegiality, openness—remain unchanged. These values have helped produce a research enterprise of unparalleled productivity and creativity. So long as they remain strong, science—and the society it serves—will prosper.

Appendix N

Extract from Report *Honor in Science*

WHY HONESTY MATTERS[1]

"The reason I stop at a traffic light is not because I have a commitment to social justice, but because there may be a cop at the light and if I don't he'll nail me."[2]

This remark was made by the president of a major hospital, during a discussion of whistleblowing by scientists. It is a good place to begin, if only because there are several reasons why we stop at traffic lights:

(a) because obeying traffic lights is an effective solution to the problem of how to cross busy intersections;
(b) because the cop may be there to nail us if we do not stop;
(c) because we may get killed or injured by someone who is (legitimately) crossing the intersection in the other direction. Or we may kill or injure others, including pedestrians.

For most of us, the risk of getting caught may not be the main reason

[1] This text is extracted from "Honor in Science," (pp. 1-7), by Sigma Xi, The Scientific Research Society, Research Triangle Park, NC, 2000.

[2] Foreman, Spencer, "Commentary: The Conflicting Missions of IRBs," in Swazey, Judith P. and Stephen R. Scher, eds., *Whistleblowing in Biomedical Research*, Government Printing Office, Washington, D.C.: 1982, pp. 41-45.

that we do not run red lights, nor is it the primary incentive that keeps us honest in our scientific research.

But how much has honesty in science got to do with such mundane matters as traffic lights? Are we comparing apples and oranges? Since the hospital president used the traffic light analogy in a discussion of integrity in science, he probably takes the view that the principles guiding a scientist in research are not significantly different from those affecting behavior in other facets of life. That is the position taken in this booklet, but it is not a universally-held view. For example, some would argue that science requires higher standards of ethical behavior than can be expected in the world at large. Others prefer to believe that the nature of science is such that ethical questions are less important than in the rest of life: how we deal with traffic lights, or with our friends and enemies, involves moral judgments and ethical standards, but the structure of DNA and the origin of submarine canyons are not affected by the character of the scientists who study them.

The latter view misses the point. Scientific problems such as the structure of DNA or the origin of submarine canyons are investigated by scientists, who may be all-too-human in their capacity to make mistakes, to miss or misinterpret critical pieces of evidence, and, on occasion, deliberately to fake research results. Science may be morally neutral, but so is a traffic light; car drivers and scientists are not.

This does not mean that mistakes and omissions are frequent in science, still less that fraud and dishonesty are commonplace. Most of us follow the rules most of the time, in our daily lives as in our scientific activities. We make occasional scientific mistakes, and on deserted streets at four in the morning we may occasionally be tempted to run a red light. But accuracy and responsible behavior are much more common than their opposites.

There are, nevertheless, many scientists who believe that to stress the fact that scientists are fallible human beings does imply that mistakes, omissions, and unethical behavior are common in science. They feel that this is not merely bad for the image of science but is simply not true. Few of them, probably, believe that research scientists can somehow avoid the temptations and frailties that affect humanity in general, but they would argue that the scientific method has, over the centuries, come to incorporate so many checks and balances that the mistakes and misinterpretations which do occur are inevitably detected and corrected. Scientists may be fallible, but science is self-correcting.

Such contrasting attitudes are evident in the responses of different scientists to the instances of scientific fraud that have been exposed from time to time. To many people, such spectacular cases are probably the visible tip of an iceberg of unknown but substantial dimensions. How-

ever, to those who believe that the scientific method is effective in identifying mistakes and fraud, such exposures are proof that the system is working as it should. Deliberate dishonesty is rare and quickly recognized; accidental errors are similarly corrected by subsequent research, and "there is no iceberg."

For the purposes of this booklet it is not necessary to resolve this question here. In the last analysis, there is no means of knowing how much scientific research is inaccurate or fraudulent. Intuitively, it may be wise to assume that the iceberg is rather larger than some would like to think. Error and even unethical behavior may not be much less prevalent in science than in other aspects of human life, and detection of error may not be inevitable. Most of the best-known exposures of fraud have tended to be in areas of scientific research where there is vigorous activity—cancer research, for example—and where replication of experiments and critical reviews of earlier work are therefore more likely to happen. Most scientists work in fields where there is much less interest or competition; and the specialized character of most research is such that it may be a very long time before your errors are noticed.

Before going further, a word is necessary about the distinction between fraud and error. We all make mistakes from time to time, despite our best efforts to be accurate. In our daily lives, for example, practically all of us have driven through a red light unintentionally, simply because we did not see it. Surely this is very different from deliberate fraud or law-breaking? Is this booklet concerned only with the latter, or with both fraud and errors?

Mainly, of course, it is concerned with unethical behavior, rather than honest mistakes, but the distinction between them is not a simple one. As

> The only ethical principle which has made science possible is that the truth shall be told all the time. If we do not penalise false statements made in error, we open up the way, don't you see, for false statements by intention. And of course a false statement of fact, made deliberately, is the most serious crime a scientist can commit.
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> C.P. Snow, *The Search*,
> Charles Scribner's Sons,
> New York, revised edition,
> 1959

the cop who stops you is liable to point out, you are as likely to be involved in an accident if you did not see the red light as if you deliberately decided to ignore it, and the scientific paper that includes an accidental error may be as unreliable as one that is based on deliberate fraud.

It is not sufficient for the scientist to admit that all human activity, including research, is liable to involve errors; he or she has a moral obligation to minimize the possibility of error by checking and rechecking the validity of the data and the conclusions that are drawn from the data.

Some would go further and argue that mistakes should be punished as severely as outright fraud, if only because it may be impossible for anyone but the scientist involved to know whether the error was accidental or deliberate. Not seeing the red light is no defense.

Some scientists may agree that carelessness deserves to be punished, but believe that to be equally severe on all types of error is to ignore one of the most important characteristics of science: that it is very difficult to know what is truth and what is not. Much research takes the form of questioning previous assumptions or "facts," and the results often show that these assumptions are invalid or are limited to certain situations. If, as Popper has suggested, we can only disprove theories, [and] never prove them, surely science is full of uncertainties? If this is so, is it reasonable that scientists should be blamed for unintentional error?

It is, of course, precisely because of these uncertainties that accuracy in research and in reporting research results becomes so important. The attempt to draw general conclusions from limited data is basic to science: we cannot put every specimen under the microscope nor can we put major weather systems into a test-tube. If subsequent work, by ourselves or others, shows that our conclusions are not so general as we had hoped, that is no discredit, provided that the conclusions were not inherently unlikely and that the data on which they were based had been obtained and reported accurately. If our original investigation was flawed, however, that is another matter.

One objection to this booklet may be that it is likely to be read only by those who have no need of the advice it contains: those who are honest and accurate by nature and whose scientific research will be therefore reliable. Those who are unscrupulous are unlikely to be deterred by anything short of discovery and punishment.

Certainly, neither codes of behavior nor statements of principles can prevent unethical behavior. They may even be endorsed enthusiastically by individuals who ignore them in practice, if only because many people are capable of rationalizing their own actions as justifiable exceptions. "Of course there needs to be a red light at that intersection, but in this particular situation, I was not in danger of harming myself or anyone else." Galileo was reputed to be better at devising scientific truths in his mind

than performing the tedious experiments that verified them, and since his time there have been many scientists with less ability who have followed his example.

But such statements of principle need not be useless, either. When the Founding Fathers of the American Republic held "these truths to be self-evident," they did not mean that there was no point in including the truths in the Declaration of Independence, only that the statements did not need to be argued or proved. This booklet is written for those who are honest and responsible; it is intended to give them practical advice, as well as reassurance that ethical issues are of vital importance.

Another type of objection is that advice on scientific research ethics ought to be unnecessary, simply because science is *not* different from the rest of human life. There may be rules of behavior to be learned to meet specific situations (e.g., "always quote exactly, even if you spot a misprint or an apparent minor error in the passage you are quoting"), but the basic principles are a matter of human experience and individual conscience.

This may be true, but there are also many situations where ethical issues are not clear-cut, and may not even be perceived by everyone. The following problems have not received much attention—or solution—since they were stated twenty years ago, yet they affect many scientists. Note that the author is not concerned with individuals who misuse their positions, but with how the position is liable to subvert the individual.

> What is most alarming about the workings of the referee system is not the occasional overt lapse of honesty on the part of some referee who suppresses prompt publication of a rival's work while he harvests the fruit by quickly repeating it—perhaps even extending it—and rushing into publication with his own account. What is far more dangerous, I believe, because it is far more insidious and wide spread, is the inevitable subconscious germination in the mind of any referee of the ideas he has obtained from the unpublished work of another person. If we are frank with ourselves, none of us can really state where most of the seminal ideas that lead us to a particular theory or line of investigation have been derived ....
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> What has been said about referees applies with even greater force to the scientists who sit on panels that judge the merit of research proposals made to government agencies or to foundations. The amount of confidential information directly applicable to a man's own line of work in the course of several years staggers the imagination.... This information consists not only of reports of what has been done in the recent past, but of what is still unpublished. It includes also the plans and protocols of work still to be performed, the truly germinal ideas that may occupy a

> scientist for years to come.... One simply cannot any longer distinguish between what one properly knows, on the basis of published scientific information, and what one has gleaned from privileged documents. The end of this road is self-deception on the one hand, or conscious deception on the other, since in time, scientists who must make research proposals learn that it is better not to reveal what they really intend to do, or to set down in plain language their choicest formulations of experimental planning, but instead write up as the program of their future work what they have in fact already performed. Again, the integrity of science is seriously compromised.[3]

If it is likely to be several years before you are invited to act as a referee or as a research award panel member, think instead about the situation that frequently arises in which you intend to publish a paper jointly with an author from another discipline. Say that the paper is in mathematical biology and that you as a biologist have worked with a mathematician. You have done your work conscientiously, and you believe that your colleague is equally reliable, but you do not have the necessary knowledge to verify that the mathematical analysis is fair and accurate. Nor does the mathematician know much biology. Are your respective responsibilities for the paper limited to your specific contributions, so that it is the job of the journal editor, referees and, ultimately, the readers to assess the validity of the paper as a whole? Many would say so, would behave that way in their professional scientific careers, and would have no doubt that they have been honorable and responsible scientists. Others would say that if you cannot understand every word and symbol in a paper of which you are the coauthor, it is your responsibility to have those sections read critically by someone who is not an author, and that whether you do this or not, you remain responsible for the entire paper, as do all the other coauthors.

Why does it all matter so much? Science may build on what others have already discovered, but surely an inaccurate or even forged piece of research can only delay other work: it will eventually be recognized as spurious, and science itself has not been harmed. Similarly, if I do my research and "shade" my experimental results just a trifle towards the result that seems to be obvious and logical, who suffers? Even if we agree that shading or carelessness are wrong, are they any worse than the similar lapses that we observe continually in other aspects of life? After all, most of us are irritated by the car that runs a red light but few of us are inclined to take the license number and report it to the police, unless some child or elderly person was endangered by the incident.

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[3] Glass, Bently, "The Ethical Basis of Science," *Science*, 150, 3 December 1965, pp. 1257-1258.

There are many valid answers to such questions. First, however, it should be said that there are few situations, if any, in which there is no "victim." In some situations--medical research, for example--the victims may be very obvious: those who remained ill or died because fraud or carelessness diverted research away from the problems that should have been investigated. In any field, however, fraudulent or careless research is likely to benefit the perpetrator at the expense of others. Take, as an extreme case, the example of the "scientist" whose extensive list of publications consisted almost entirely of articles by others that he copied word-for-word from obscure biomedical journals and then published in his own name in other obscure journals.[4] It could be argued that the original authors had gained the credit due to them when the articles were first published, and that scientific knowledge benefited through the wider dissemination of these research reports in other journals. Who suffered? The answer should be obvious: those scientists who did not get the academic appointments that the plagiarist obtained on the strength of his spurious list of publications. This example is an extension of the situation in which someone obtains a job by claiming a degree or other qualifications that he or she does not possess: it is unfair both on those who do not have the qualifications and are honest about it, and on those who earned those qualifications the hard and honorable way.

More fundamentally, however, scientific honesty is vital because there is no cop at the scientific research traffic light. Nor can there be, for scientific accuracy and honesty cannot normally be reduced to something as simple as whether the light was red or green. The referee of a scientific journal, for example, is not a cop and should not be expected to determine whether a research report has been honestly produced. A referee is appointed to advise whether the results that are reported are sufficiently important to merit publication. Some errors are detected by referees, and others by readers, but neither referee nor reader can verify the critical elements of much scientific research except by doing the work over again.

It is because we cannot police scientific research as we do our highway intersections that thesis-writing is such a fundamental part of the work required for Ph.D. and other research degrees. Those of us who have been through the experience, even if it was many years ago, can usually recall that frustrating and time-consuming period, after the research was done and the thesis had been drafted, when we had to go back and check on the accuracy of quotations, page references and other details, so that the thesis could not be faulted or sent back on such grounds.

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[4] See Broad, William and Nicholas Wade, *Betrayers of the Truth,* Simon & Schuster, New York: 1982, pp. 38-56.

The university was saying, in effect, "We put you through these hoops at this time with everyone watching your performance very carefully, because in the research that you are likely to do in the future we and other scientists need to be able to trust you to jump through the same hoops without being watched." Graduate school is also the place to learn that one does not publish research results and conclusions until one is certain of their accuracy and that this is why it is necessary to define one's problem sufficiently narrowly that one can gain the comprehensive knowledge and understanding that are essential. Inevitably, therefore, individual scientists tend to become fairly narrow specialists. Yet the progress of science as a whole depends on communication and integration of these individual specialized results: the loneliness of the individual scientist exists simultaneously with interdependence among all scientists. In Bronowski's words:

> All this knowledge, all our knowledge, has been built up communally; there would be no astrophysics, there would be no history, there would not even be language, if man were a solitary animal. What follows? It follows that we must be able to rely on other people; we must be able to trust their word. That is, it follows that there is a principle which binds society together, because without it the individual would be helpless to tell the truth from the false. This principle is truthfulness.[5]

[5] Quoted by Bently Glass (see note 3 above) from J. Bronowski, *Science and Human Values,* Messner, New York: 1956, p. 73.