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ETHICAL PROBLEMS OF SCIENCE

Background Paper for the Second Pugwash Science
and Ethical Symposium, Dubrovnik, January 1976

The report from the 22nd Pugwash Symposium, held at Dubrovnik in January 1975, called for a continuing Pugwash activity in "science and ethics," including an annual symposium on various topics within the field to be held at the Inter-University Center in Dubrovnik. A small group was appointed to monitor research on science and ethics, to coordinate with the UNESCO program on the human implications of scientific advances, including the misuse of science, and to plan for a second symposium in January 1976, covering the following topics:

Ethical Problems of Science

1. the requirement of openness in the international scientific community;
2. the responsibility of scientists to inform public opinion;
3. the role of ethical values in scientific research;
4. ethical problems faced by scientists in the struggle for global survival;
5. toward an International Code of Ethics for scientists.[1]

This document is intended to serve as a background paper for the 1976 symposium; as such, it will detail for the Pugwash Continuing Committee the symposium agenda topics and their relevance to the Pugwash movement, and will provide an integrative focus for the papers prepared by the symposium participants and a guide to symposium deliberations. Throughout the paper, emphasis will be placed on the role that Pugwash can play in furthering the impact of ethical values and social responsibility within the international community of scientists.

Science, Ethics and the Pugwash Movement

It is not the purpose of this background paper to report fully on the present state of research and evaluation in the field of science and ethics.[2] That task has been attempted on a number of past occasions, perhaps most recently by William Blanpied and Gerald Holton for the Harvard Program on Public Conceptions of Science.[3] It is important to note, however, the variety of levels and settings where the role of ethics in science has been considered. The nature of the value system inherent in science is perhaps the most basic and long-standing of the problems which have been considered. According to many philosophers and sociologists of science, the only values internal to science are those necessary to the practice of science: for some, these are called the "norms of science"; for others, there is really only a single norm, "the seeking after truth". As shall be seen below, this value system creates important social obligations for the scientist, in terms of patterns of interaction within the system of science and also with regard to the scientist's relationship to society. Also important, however, are the professional and personal values which the scientist brings to his scientific activities. These flow from systems of morality or ethics developed outside of science, but have become of crucial importance within the social system of science as the involvement of science and technology in the problems of society has increased. At the highest level, systems of morality of universal extent (e.g., Rawls' conception of distributive justice[4]) may guide the social behavior of some scientists entirely. At another level, a kind of "situational ethic" may be operative, directing the behavior of different scientists along distinct paths depending upon their perception of the situation they confront and the relative weights they attach to conflicting goals - e.g., between national security and the freedom of international science.[5]

The second differentiation in the field of science and ethics which is relevant to Pugwash concerns refers to the various social settings in which the problem has been investigated. As shall be seen, different considerations have generally been applied to pure science, applied science and public service science. Scientific professions having important personal or direct relationships with the public (e.g., medicine) have a long history of strongly operative ethical codes. Applied scientists and engineers have an established tradition of service to their employers, but also a more recently developing concern for doing work which is in the public interest; problems arise when, as often happens, the two standards are in conflict. Pure scientists, historically removed from public involvement, have tended to place exclusive ethical reliance upon the internal norms of science; one of the most important of these, neutrality and value freedom, has traditionally been interpreted as imposing a societal posture of detachment. Detachment has, however, been difficult to preserve in settings where the effects of science upon the public, for benefit or for harm, have been immediate and obvious. One of these settings is war and the threat of war. Philipp Lenard and Johannes Stark were clearly guilty of violating the norms of science for contributing to the destruction of free science in Hitler's Germany. Yet, for participating in the destruction of an entire class of people, many of whom happened to be scientists, they were also guilty of violating universal standards of morality to which all scientists, as human beings, must be held. Similarly, the Nazi physicians, whether participating in human experimentation at concentration camps or the S.S. Lebensform activities in peaceful German villages, were in obvious violation of the Hippocratic oath. However, because of the vaunted "value freedom" of science, it is more difficult to assess the responsibility of individual chemists and physicists for their actions in war. Fritz Haber directed the manufacture and use of poison gas during World War I in furtherance of the supposed "higher value" of preserving German civilization; he was subsequently ostracized for a time from institutionalized international science, yet he was nevertheless awarded the Nobel prize (he later suffered on racial grounds at the hands of the Nazis). The American chemists who worked on napalm and defoliation agents during the Viet Nam War did so for a similar complex of reasons but with greater anonymity.

It is in physics and nuclear weapons where the ethical problems of science in war have been perhaps most clearly drawn. Alice K. Smith has provided a detailed study of the emergence and expression of moral conscience among the Los Alamos and Met Lab scientists during the period before and after Hiroshima.[6] Collective action by scientists opposed to military control of atomic energy and in favor of its nationalization was an important theme in the immediate postwar years and the decades which followed. Smith concentrates on the social responsibility of nuclear scientists in the United States; but the problem is truly global, and has been recognized as such by a significant component of the international scientific community. The Pugwash movement is probably the strongest expression of the concern of scientists throughout the world for arms control, international security and world peace.

Almost from the beginning, however, Pugwash has been concerned with other settings where science and technology interact with society and where social responsibility in science requires expression. Year after year, annual conference working groups and symposia agendas detail these concerns: science, technology and international development; population and health; energy and ecology; the scientists' role in society. As perhaps the oldest and most prestigious international movement of scientists, it is both proper for andincumbent upon Pugwash to take the lead in stimulating and evaluating research on the international dimension of social responsibility in science and its basis in systems of values, personal and professional, which are shared by the community of scientists.

A Reconsideration of the Components of Science and Ethics

Problems of ethics in science can be approached in a number of ways. The use of two separate but intersecting dimensions suggests a range of problems illustrative of the topics to be considered at the 1976 symposium. The first dimension points out the contrast in science between, on the one hand, its nature as a social activity with norms of behavior and responsibility and, on the other, its role as a way of life for the individual scientist with the personal choices which must be made in the advancement of a professional career. The second dimension distinguishes between the set of problems internal to science, or intrinsic to scientific activity, and the set of problems external to science, or involved in the relationship of science to society.[7] A matrix generated by plotting the first dimension vertically and the second horizontally comprises four cells; one of the topics for the 1976 symposium can readily be placed in each of these cells.

ETHICAL PROBLEMS OF SCIENCE

	INTERNAL	EXTERNAL
SOCIAL	OPENNESS IN THE INTERNATIONAL SCIENTIFIC COMMUNITY	SCIENCE INFORMING PUBLIC OPINION
PERSONAL	ETHICAL VALUES IN SCIENTIFIC RESEARCH	THE GLOBAL SOCIAL RESPONSIBILITY OF SCIENCE

The interrelationship of the topics presented in the chart is easily clarified. Openness in the international scientific community is an essential component of the social system of science, one of the intrinsic norms which govern scientific behavior.[8] However, most of the crucial ethical choices in science are made by individuals, based on the application of personal and professional values to specific research situations. Further, the social system of science is not closed but exists in society, on which it depends for understanding and support. The popularization of science movement attempts to promote public support by explaining the benefits which flow to society from scientific research. Public support also requires that information be provided concerning the negative effects and consequences of scientific research, so that informed choices can be made with regard to the applications of science and the future allocations of research funds. Finally, the individual scientist is responsible for bringing his own personal and professional values to bear upon the use he makes of his scientific talent, whether at local, national or global levels. Despite the internationality of the norms of science (and the universality of the logic of scientific method), the choices made and the values asserted by scientists have varied widely, in large part as a result of differences in background, training, and experiences - that is, the scientists' "social situation". Some have argued that the primary social distinction among scientists is nationality, that scientists inevitably share national values and serve national interests.[9] It is hoped, however, that Pugwash, as an international movement of scientists, will explore the personal and social bases for the application of transnational values to the problems of science in society. The potential for an International Code of Ethics for Scientists will be examined in terms of its function as a connective between the internal and external settings of science and as an expression of the social dimension of personal values. Given these components, an International Code of Ethics drafted by the members of the symposium on behalf of scientists throughout the world might incorporate such values specific to each of the four topic areas as are crucial to the health and responsibility of the international scientific community.

Openness in the International Scientific Community

It is anticipated that symposium papers and discussions on the topic of "openness" in the international scientific community will examine such aspects as:

1. restrictions on the free movement of scientists and scientific knowledge across national lines;
2. governmentally imposed requirements of secrecy and their effect upon scientific growth and values;
3. national and corporate technological imperialism, and the creation of a dependency relationship through patent laws and other restrictions on scientific and technological information exchange;
4. the preservation and widening of the technological gap between developed and developing nations through nationally bounded

research and development efforts.

Such primarily national problems of openness in science as those created by Lysenkoism and McCarthyism are not of direct concern to the symposium, except insofar as they create difficulties for the movement of scientists into or out of individual nations.[10] It is suggested that the symposium consider the extent to which openness is a necessity (a norm or law) in science, essential for its growth and its diffusion throughout the world. Are the restraints upon openness and freedom in science primarly political? How legitimate are these restraints and what are their limits? What implications exist for the international scientific community and the individual scientist?

In the twentieth century, the primary threat to openness in international science has, of course, been war, the preparation for war and its aftermath. The long and strongly held claim that "the sciences were never at war" perished during the gas attacks of World War I. It was in World War II, however, where scientists on both sides surrendered their skills entirely to the service of the national interest. The most massive scientific and technological effort carried out during the war, the Manhattan Project, operated under rigid rules of secrecy, both from the outside world and among the different task groups within the Project itself. For many of the scientists, like Leo Szilard and James Franck, who came to oppose nationalization of nuclear weapons and atomic energy, a major argument was the "garrison state" pattern of scientific organization which secrecy and security would require.

Secrecy and restrictions on free movement are not harmful only to the status and growth of science; they also result in bad technology and bad policy. As the 1964 Commoner Report of the American Association for the Advancement of Science states:

> Secrecy, which has become ubiquitous in modern, large-scale science and technology, hampers the processes of scientific discourse. In the normal procedures of science, errors or inadequacies in scientific information are detected and corrected through open dissemination of results and free discussion of their significance. When secrecy intervenes, such inadequacies are not subject to the scrutiny of the independent scientific community and may go uncorrected for relatively long periods of time; faulty action may result.[11]

A closed system of national science has negative implications for the external dimension of science. It tends toward the subordination of science to the state and lures or compels scientists into an acquiescent posture toward economic influence and political authority. The result is a serious weakening of the ability of scientists to assert moral values and social responsibility when freedom of science is threatened.[12]

Substantive issues in the external dimension of science which are affected by questions of openness and freedom of movement include: transnational "invisible colleges" in science and international scientific cooperation in specific subject settings; freedom of interaction in science to promote international understanding and integration rather than competition and hostility; the growth of shared science and technology in the service of global well-being; and mechanisms for international diffusion of innovations and technology transfer.

Science Informing Public Opinion

In an important sense, the public information function of science is the external equivalent of openness within the scientific community. Just as secrecy in science negatively effects its health and growth, so also does the failure to communicate the nature and meaning of scientific developments retard public understanding, acceptance and support, all crucial external bases for the well-being of science in society. It is possible to distinguish two types of public information in science. The first type, popularization of science, has as its goal public acceptance of the value of scientific research through public understanding of the benefits which flow from science. In the days of entrepreneurial science, when support came primarily through private benefactions, securing wealthy patrons was an essential activity in fields as expensive as astronomy.[13] Later, as a result of the rapidly accelerating cost of scientific research and the geometric increase in the number of scientists needing jobs, the financial support of government became crucial, in peace as well as war. To obtain this support, government officials had to be sold on the economic and political value of subsidized national scientific efforts.[14] Support for science among the wider public was furthered by frequently held fairs and expositions throughout the industrialized world and by the emergence and growth of popularized science in newspapers, magazines and electronic media.

The second type of public information function has developed more recently and has generated considerably more conflict. This is the attempt to provide governmental decision-makers or the public at large with the scientific and technical expertise necessary to make crucial social and economic choices. Advocacy of this function is based on two important assumptions: that detailed information about the positive and negative impacts of science and technology is prerequisite to the ability to control the direction of their growth; and that an informed citizenry and its representatives constitute the surest guarantee against the misuse and abuse of science. The fulfillment of these assumptions is far from assured at present anywhere in the world; furthering them should be a Pugwash goal and a specific concern of the 1976 Dubrovnik Symposium.

In most, if not all, scientifically advanced nations, technical information is not readily available to every locale within the decision-making system. In some cases, a single branch or sector has a near monopoly of such information; in others, the information is available only in a biased, self-serving form. The experience in the United States with the cover-ups and distortions perpetrated by government agencies like the Atomic Energy Commission has led a number of scientists and scientific societies to call for "alternative expertise" or "supplementary advice" from private, impartial sectors of the scientific community.[15] Proposals have been made to counter the dominant role of the executive branch and the central government by means of more organized and extensive scientific and technical advice to the United States Congress and to the state executives and legislatures.[16]

A major interest at the coming symposium, and to the Pugwash movement generally should be the international dimension of the technical assistance function. At present, much of the scientific and technical advice flowing from advanced to developing nations tends to further the goal of technological imperialism, for example, by creating a dependence for software in the provision of hardware or a permanent need for spare parts to keep transferred machinery operating. Part of the solution to this problem lies in the diffusion of advanced scientific capacity, or, alternatively, in a greater reliance on the development of indigenous technology. Consideration should also be given, however, to the possibility of a transnational mechanism for alternative expertise and supplementary advice. Technology transfer can be accomplished on a more humane basis without accompanying political and economic dependence if it is assisted by international scientific societies or concerned individual scientists, whether working through formal organizations like UNESCO or established informal groups like Pugwash.[17]

Serious questions have been raised in the public mind in recent years concerning the supposed unmixed blessings of science and technology, perhaps especially in regard to atomic energy. An early dispute developed over the physiological threat posed by the radiation emanating from atmospheric nuclear tests. The most important contemporary issue concerns dangers of radiation, catastrophic accident and sabotage attendant upon the operation of fission reactors. In the United States, the Scientists' Institute for Public Information was formed in the late 1950's to provide the public with information necessary to understand and take an informed position on complex issues relating science to society. The areas in which this organization has had an interest include nuclear weapons and their testing, environmental quality, chemical and biological warfare, drug abuse and genetic issues related to race.[18] The Union of Concerned Scientists, on the other hand, attempts to assist private citizens in confronting the political-scientific establishment by providing technical advice for public hearings, law suits and the like, especially concerning the award of fission plant licenses by the Atomic Energy Commission.[19]

Here again, there is need for evaluating and advancing the international effort at public information, to which it is hoped the 1976 Dubrovnik Symposium will contribute. Government leaders, experts and the general public of developing nations should be made aware of the experiences of the advanced nations, so that they can avoid repeating the same mistakes and travelling too far down the same road. Furthermore, it is incumbent upon concerned scientists and engineers in developed and developing nations to work together in this effort, since most of the dangers of unbridled science and technology possess transnational dimensions; a few obvious examples include proliferation of nuclear weapons, the transportation and storage of fissionable waste materials, and the spread of environmental pollutants.

The value basis of the public information function should be quite apparent in the above: the process of informing the public about the negative effects of science and technology is an important expression of the scientist's social responsibility. Inevitably, the scientist who performs this task will be identified with specific values in dispute and will be forced to take a stand on issues. Is this a legitimate aspect of what it is to do science? At what point do values and positions enter into science: only when science is applied in society; or as well in the specific research choices internal to science?

Ethical Values in Scientific Research

Positivism remains perhaps the dominant ethic among the practitioners of science and provides the set of characteristic patterns of scientific behavior regarded by many of those who study science and scientists as central to the profession. For example, Karl Popper's ideal model for doing science is positivistic, as is the pattern of proper social behavior in science labelled by the Mertonians the "norms of science". Central to all positivistic views of science is the concept of value freedom, the norm of disinterestedness. According to Robert Baum, two of the basic assumptions of Scientific Positivism are:

> Science is value neutral; that is, the scientist qua scientist makes no value judgements.
> Ethical and other normative "judgements" are actually only expressions of emotions, attempts to evoke emotions in others, and/or commands.[20]

Baum criticizes Scientific Positivism for its internal inconsistencies and, especially, because of "its sterility with regard to the most basic concern of ethics - that of personal decision-making". That is really the crux of the problem for the scientist: he must make choices regarding the nature of his research and the applications which will be made of it. It is difficult to avoid the occasional intrusion of personal values, whatever one's position on the "value-freedom" of science itself.

As has been shown above, "value-freedom", the constant searching after truth in science, imposes important moral requirements: honesty, accuracy and skepticism toward the scientist's own work and that of colleagues; and the defense of science itself against external threats to its openness and independence. However, the seeking after truth is not alone a sufficient guide for the behavior of the scientist who is increasingly and persistently caught up in society. The central canon of the Society for Social Responsibility in Science, to seek work which benefits mankind and to abstain from that which injures it, affirms the fact that scientific choice is greatly influenced by and cannot avoid values; as such it seems to provide the minimum ethical standard for personal and social responsibility. It should not be the task of the 1976 Dubrovnik Symposium to engage in a philosophical examination of values and ethical systems. Instead, it should explore the institutional and normative constraints upon the incorporation of values into scientific choice and the ways in which Pugwash might stimulate activities to over-come the prevailing socialization pattern of the scientist and engineer, implemented by means of classroom, textbook, job situation and professional society, toward the avoidance of the application of values to his work.

Gerald Holton has divided ethical issues in science into two parts - those intrinsic to scientific activity itself and those extrinsic to science, involved in its relation to societal institutions and the general culture.[21] Since this division is closely related to the categorization by this background paper of internal and external problems of science, it can by analogy be asserted that the problem of ethical values in scientific research is for the most part an intrinsic ethical issue. The problem can then be defined as follows: whether or not the scientist, as an individual, in school or on the job, has the ability or inclination to come to grips with the ethical problems which are intrinsic in his professional activities. Holton's paper is most suggestive of the kinds of questions which might be fruitfully addressed by the symposium.

1. The scientist as an individual: case studies of the ways important and not-so-important scientists have dealt with ethical problems arising in the course of their work; studies of ethical problems arising from the growth of science and its attendant pressures.
2. The scientist as a member of an historic tradition: problems of communication, freedom and secrecy in science; changes in the historical norms of science which may be imposed by its interdependence with political and social institutions.
3. The scientist as a member of a national and transnational community: case studies of the scientific ethos in a variety

of historical periods and locales and under a variety of ideologies and philosophical systems; the responsibility of scientific societies in directing, governing, protecting, rewarding and censuring their members for their professional conduct or misconduct; the responsibility of the members of scientific societies to evaluate the behavior of these societies according to the same criteria; the rights and obligations of the scientist as consultant and expert to governments on questions of national and international importance.[22]

It is possible, assuming the attainment of transnational consensus, that a code of ethics might be formulated to cover most of the extreme forms of scientific misbehavior and distorted values which have posed serious dangers to the social system of science or to society. Nonetheless, in most cases ethical standards will pertain to the individual scientist and will be defined in terms of his personal contact with a specific situation. The choice between alternative research projects, the selection of one job over another, the question of whether or not to join a particular organization or sign a specific appeal, decisions such as these are matters where ethical judgments apply, but not normally judgments in conformity with absolute ethical standards. Instead, such decisions are very much a product of the personal and professional values possessed by the scientist and the situation in which he finds himself. The possibility should be explored that there exists a situationally defined ethic, that is, an ethic which flows from the experiences of scientists in their work and from their positions in society. It is quite possible that commonalities among experiences will serve to promote a collective ethical standard articulatable by a professional organization or group of organizations. Among the major concerns of Pugwash should be the determination of the feasibility of a set of standards for research touching on the major international problems of science, where scientific cooperation can promote global understanding and integration, and the articulation of the collective opposition of the international scientific community to practices which threaten international security, widen the gulf between advanced and developing nations and disturb the physical equilibrium of the planet.

The Global Social Responsibility of Science

Many of the personal ethical problems faced by scientists are the result of attempts at incorporating social responsibility into the actual conduct of scientific activity. This situation is perhaps clearest in the life sciences where the effects of research on human subjects pose direct and immediate ethical questions.[23] It is also evident, however, in a wide variety of other areas, including nuclear weapons, fission energy, environmental pollution and agricultural resources. It could, indeed, be argued that there is a clash between the internal and external dimensions of science, between the search for truth and the advancement of knowledge, on the one hand, and the drive to make science and technology relevant to and responsible toward society, on the other hand. In the United States, this clash has often been fought, as William Blanpied points out, in the board rooms and meeting halls of professional scientific societies. Discipline-bounded societies have continued to stress the "objectivity" and "value-freedom" of their science and have consequently attempted to restrict their role to the facilitation of communications among their members through meetings and journals. This assertion has been most strongly and persistently made in the pure sciences, where the research which fuels the engine of scientific growth has been traditionally abstracted from social involvement or concern. In addition, purity and objectivity have also been bound up with the reward system in specific disciplines and the hierarchy of status among scientists generally. Engineers, in contrast, have been necessarily forced to strike a balance - often inadequately accomplished, it must be admitted - between social responsibility and loyalty to their employers. Physicians, owing primary responsibility to their patients, must adhere under penalty of law and professional standing to rigid codes of societal conduct. However, scientists who wish to incorporate social values into their research must usually do so outside the reward structure of their disciplines and with an attendant sacrifice of recognition and advancement. Moreover, scientist who seek to raise ethical questions within the confines of their professional societies or who call for the adoption of codes of responsibility opposing the misuse of science usually run into the stone wall of "value-freedom".[25] Nevertheless, the intensity and pervasiveness of social issues and moral concerns within specific scientific disciplines has fostered the creation of a number of science and society subgroups;[26] and the similarity of these issues and concerns across disciplinary boundaries has led to the emergence of formal mutidisciplinary organizations devoted to the expression and implementation of social responsibility at national and international levels.[27] A major focus of the 1976 Dubrovnik Symposium should be an evaluation and assessment of the past success and future potential of these organizations, including, it is hoped, the Pugwash movement itself.

There is, however, a further restraint against the professional practice of social responsibility. Scientists who seek to do research or gather data, for example, on the potential deleterious effects of scientific and technical advances, have often found that grants and contracts are not available for this type of research or the agencies controlling the data are unwilling to reveal it or attempt to minimize its implications. In the United States, atomic energy is an area where these conditions have long been present and still persist - although recent developments, stimulated both by government and the scientific community, may bring important changes in the near future. The contemporary professional legitimacy of "technology assessment" and its growing support by governments may be an indicator of the increasing impact of societal problems on the direction of scientific research. However, there remains as yet no firm consensus regarding just what precisely is technology assessment, either within the scientific community or among government officials. While it has been argued by many leading scientists and political leaders that technology assessment provides a formal mechanism for incorporating social concerns into the process of planning for scientific innovations and technological applications, others have attacked critical assessments of the social implications of particular innovations or applications on the ground that they are too heavily influenced by highly controversial personal values.[28]

The scientist who commits a good part of his professional effort to public interest science finds that this activity detracts from his professional advancement, whether by indicating to this superiors an "aberrant" pattern of behavior or merely by taking valuable time away from more "legitimate" research efforts. Disturbed by this situation, Bernard Feld (himself a leading public interest scientist, but one who has had, like many of his colleagues, primarily an avocational interest in the social implications of physics) has called for the legitimation of public interest research by scientists, that is, its applicability toward professional advancement.[29] Such a development could be expected to bring about an increase in the number of scientists able to maintain a professional interest in both pure research and the social implications of science and in the tendency, already apparent, for a number of scientists to move entirely into hybrid disciplines, like arms control and ecology, which combine scientific expertise with social concerns. There is a growing number of groups and centers at colleges and universities throughout the world which conduct research and offer courses at the interface between science, technology and society; at other academic institutions, interdisciplinary courses relating science and technology to society and culture have been developed, with the goal of "socialising" the next generation of scientists, that is, promoting an awareness of their social responsibility as scientists.[30] It would be entirely in line with traditional concerns for Pugwash to sponsor an exchange among representatives from a number of such groups and institutions around the world, perhaps under auspices of the Dubrovnik Symposium series. From a global perspective, it is essential that academic programs consider the international dimension of social responsibility rather than concentrate exclusively on national problems and interests. It is also necessary that modifications in the socialization patterns of scientists and engineers toward the incorporation of societally defined norms and the legitimacy of public interest science be carried out on a global basis. The international scientific community can only be strenghtened by the development of a commonality of interests and an interdependence in the struggle for solutions to global problems threatening the freedom of science and the very survival of humanity.

Ways must be found to translate the latent community of interest among the scientists of the world in problems as crucial as arms control, ecology and human experimentation into a global perspective regarding the definition of such problems and a global strategy toward their solution. The bounds of global public interest science must be broadened to include scientists who recognize their responsibility but have as yet found no acceptable means, as scientists or citizens, to express it. Consideration should be given at the 1976 symposium to the potential for an International Code of Ethics for Scientists, which will raise to the same level as the internal norms of science the external responsibility of the scientist to society.[31] Scientists and engineers must unite in a common effort to assert control over the negative effects of science and technology. Otherwise, they may eventually find that the uses which have been made of their efforts have become morally unacceptable to them, professionally and personally; or alternatively, that other institutions have taken all control over the effects of science and technology away from them, and in a manner which may ultimately threaten their individual freedom and the freedom of science itself.

References

1. 22nd Pugwash Symposium, "Science and Ethics" Dubrovnik, Yugoslavia, 14-18 January 1975), Report from the Symposium, pp. 5-7.

2. In furtherance of the charge of the 1975 Symposium, monitoring efforts are underway and will be reported to the Pugwash Continuing Committee and the 1976 Symposium participants at a later date, but in advance of the Symposium.

3. The Ethical and Human Values Implications of Science and Technology: a Preliminary Directory Reviewing Contemporary Activity; Newsletter 8 of the Program on Public Conceptions of Science (Jefferson Physical Laboratory of Harvard University, Cambridge, Massachusetts, June 1974).

4. John Rawls, A Theory of Justice (Cambridge, Mass.: Harvard University Press, 1971).

5. This "situational ethic" for science is discussed in my own paper, "The International Scientific Community and the Global Social Responsibility of Science", delivered at the 22nd Pugwash Symposium (cited in ref.1).

6. Alice K. Smith, A Peril and a Hope: the Scientists' Movement in America, 1945-47 (Chicago: University of Chicago Press, 1965).

7. Gerald Holton has elaborated the distinction between problems which are intrinsic and extrinsic to science in his paper, "Ethical Issues Posed by the Impact of Science and Technology: a Proposal for the Structure and Priority of Studies", delivered at the 22nd Pugwash Symposium (cited in ref. 1).

8. Robert K. Merton, "Science and Democratic Social Structure", chap. XII in Social Theory and Social Structure (Glencoe, Ill.: the Free Press, 1949); Bernard Barber, "The Social Organization of Science: Some General Considerations", chap. 4 in Science and the Social Order (Glencoe, Ill.: the Free Press, 1952).

9. See, e.g., Norman W. Storer, "The Internationality of Science and the Nationality of Scientists", International Social Science Journal 22 (1970).
10. See, e.g. Zhores Medvedev, "Fruitful Meetings between Scientists of the World", in The Medvedev Papers (London: Macmillan, 1971); Michael Polanyi, "Securing a Visa (to the United States)" Bulletin of the Atomic Scientists (October, 1952).
11. Report of the Committee on Science in the Promotion of Human Welfare of the American Association for the Advancement of Science, December 31, 1964, reprinted in Gerald Holton (ed) Science and Culture (Boston: Beacon Press, 1965), p. 313.
12. These problems have been discussed in the context of German science in the 1930's and American science in the 1950's in Joseph Haberer, Politics and the Community of Science (NY: Van Nostrand Reinhold, 1969).
13. Howard S. Miller, Dollars for Research: Science and Its Patrons in Nineteenth Century America (Seattle: University of Washington Press, 1970). The movement for private support of science has been called by Joseph Ben-David "Scientistic". The Scientist's Role in Society (Englewood Cliffs, N.J.: Prentice-Hall, 1971), pp. 89-94.
14. Vannevar Bush, the wartime director of the United States Office of Scientific Research and Development, performed this task with great success in a document prepared near the close of the war to outline the potential benefits resulting from continued government funding of scientific research and development. Science, the Endless Frontier (Washington: U.S. Government Printing Office, 1945).
15. Gunnar Skirbekk discussed this point from the perspective of internal ethics in science in his paper, "Some Reflections on Expertise and Politics", delivered at the 22nd Pugwash Symposium (cited in ref. 1).

16. A number of professional societies in the United States, coordinated by the American Association for the Advancement of Science, have recently initiated a Congressional Scientist - Fellow Program, the purpose of which is to place younger scientists on Congressional staffs for periods up to a year. Joel Primack and Frank von Hippel, *Advice and Dissent: Scientists in the Political Arena* (NY: Basic Books, 1974), pp. 278-279.

17. A workshop was recently held under the auspices of Pugwash to draft a set of recommendations to govern the international transfer of technology.

18. Barry Commoner has discussed the work of this organization in *Science and Survival* (NY: Viking, 1967).

19. An excellent examination of the procedures whereby citizens and experts can cooperate in challenging this particular "power" structure can be found in Steven Ebbin and Raphael Kasper, *Citizen Groups and the Nuclear Power Controversy: Uses of Scientific and Technological Information* (Cambridge, Mass.: MIT Press, 1974).

20. Robert J. Baum, "A Philosophical/Historical Perspective on Contemporary Concerns and Trends in the Area of Science and Values"; Newsletter 9 of the Program on Public Conceptions of Science, Harvard University, October 1974, p. 27.

21. Holton, *op cit* (cited in ref. 7).

22. *Ibid*, pp. 7-10.

23. The Institute of Society, Ethics and the Life Science (the Hastings Center) has served as both a locale for research and as a clearinghouse for reports and studies in this area. See its excellent, up-to-date *Bibliography of Society, Ethics and the Life Sciences*, 1974 edition, available from the Hastings Center, Hastings-on-Hudson, New York.

24. William Blanpied, "Subjective Impressions Regarding Contemporary Concerns and Trends" in The Ethical and Human Value Implications of Science and Technology (cited in ref. 3).

25. Charles Schwartz, a physicist active in Scientists and Engineers for Social and Political Action, has discussed his failure to convince the American Physical Society to devote attention to political issues of concern to scientists, specifically, the role of physics in the Viet Nam War. The Social Responsibility of the Scientists, ed. Martin Brown (NY: Free Press, 1971), pp. 19-34.

26. Recent activities of these subgroups in the United States were discussed at the Alta Conference, Alta, Utah, 7-9 September 1973. See the report of the Conference, "Scientists in the Public Interest: the Role of Professional Societies". (Copies are available from the Department of Physics, University of Utah).

27. Some major organizations of this type are examined by Stuart Blume in Toward a Political Sociology of Science (NY: Free Press, 1974), pp. 145-176

28. See, for example, the chapters on technology assessment in Albert Teich (ed), Technology and Man's Future (NY: St. Martin's Press, 1973).

29. Bernard Feld, "On Legitimizing Public-Service Science in the University" Daedalus 104 (Winter 1975), pp. 244-247.

30. See, e.g., the "Partial List of Groups Active in Areas Related to the Ethical and Human Value Implications of Science and Technology", in Newsletter 8 of the Program on Public Conceptions of Science (cited in ref. 3). See also "Science, Technology and Society, a Guide to the Field", Program on Science, Technology and Society, Cornell University, forthcoming. Both of these sources include groups active outside the United States.

31. Recently, an international symposium of distinguished scientists, meeting at Haifa to celebrate the fiftieth anniversary of the Technion-Israel Institute of Technology, drafted a declaration incorporating a number of the considerations mentioned above. "The Mount Carmel Declaration on Technology and Moral Responsibility", drafted at the closing session of the Wunsch International Symposium on "Ethics in an Age of Pervasive Technology"; Haifa, Israel, 25 December, 1974.

Paul H. De Forest (U.S.A.)

ETHICAL PROBLEMS OF SCIENCE

Background Paper for the Second Pugwash Science and Ethics Symposium, Dubrovnik, January 1976

The report from the 22nd Pugwash Symposium, held at Dubrovnik in January 1975, called for a continuing Pugwash activity in "science and ethics", including an annual symposium on various topics within the field to be held at the Inter-University Center in Dubrovnik. A small group was appointed to monitor research on science and ethics, to coordinate with the UNESCO program on the human implications of scientific advances, including the misuse of science, and to plan for a second symposium in January 1976, covering the following topics:

Ethical Problems of Science

1. the requirement of openness in the international scientific community;
2. the responsibility of scientists to inform public opinion;
3. the role of ethical values in scientific research;
4. ethical problems faced by scientists in the struggle for global survival;
5. toward an International Code of Ethics for scientists.[1]

This document is intended to serve as a background paper for the 1976 symposium; as such, it will detail for the Pugwash Continuing Committee the symposium agenda topics and their relevance to the Pugwash movement, and will provide an integrative focus for the papers prepared by the symposium participants and a guide to symposium deliberations. Throughout the paper, emphasis will be placed on the role that Pugwash can play in furthering the impact of ethical values and social responsibility within the international community of scientists.