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THE SOCIAL CONTROL OF SCIENCE AND TECHNOLOGY

By MICHAEL S. BARAM

SCIENCE and technology increasingly work changes in the complex matrix of society. These changes pervade our ecological systems and our physical and psychic health. Less perceptibly, they pervade our culture, our values, and our value based institutions such as the law. In turn, our values and institutions shape the progress and utilization of science and technology.

As we know, science and technology have provided society with enormous material benefits and a higher standard of living and health. But we now realize that this process has been accompanied by alarming rates of resource consumption and many new hazards to ecological systems and health.

Social response to these unexpected problems has been of a remedial nature — *e.g.,* how to diminish pollution through regulation and technology. But it must be repeated that our values and institutions shape the progress and use of science and technology, and therefore the fundamental social response must be of a preventative or a priori nature to the extent that this is possible.

This important task can be described as the need to formulate coherent and humane social controls on science and technology.

Of course when we talk about science and technology, we are not discussing discrete activities. We are depicting an interrelated number of events which occur across a spectrum which ranges from basic research through applied research and developmental technology to application and use technologies.

Since World War II, events along this spectrum have been highly dependent on federal funds. In 1969, approximately 65 percent of the funds expended in the United States for basic research, applied research, and development technology were provided by federal agencies. This reliance on federal support provides some justification for public interest in the social control of science and technology.

Most such social change occurs during the latter stages, where technology is manifested either in specific acts — such as organ transplantation techniques — or as part of a major public or private system — such as nuclear energy or computer applications.

The most substantial expenditures and investments occur during the developmental technology stage, after a number of important decisions have been made to pursue development of prototypes, production,

application, and use. Of the approximately $17 billion of federal support for research and development in 1969, it is estimated that $5 billion went for research, and $11 billion for development. Production and application activities undoubtedly involved billions more. Similar ratios prevail in the private sector.

These investments must be recognized in human as well as economic terms, for it is during the development and subsequent technology stages that large numbers of engineers, administrators, managers, production and shop personnel, salesmen, and subcontractors commit their careers, personal values, and families — ultimately their communities — to the specific technological activity or system. Therefore, all *subsequent* social controls must consider this set of political, economic, and human factors which has been developed.

Numerous social controls on science and technology have been developing and functioning over the years.

The table on page 569 suggests *in general terms* what these controls are and where they function in relation to the spectrum of activities.

The cluster of legal doctrines in the table all function during the advanced technology stages, *after* decisions committing economic and human resources have been made, and normally *after* injury has occurred. By this time, fully developed systems and practices are in use without coherent controls.

This has led to condemnation of law as a modern system of control. As Jacques Ellul has said:

> The judicial regime is simply not adapted to technical civilization, and this is one of the causes of its inefficiency and of the ever greater contempt felt toward it.
>
> Law is conceived as a function of a traditional society. It has not registered the essential transformation of the times. Its content is exactly what it was three centuries ago. It has experienced only a few fragmentary transformations (such as the corporation) — no other attempts at modernization have been made. Nor have form and methods varied any more than content. Judicial technique has been little affected by the techniques that surround us today; had it been, it might have gained much in speed and flexibility.
>
> Faced with this importance of the law, society passes to the opposite extreme and burdens administration with everything that is the product of the times in the judicial sphere. Administration, because it is better adapted from the technical point of view, continually enlarges its sphere at the expense of the judicial, which remains centered on vanishing problems such as codicils, community reversions, and the like. These last, and all similar problems that are the exclusive concern of our law, are problems that relate to an individualistic society of private property, political stability, and judicial subtlety.[1]

In specific terms, the legal system has not interposed itself as an effective control on science and technology; it does not perform a control function early enough on the spectrum of events.

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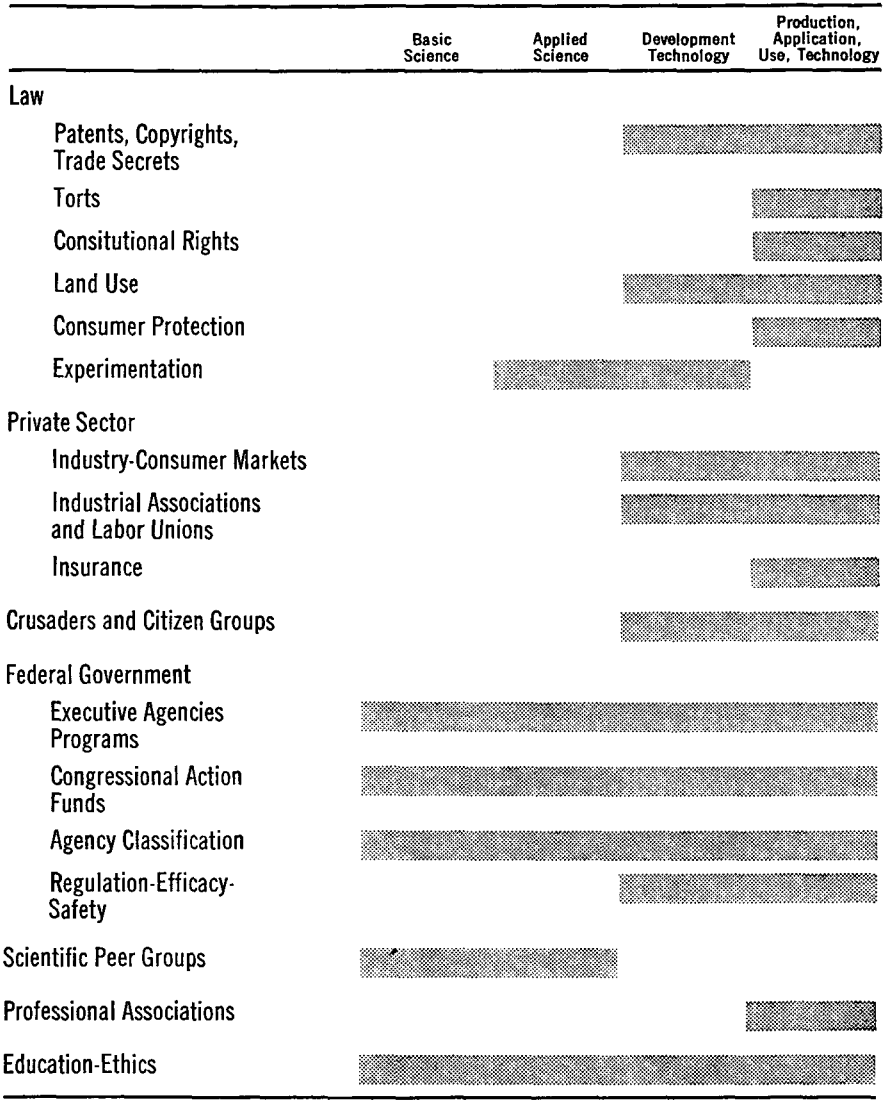
[1] J. ELLUL, THE TECHNOLOGICAL SOCIETY 251 (1964).

SOCIAL CONTROLS ON SCIENCE AND TECHNOLOGY



Harold Green, in discussing this issue, has said:

> The basic question is whether our legal system is capable of imposing effective social control over new technologies before they inflict very substantial, or even irreparable injury upon society. It seems clear that we cannot rely on the courts alone to protect society against fast-moving technological developments. Judge-made rules of law always come after, and usually long after, the potential for injury has been demonstrated . . . .[2]

This characteristic of retroactivity limits the ability of the legal system to respond to a number of modern social problems, in particular

[2] H. GREEN, *The New Technological Era: A View From The Law* in MONOGRAPH 1 (Program of Policies Studies, George Washington University 1967).

the harmful effects of science, technology, and environmental deterioration. Retroactivity is inherent in a legal system based on the values and conflicts of the private sector of society. The courts have not been designed to serve as oracles, but to grapple with actual conflict manifested in specific acts or injuries. They lack the technical, astrological, or other expertise needed for the difficult task of evaluating present diffuse effects and future effects. Consequently, the courts are reluctant to impose controls and, for example, have rarely intruded on the substantive decisions of public agencies, which presumably are technically expert.

Judicial procedures which reinforce concepts of justice and due process, and include statutes of limitations, and rules of evidence and standing, have also brought an immobility to the law so that it cannot respond easily to issues of deleterious damage or public health.

Recent developments in environmental litigations have ameliorated some of these procedural obstacles, particularly the issue of standing for citizen's groups alleging other than economic injuries. However, in *Sierra Club v. Hickel*,[3] the Court of Appeals for the Ninth Circuit denied that the Sierra Club had standing because the Club had not alleged that its members would be affected, beyond displeasure, by the scheduled action of the Department of the Interior. This may indicate that the bounds of procedural flexibility have been reached.

This list of legal problems is incomplete, but is sufficient to justify the conclusion in a recent law review note that "[t]he passive nature of the courts and the difficulties encountered in their use make it clear that they cannot serve as society's primary instrument for technology assessment."[4]

The controls of the private sector are similarly clustered in the advanced technology and use stages. Industrial decisions and insurance controls are implemented without full consideration of the public interest. Decisions are made on market or profit considerations, based on what the consumer wants or can be manipulated to want, and do not consider larger public interests in the preservation of natural resources or public health. Advertisements boost sales of items attractive to individual consumers, but which collectively erode environmental quality, other public interests, and, ultimately, private interests.

Sales of snowmobiles to the new breed of armchair sportsmen now climb to ½ million annually and provide a current case in point, but the automobile represents the ultimate absurdity. Auto birth rates are now treble human birth rates in the United States, 10 million to three million. Auto death rates occur in similar ratio. Our automobiles produce most

[3] 39 U.S.L.W. 2180-81 (9th Cir. Sept. 16, 1970).

[4] Portnoy, *The Role of Courts in Technology Assessment*, 55 CORNELL L. REV. 861 (1970).

of our air pollution, are dangerously designed, and are not economically recycled. How much longer can these absurd ratios and harmful effects be tolerated, despite the importance of the industry to the economy?

Obviously, many of our problems labeled technology induced or environmental, are in reality, the behavioral problems of a materialistic society. As such, we cannot expect effective private sector controls to emerge, nor can we expect courts to alter such "normal" behavior.

Crusaders and citizen's groups have recently proven somewhat effective as technology-curbers, but have not provided coherent, a priori controls. Crusaders are in short supply, and citizen's groups lack funds, technical expertise, and national political strength. They can only attack discrete problems, often on a local scale, and must ultimately resort to the legal system with its shortcomings.

The Internal Revenue Service is now reconsidering the tax exempt status of public interest groups which litigate or support litigation for environmental protection and other "public good" purposes. Its decision may preclude, in an economic sense, most of the litigation which could force onto the legal system an assessment and control function.[5]

The task of the public interest group is made extremely difficult by the fact that, once again, substantial economic and human commitments have already been made in support of harmful developments, on a scale far larger than the immediate interests represented by such groups. Without substantial evidence of harm to public health, such groups appear to represent merely their own aesthetic or otherwise elitist values, or a Luddite revival. This is not said to disparage such activities. They have served to educate and involve citizens and represent an exciting and valuable development.

The public agencies have actual and potential social control functions across the complete spectrum of scientific and technological activities. But this role is inextricably wound up with their several other functions which include the promotion of certain activities for national purposes like defense or the balance of payments, and the regulation of activities according to numerous criteria having little relationship to the social interest.

Agencies possess the financial and technical resources, and sometimes the authority, to function as effective social controls, but have in general failed to do so. Reasons for this failure have often been cited and are true to varying degrees: bureaucracy and inertia, ignorance and lack of sensitivity to noneconomic interests, fragmentation of authority by design or by new developments which supercede them.

Legislation has proven no guarantee of implementation. The refuse section of the 1899 Rivers and Harbors Act[6] is a potentially powerful

[5] 1 BNA ENVIRONMENTAL REP., CURRENT DEVELOPMENTS 629 (1970).

[6] 33 U.S.C. § 407 (1964).

source of authority for combatting most forms of water pollution as they occur. Yet for 70 years, it has been ignored by the Corps of Engineers and the Department of Justice.

The rational measure of reorganizing the federal agencies or creating new administrative bodies to better control science and technology has been under discussion for some time. This would enable one or several new and prescient groups to function as long-range planners with coherent control authority. For example, a single agency could perhaps determine national and regional energy needs, then plan, license for construction, and regulate in the public interest more effectively than the present multiple-agency situation. Reliance on teams of technical experts and experts from other fields such as law, health, and economics could be built into such reorganization plans.

These are certainly steps in the right direction. Of our present array of social controls, perhaps the public agencies (which support most research and development) could effectively perform assessment and control functions where they are most important — before there is large scale development and commitment of economic and human resources.

Hugh Folk, in considering present and future social control by public agencies, has already discerned some pragmatic problems.[7] Experts will once again be drawn from the same pool. Many will actually have contributed, in industry or government, to the problems they will be called upon to solve. Few experts will be able to apply their disciplinary background to a wider range of social issues, and experts will need extraordinary courage to function in a truly critical sense, since their careers will still be rooted in the same industrial-governmental milieu. What will happen to the expert who tries to serve the public interest by calling for a halt to a particular line of research? A test case is before us now, involving radiation safety standards. Drs. Goffman and Tamplin have challenged the AEC and its affiliates in industry and the universities.

Folk's central thesis must be repeated here: assessment and control are essentially policymaking processes, and as such, will be embroiled in political controversy. He fears the repetition of nonrational policymaking processes which result in agency establishment of "standards at levels slightly below that at which people complain vigorously . . . thus keep[ing] the public sullen but not mutinous."[8] Designs for central or supreme assessment and control authorities must meet these issues squarely if real change is to occur.

Let us briefly consider peer groups who are well-positioned to assess and control early in the basic and applied science stages.

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[7] Folk, *The Role of Technology Assessment in Public Policy*, Dec. 29, 1969 (AAAS Meeting Paper).

[8] *Id.*

Based on personal observation in part, I do not think scientific peer groups presently have the objectivity or capability to function as coherent and humane social controls. The members of a peer group share the narrow confines of their discipline and individual success is measured by the degree to which one plunges more deeply into, and more narrowly draws the bounds of, his research. There are no peer group rewards for activities or perceptions which extend beyond the discipline or relate it to social problems. Members are therefore not motivated nor trained to relate their peer group activity to broader social concerns, and because of their closeness and commitment to their work, they are unable to objectively assess implications and recommend controls.

Genetic research today provides us with a fully developed case in point. It is proceeding rapidly in the United States and Britain, and periodically, significant breakthroughs are announced. Members of the peer group and others have frequently discussed the potential applications of their work, and it has become a fashionable topic. Despite the potential for genetic engineering and its misuse for political and social goals repugnant to our professed values, this work continues at an urgent pace. It would seem that the historical evidence of the political misuse of science and technology in this century would at least bring about a slight pause or slowdown in activities until our legal and other control systems have time to prepare principles to control experimentation and to provide other public and private safeguards.

It is a disturbing experience to discuss these issues with biologists. Their responses avoid the central issue of slowing or suspending work to formulate controls and include the following:

> If we don't do it, somebody else will;
>
> Don't worry about secret and horrible developments, all work is done in large expensive labs funded by the government;
>
> Further work will improve the health of society and upgrade the gene pool;
>
> Cloning of humans is at least 5 (or 10) years away;
>
> Science is intrinsically valuable in its contribtuion to man's collective knowledge, and it must not be controlled for social purposes of any sort.

Self-enclosed peer groups cannot be entrusted with self-control, perhaps because of their narrow disciplinary backgrounds or self-interest, or because our educational system does not foster ethical and interdisciplinary values in professional training.[9]

Finally, we must consider the problems of education. Our graduate schools and departments represent artificial divisions of knowledge and experience, and deprive students of important opportunities and professional qualities. Substantive specialization and procedural barriers

[9] *See* Morgenthau, *Modern Science and Political Power,* 64 COLUM. L. REV. 1386 (1964).

prevent students from working with colleagues in other disciplines, and often from clinical work of a socially relevant nature. As a result, students are deprived of the chance to acquire some information on values, attitudes, and methods of other disciplines, and of the opportunity to synthesize and apply the results to social issues. These limitations in training are then reflected in careers and social problems.

The social control of science and technology will be a troublesome and never wholly successful undertaking. It bears a potential for the politicization and regimentation of intellectual activity, which has been realized in Russian genetics. Nor will the task lend itself to a specific solution — there are no administrative, legislative, or judicial panaceas.

It must be recognized that future impact assessment and derivative control will always be limited as man's intellectual and imaginative resources are limited. Our measuring devices are still too crude to discern pernicious impacts in many cases. The practice is made more difficult and speculative as it is undertaken further back along the spectrum before developmental technology.

But the practice must begin and develop, and pervade all the social control mechanisms we now have and may devise. There are a number of reforms that can be introduced in our present array of social controls.

Independent adversaries must be fostered. A tax-exempt status ruling by the IRS would be a helpful first step for citizen's groups pursuing activities in the public interest — *e.g.,* as demonstrated by their concern for public health. Multiple-year grants to interdisciplinary groups, perhaps based at universities, could foster independent adversaries by establishing new career patterns. Congress, through its committee structure and Reference Service, should assist in this process.

Litigants should continue to press for responses from the legal system. Environmental litigation has been marked by ingenuity, but it lacks a coherent rationale. If *Sierra Club v. Hickel*[10] is an omen of anything, it may be that mere displeasure or aggravation of elitist values held by a citizen's group will not be sufficient to challenge agency and industrial action which serves economic or public recreational interests, even though on a crass and commercial basis. Perhaps this is as it should be. Litigation to control environmental quality and science and technology should seek a coherent and important *raison d'etre* — *e.g.,* public health.

Public health, in both physical and psychic terms, includes aesthetic and recreational values and the importance of eco-systems. Public health must therefore provide the nexus between citizen group social action or litigation and the public interest. The federal agencies, under the National Environmental Policy Act (NEPA),[11] must now consider

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[10] 39 U.S.L.W. 2180-81 (9th Cir. Sept. 16, 1970).

[11] 42 U.S.C. §§ 4321 *et seq.* (Supp. V, 1970).

health effects. Establishing public health as the nexus does not simplify decisionmaking but it does reduce subjective value clashes and uses science and technology in a beneficial manner.

Administrative agencies must be reorganized sensibly in light of national needs and available scientific and technological resources.

Legislation must be generated to provide guidelines for the administrative agencies, similar to those provided by NEPA, which impose substantive and procedural duties on all federal agencies to implement a broad policy of preventing and eliminating environmental damage. Section 102(2) of NEPA requires that the federal agencies, in their policies, recommendations, and other major federal actions affecting environmental quality, shall

> (A) utilize a systematic, interdisciplinary approach . . . in decisionmaking which may have an impact on man's environment;
>
> (B) . . . insure that presently unquantified environmental amenities and values . . . be given appropriate consideration in decisionmaking along with economic and technical considerations;
>
> (C) include in every recommendation . . . and other major Federal actions . . . detailed statement . . . on —
>
> (i) the environmental impact of the proposed action,
>
> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
>
> (iii) alternatives to the proposed action,
>
> (iv) the relationship between . . . short-term uses . . . and long-term productivity, and
>
> (v) any irreversible and irretrievable commitments of resources which would be involved . . . .
>
> . . . .
>
> (D) study, develop and describe appropriate alternatives . . . .[12]

We can only speculate on what the real impact of NEPA will be on environmental quality. Perhaps its primary significance will be to instill certain habits and values in federal officials and their expert resources. The habits would hopefully include *interdisciplinary assessment* and *consideration of alternatives,* and a *value system which will include health and aesthetic considerations.*

Realistically, we can expect NEPA to slow down the agency decisionmaking process and this will help matters. Finally, NEPA will bring about the generation of information by the federal agencies which should become available in useful form to adversaries who invoke the Freedom of Information Act.[13] The broad-based studies of harmful effects and alternatives by the agencies will be helpful, either because of contents or omissions, to environmental action groups. Hopefully, executive privilege and other exceptions to the Freedom of Information

[12] 42 U.S.C. § 4332 (Supp. V, 1970). A full review of NEPA is presented in an unpublished article by Ronald C. Peterson, Yale Law School, entitled *Title I of the National Environmental Policy Act of 1969.* It is available from the Environmental Law Institute, 1346 Conn. Ave., Washington, D.C.

[13] 5 U.S.C. § 552 (Supp. V, 1970).

Act will not be invoked to the detriment of Congressional purpose as expressed in NEPA. Unfortunately, this has occurred in *Soucie v. DuBridge*,[14] where the Office of Science and Technology report to the President on the SST was successfully withheld from conservationists.

Obviously, NEPA will also bring about some assessment and agency control of science and technology, when environmental effects are predicted. However, there is a need for legislation, similarly grounded in a multiple-value system and the habit of assessment, which will more directly confront the need for a priori control of science and technology. This legislation should be directed at the substantial agency sponsorship of research and development, and thereby regulate federal procurement and government contractor activities.

Finally, the most important social control must be discussed — education. The training and values of our professionals in law, engineering, and other fields must be responsive to the problems that beset society. The intense specialization that marks graduate education fosters narrow professionalism in subsequent careers. Peer group rewards have not been provided to members who apply their training to problems which extend beyond disciplinary confines.

No new degree programs will provide us with the answers. Rather, every degree program we now have must be enriched with interdisciplinary, clinical, or preferably problem-focused components. Interdisciplinary does not mean antidisciplinary.

It is my good fortune to be a part of several innovative developments in higher education. At the Massachusetts Institute of Technology, the School of Engineering is moving in new, exciting directions to confront problems of bio-medical engineering, and environmental quality.

The Civil Engineering Department has brought into its faculty and academic structure an interdisciplinary team made up of a political scientist, a lawyer, and an economist to work with the engineering faculty on water resources, transportation systems, systems engineering, and environmental quality. Engineering students can now enrich their academic programs with courses and research which relate their engineering disciplines to the full complexity of the social context in which they will eventually work. A number of engineering students will soon join with members of the Harvard and Boston University Law Schools' Environmental Law Societies on a number of projects confronting local and national environmental issues.

An experimental 2-year masters program on the Social Application of Technology has also been launched. This program will provide members the opportunity to confront a complex social problem, fully explore all aspects of the problem, and apply their learning to its resolution in a pragmatic context. Off-campus research and learning-by-

[14] 39 U.S.L.W. 2123 (D.C. Colo. Aug. 25, 1970).

doing will hopefully produce a new type of professional ideally suited for public service. A core group of courses is now being devised and will include law, government and bureaucracy, applied economics, and project-related technology.

Professor Jerrold Zacharias is now working on adapting MIT's advanced degree programs to specifically train students for college teaching careers in science and engineering. A mastery of a discipline, educational methods and technology, ethical and legal materials, and interdisciplinary research as vehicles for educating are now considered to be important features of this development. Graduates will be expected to bring breadth and innovative qualities to their teaching careers and will be able to relate their discipline to the social context.

Finally, at Boston University Law School, the new Center for Law and the Health Sciences has established a program which enables law students to engage in work with graduate students from other disciplines on social problems of a health-related nature. Student and faculty participants are drawn from different disciplines and institutions, and students will receive academic credit through ad hoc institutional arrangements.

Washington, D.C., chief circuit judge, David Bazelon, has played a major role in this undertaking and he presided over the recently completed summer pilot program. During this program, 15 graduate students from Boston University, Brandeis, Harvard, and MIT divided into four interdisciplinary teams and each team confronted a complex health problem: genetic counseling, health insurance reform, multiple-service health centers, or the training of mental health professionals. Each team contained a law student, medical student, economist or urban planner, and student from a discipline particularly relevant to the problem — *e.g.,* bioengineering, ethics, etc. Fifteen faculty members, representing a number of disciplines, served as a general resource to the students at scheduled meetings and informal sessions.

Interdisciplinary education presents a number of organizational problems and a number of unique educational benefits. Much was learned from the summer pilot program, and the ongoing program is now about to commence.

Problem orientation has proven to be an important aspect of the interdisciplinary program, in that it forces learning, synthesis, and application onto students, while enabling them to undertake considerable initiative in defining and working on the problem in a context of competing values. With this approach the Center hopes to enrich the graduate education of a number of students and enable them to function effectively in health related careers.

The social control of science and technology, through the training of new kinds of professionals, is one of the most important tasks at

hand for law schools, schools of science and engineering, and other programs of higher education. This task must become an ongoing process, and needs interdisciplinary cooperation and public agency support. Law faculty, in particular, are needed to help build and implement these new programs of public service which are related to the social system and values. For it is only out of individual and collective wisdom and temperance induced by an appreciation of another's values that we will control science and technology in a coherent and humane fashion.