Does Science Have More to Fear From Its Friends Than Its Enemies?

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INTRODUCTION

Today there is a general sense of crisis about science as an institution, and concern about the future of science in American society, if not in all industrial societies on this side of the iron curtain. This sense of malaise has been triggered by the decline of federal support for science, expressed in real terms, which has been going on continuously since its peak in 1967. The trends in federal support of science in the universities have been paralleled by a disenchantment with science in industry and government and a shift of research policy toward the search for evolutionary improvement in existing products and services in preference to more fundamental innovations. Although the financial support situation in Europe has been more stable, many of the "atmospheric" factors parallel those so evident in the United States. In part science has not fallen so far there because it has not ridden so high. But financial support in any case is only a small part of what defines a crisis of confidence between science and society.[1]

Much public attention has also been given to the growth of antirational cults, and to the general decline of faith in rationality, and in the ability of the human race to resolve its problems by rational, sometimes pejoratively dubbed "reductionist," methods. Instances of belief in irrational cults are the rise in belief in astrology, even among some science students,[2] and revival of political agitation against the teaching of evolution, as in the California school controversy.[3] Many of these cults advertise themselves as being holistic and concerned with the unity of all knowledge, in contrast with the analytical and "reductionist" approach of official science and scholarship. Yet in these in-

stances it is also interesting to note that the new cults attempt to clothe themselves in the trappings of science and present their body of belief as scientific theories.[4] Horoscopes are cast by computer, thus making them appear more scientific. What are basically anti-scientific heresies present themselves as friendly to science in some deeper sense, purporting to incorporate traditional science within some more all-encompassing universalistic framework.[5]

Much attention has also been given to the dramatic decline of the perennial American love affair with technology, following closely on the heels of one of the most spectacular technological achievements of all time, the landing of men on the moon and their safe return to earth. This disenchantment with technology has, of course, been brought about in part by findings of science, which has become increasingly able to detect ever more subtle secondary effects of technology, particularly on the natural environment and on human health.

Indeed one of the more surprising aspects of the anti-science and anti-technology movements has been the participation of scientists themselves in the process, both directly as advocates of the natural environment against the encroachments of technology, and more indirectly through general denigration of the ideological norms of science—its devotion to "objectivity" and to the pursuit of truth wherever it may lead.[6] Many scientists have become deeply pessimistic about the future of science as an intellectual enterprise. A few years ago a retiring president of the American Association for the Advancement of Science declared that all the great discoveries of science had already been made, and that the rest consisted merely of filling in less and less interesting gaps in a framework of theory that was already essentially complete.[7] In the meanwhile a number of environmental scientists had "gone public" with declarations that most of the ills of the modern world could be attributed to technology, especially the most recent science-based technology.[8] A majority felt that the evils of technology could be ascribed to the corrupt institutions in which it was applied, and they appealed to the conscience of scientists to refuse to serve those institutions, but instead to dedicate themselves to "science for the people." Others were more inclined to view the evils as inherent in the technologies themselves. They appealed for a wholly new kind of technology, more "human" in scale, attacking the principles of interdependence and division of labor which have been the basis for the successful social application of most technological advances.[9]

Many of the issues outlined above have been dealt with on both sides in a recent issue of *Daedalus* under the title, "Science and Its Public: The Changing Relationship," edited by Professor Gerald Holton, who has devoted a good deal of his recent scholarly attention to analyzing these phenomena.[10] Although there is much in common between the modern reaction against science and technology and the romantic reaction that occurred toward the end of the 19th century, disillusionment and self-doubt have penetrated more deeply into the outlook of the scientific community itself than was the case in earlier periods.

ORIGINS OF THE REACTION

Several recent commentators have blamed the present situation of science as an institution on science itself, and particularly on the behavior of scientists in their interaction with the public and with the political process. They have called for a retreat of science and scientists from the public arena into which the successes of the post-war era have projected them, and for a return to the lonely individual working in his laboratory and obeying what are seen as the traditional norms of science—scrupulous objectivity in the reporting of data, the shunning of publicity and the popular media, and the refusal to pass judgment on issues that are not strictly scientific and in principle decidable by experiment. Robert Nisbet[11] and Joseph Ben David,[12] both sociologists, have recently written popular articles expressing this theme with considerable eloquence. Others, especially some of the younger generation of scientists, have recommended an opposite prescription, namely abandonment of the "pretense" of objectivity, and the duty to take an active political role in assuring the use of science exclusively for the public welfare, usually defined in populist and egalitarian terms.

Much of the problem for science today stems not from its failures, but from its successes, the expectations they have created, and the dubious allies and supporters they have attracted.

My own view is that the present plight of science is deeper than these simple dichotomies would suggest. Indeed much of the problem for science in society today stems not from its failures but from its successes, the expectations that they have created, and the dubious allies and supporters they have attracted. In addition the *hubris* created among scientists themselves by their success and by the willingness of politicians to listen to them has led them to make exaggerated claims and promises. In this sense the successes of science, both real and imagined, have created a climate that is ripe for a reaction against science and technology, and this is what I really had in mind with the rhetorical question in the title of this paper.

THREE PROBLEMS OF SCIENCE IN SOCIETY

I would now like to discuss three different but interrelated problems that characterize the present place of science in the contemporary sociopolitical context. Each has been hinted at in what I have already said, and stems from the success of science and the friends and defenders it has thereby attracted. Let me be more explicit; the three points I have in mind are:

(1) The seizure by politicians of dramatic initiatives in R&D intended to cope with major social problems attracting current political attention, what I might call the "War-on-X" syndrome.

(2) The *hubris* of scientists who make excessive claims to the public and to decision makers for the practical potential of various scientific findings and methodologies at the current stage of their development.

(3) The increasing tendency of the political process to call on scientists and scientific groups to arbitrate controversial public issues that cannot be settled by scientific data and theories alone, and the response of the technical community to this challenge.

In each of these areas the scientist is the willing, sometimes the too willing, participant in a process that is relatively new in the history of science, at least in scale, though not so new in the history of some of the technical professions such as medicine. The difficulty is that each of the phenomena of science–society interaction leads to public confusion about the social role of science and scientists, and ultimately to loss of faith in the apolitical image of science, which has been an important factor in preserving public support and credibility for science in the past.

THE WAR-ON-X SYNDROME

This is, perhaps, the most familiar problem of science in society because it is the oldest historically. In the 1950's and early 1960's it was manifested by politicians promoting dramatic military development programs such as the nuclear-propelled aircraft (a failure) or the nuclear-powered missile submarine (a success) or the supersonic bomber (a failure) or the nuclear-powered rocket (a failure), or peaceful nuclear explosives. This phase culminated in the successful Apollo missions of the late 1960's. Each of these projects had a prime political proponent, who allied himself with scientists and engineers who could provide him with plausible technical backing for his proposals, and who were often direct participants in any R&D projects that resulted.

But all of this led by the end of the 1960's to a widespread belief that the same methods that had frequently been successful in military and space projects (and the failures were quickly forgotten; who today has ever heard of ANP, Dynosoar, Skybolt, or Rover?) could be transferred to the social problems that were now besetting the country. "If we can put a man on the moon, why can't we build a decent mass-transit system (or mass produce low-cost urban housing, or eliminate crime or poverty or reduce population growth, or solve the energy crisis, or feed the world)?" Richard Nelson has characterized this as the "moon-ghetto metaphor" in a very perceptive article with the revealing subtitle, "A Study of the Current Malaise of Rational Analysis of Social Problems."[13] Authors such as Nelson draw attention to the contrast between space military projects, which do not directly and perceptibly affect large numbers of people and vested interests, and large-scale projects in civilian technology, which have to enter a complex existing technostructure, threatening many established relationships and interests.

Despite the widely alleged public disenchantment with science and technology, we have seen a remarkable proliferation of such "wars" on social problems, which seems to imply not disillusionment, but touching faith in the power of science and technology to resolve any problem on which its resources have been sufficiently focused, though perhaps disenchantment with the propensity of scientists to "do their own thing" unless their feet are held to the fire by political mandate. The war on poverty, the war on crime, the war on cancer, and now project independence are all manifestations of both an uncritical faith in the problem-solving capacities of science and a belief that it must be subjected to strong political guidance in order to achieve goals defined for it by society rather than by the internal processes of science.

There were, of course, other wars that never got off the ground. One example is the famous "MacGruder exercise," abortively launched by the Nixon administration with the announced objective of restoring the lagging technological position of the United States in international trade. This was to be a $2–$3 billion infusion of R&D funding to develop new technologies that might eventually be used in the commercial sector.[14] Its demise occurred partly for budgetary reasons, partly because of the lack of truly novel ideas generated within the federal bureaucracy, and partly because the entanglements of Watergate diverted Presidential attention.

Another example of an initiative that eventually petered out originated in the Congress and strove for most of the 1960's to create a "wet NASA," an independent R&D agency that was to exploit the "boundless" resources of the oceans and draw together in one agency all the scattered oceanographic activities of the federal government. This was eventually scaled down into a more modest National Oceanographic and Atmospheric Administration within the Department of Commerce, which left behind a number of ocean-oriented activities in agencies where they had always been. Again the central initiative was

for R&D to advance what was seen as a new and important practical social goal, although in this instance the practical potential was probably exaggerated even more than in the case of the space program.

In this connection it is worth observing that an R&D program, especially if massive, can be quite attractive politically because it appears less threatening to contending economic and political interests than would be a more operational program or a change in government policies toward particular parts of the private sector or the federal bureaucracy. Thus an R&D program, particularly a large-scale one that produces lots of sophisticated hardware, can be a politically useful surrogate for more policy-oriented action. Demonstration programs in particular can often be mounted with much less political opposition than full-scale policy initiatives.

Smaller-scale examples of congressionally mandated technological initiatives to solve social problems can be cited in the legislation to create a solar-energy research institute and a solar-heating and -cooling demonstration program, or in "Project Breakthrough" in the Department of Health, Education, and Welfare, which was intended to show the way to the large-scale application of industrial construction techniques to the building of low-cost housing,[15] or in various urban mass-transportation demonstration projects such as the abortive Morgantown, West Virginia, demonstration of personalized rapid transit.[16] In fact one can point to very few instances in which such federally conceived and financed demonstration projects have resulted in the large-scale commercial application of the technology or technique being demonstrated.[17]

The history of biomedical research is, of course, an illustration of the same phenomenon, in which "wars" on various kinds of diseases have played a prominent part. Although these wars usually remained under the fairly close control of scientific strategists, they occasionally burst into the political arena, most recently in the case of the national cancer program, in which the politicians threatened to take over control, not only of the grand strategy, but of the tactics of research as well. These biomedical "wars" also illustrate the point I made in regard to research being a useful political substitute for more direct action. Indeed the biomedical research program for years enabled the Congress to satisfy the public that it was doing something about health without its having to address the knotty problem of national health insurance or the reorganization of the national health-care delivery system, which would have trodden on the toes of vested interests that a disease-centered R&D program could avoid. But, of course, the failure to address delivery problems probably guaranteed eventual public disillusionment with the results of research, even though in terms of developed curative technology this research was a spectacular success. Thus it is that more than ten years after spectacular success in achieving cheap and reliable vaccines for polio and rubella, a large fraction of the population is not immunized, and public-health officials fear renewed outbreaks of these diseases with their socially costly aftereffects.

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Another example of a different kind, which equally illustrates the readiness of the political system to repose almost infinite faith in the powers of science and technology under suitable direction, was the attempt to legislate specific environmental standards, for example in the Clean Air Amendments of 1970.[18] The legislation of specific emission standards was predicated on the belief that the auto companies could develop the technology to meet almost any standards if the penalties for failure to do so were made severe enough. As a matter of fact, the technical success achieved came closer to meeting congressional expectations than most experts would have predicted at the time the law was passed, and, paradoxically, this may have further contributed to the loss of public credibility of experts.

In many ways the National Environmental Policy Act, with its section 102 mandating environmental impact statements,[19] may be regarded as a different manifestation of congressional faith in "rational analysis of social problems," an expectation that questions of environmental decision-making could be settled by a careful marshaling of all the scientific facts. Similarly, the creation of the Office of Technology Assessment (OTA)[20] seems to have been motivated largely by a belief that Congress was not getting the benefit of existing scientific knowledge and capabilities. Critics of technology have expressed disappointment that OTA appears to have adopted a pro-technology stance, and has fostered the belief that many social problems of concern to the Congress and the public could be addressed by better direction of the nation's scientific and technological resources, rather than by limitations on technology or by redistribution of political and economic power.

What does one make of all this? In most of the examples I have cited, the political action taken can be regarded as basically friendly to science and technology. The problem, in fact, was an excess of friendliness that was not always appreciated by the technical community, a bear hug that threatened ultimately to choke off the real sources of innovation and to cause science to expend its intellectual capital on immediate

problem-solving without replenishing the bank of knowledge. At least that was the way many scientists viewed the situation, especially in biomedical research. It may be too early to assess the total effects of all these developments dispassionately. In the case of energy and cancer the new efforts have not yet been called on to deliver on the ostensible promises made in their name. In biomedical research as a whole, the program has suffered a severe setback in order to secure the funding for the "targeted," i.e. politically directed, research of the national cancer program. On the other hand, the scientific community, including the basic research community, remained more influential than originally anticipated in the preparation of the national cancer plan, and science, although it did suffer, did not suffer to the degree that many feared when the legislation was passed.

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THE *HUBRIS* OF SCIENTISTS

In most of the political wars on social problems many scientists have been willing to become the allies of the politicians in developing the battle plans. In some cases this was sincerely motivated; in others there was probably an unconscious motivation in that the scientists advising legislators would be likely to benefit in their own research if the programs were funded. This was probably as true in the case of environmental legislation and other legislation requiring extensive impact analysis as it was in the case of large-scale development projects. In most cases the promises made, though sincere, were probably exaggerated, based in turn on exaggerated confidence in the base of knowledge that was available to plan an applied research program with a reasonable prospect of success, or to provide a definitive evaluation of the impact of a proposed government program. This was especially true in several of the social programs, although in fairness one must say that scientific strategies often became heavily distorted by the time they emerged from the political process.[21]

In the early 1960's basic science and what might be called pure technology—technology for its own sake such as the Apollo project—were seen as automatic engines of national and regional economic growth. The political fright created by the Soviet Sputnik in 1957 resulted in widespread belief in a science gap *vis à vis* the Soviet Union, which was not restricted to space technology but was believed to extend across the whole broad front of science. In all candor, scientists themselves did little to discourage this belief in a comprehensive lag in basic science and science education, since it served the interests of the academic scientific community. The basic-science community rode high in political popularity for a period, aided by a rising public demand for higher education, particularly graduate education. This demand was partly demographic in origin, resulting from the post war "baby boom," but also from faith in science and rationality. During this period, however, there is little question that basic research and graduate education were oversold to the public and the Congress, and that the resulting reaction has been more severe than it might otherwise have been. The science community was sorely tempted by its political friends, and it succumbed in some measure to the temptation, probably to the long-range detriment of science as an institution.

The post-war history of science can be viewed as a series of periods in which different scientific disciplines rose to favor and then gradually faded from the center of the stage. The emergence of each discipline was the outgrowth of an earlier breakthrough related to that discipline that had a large public impact. Thus, for the first decade after World War II, nuclear physics may be said to have been riding high on the achievements of radar and the Manhattan Project. With the invention of the transistor and the growth of solid-state electronics in the 1950's, solid-state physics emerged as the most popular discipline, resulting in the creation of the university materials laboratories in the 1960's. By the mid-60's the success of the RAND Corporation in the development of strategic doctrine for the Air Force brought mathematical economics and systems analysis to the center of the stage, and physicists were pushed into the background. The claims of the economists and systems analysts reached their peak when the Johnson administration decided to introduce Planning–Programming–Budgeting (known as PPB) into the whole governmental budgetary process, and at the same time similar techniques became very popular in industry.[22] With the rise of the environmental movement in the late 1960's, the biologists came into their own, particularly the ecologists, who replaced the physicists and systems analysts as the darlings of the politicians. Their political friends in Congress pushed their own biological Manhattan Project in the form of the International Biological program (IBP),[23] and ecologists were in great demand for environmental impact statements, even while there was considerable public confusion about what an ecologist really was.

Of course I have oversimplified, and I have left out many important groups, such as the computer experts, the aeronautical engineers, the control theorists, and many others who enjoyed moments of

glory. Each of these groups to some extent tended to see the whole world through the colored glasses of its own specialty and to try to impose the particular intellectual pattern of its discipline on a wider slice of reality than subsequently proved viable. In each case, too, the relatively modest claims of the originators of a new intellectual technique tended to escalate in the hands of their disciples and followers, with each intellectual generation becoming increasingly doctrinaire until the discordance between their doctrines and reality began to erode their influence.

In the meanwhile, also, the promoters of specific technological solutions to the nation's problems continue to be active. It is not so much that the solutions they promote are wrong or infeasible as that they are promised as just around the corner if only the government will pump sufficient money into their implementation on a short time scale. If the solution is adopted and funded on a major scale its ultimate success becomes elusive as the cost estimates escalate and the time of the first large-scale demonstration is repeatedly postponed. In the energy field we have seen this with nuclear power itself, with the controlled-fusion program, with the fast breeder reactor, and most recently with laser fusion and laser isotope separation. Even in the field of private industry we have witnessed a series of overblown hopes or claims followed by retrenchment; the videotelephone, for example, or cable TV and the "wired city," or management information systems implemented on computers, or the du Pont synthetic, "Corfam."

The fault does not lie entirely with the *hubris* of scientists; the media tend to convert every partial technical success into a full-scale development that is just around the corner, and every basic scientific discovery is tortured and twisted to tease out the possibility of some far-fetched application. For every fiasco or postponement of a major project there are, of course, many successes —the minicomputer, the polio and measles vaccines, the three-way catalyst for the control of auto emissions, the geostationary communications satellite. But smooth and orderly achievement within targeted cost and time goals tends to be soon forgotten in comparison with broken or deferred promises. The cumulative impact of many disappointments steadily erodes the layperson's faith in science and technology, and it is in this sense that I assert that in the long run science probably has more to fear from its friends than from its enemies.

During the years when the great government technological agencies, such as AEC, NASA, and DOD, were in the saddle, their arrogant behavior toward critics and their propensity for secretiveness, or at least the appearance of secretiveness, were also a source of loss of public confidence in science and technology. The former Atomic Energy Commission was a particular offender in this regard, especially in matters having to do with fallout from weapon tests in the 1950's and in matters of reactor safety in more recent years. Although the AEC might legitimately defend itself by saying that few of the facts "revealed" by its critics were actually unavailable in published reports, these were often not very accessible, and many facts about reactor safety came to public attention only gradually and with the appearance of great reluctance on the part of AEC officials. This impression of lack of candor on the part of many government technological agencies and officials again added fuel to the fires of disillusionment on the part of the public, and especially of the news media, a disillusionment often fostered by scientific critics outside the agencies involved.

SCIENTISTS AS JUDGES AND ADVOCATES

To an increasing degree, as public issues of high technical content, such as nuclear safety or the ABM, have emerged into the public arena for debate, Congress and government decision makers have turned to scientific groups or individuals either to legitimize decisions already made or to pronounce in an objective manner on the technical judgments and interpretations underlying a public dispute. The 1970 Clean Air Amendments called on the EPA to contract with the National Academy of Sciences to advise on whether mandated automobile-emission standards were feasible on the timetable written into the bill.[24] At one time there were more than fifty pieces of legislation in the Congress that called for some kind of National Academy study aimed at resolving an issue under dispute. Scientists are continually asked to testify before one Congressional committee after another on some issue involving scientific information. Thus, paradoxically, at a time when the public is alleged to be disillusioned with science, politicians are calling on scientists for advice on an ever-expanding range of issues. Although this phenomenon runs counter to the usual conventional wisdom about public disenchantment with science, it is also fraught with future dangers for the scientific community.

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It is characteristic of the kinds of issues on which politicians seek scientific advice that they are "mixed," that is, they involve both a technical and a political or value-judgment element. Furthermore, even on the

technical side, the evidence needed to reach definitive conclusions is seldom all in. Rather scientists are being asked to give their best professional judgment in the face of a high degree of technical uncertainty. Yet this judgment may become the basis of important legislation affecting major economic interests, or the health and welfare of large numbers of people, or both. The pressure of politicians on scientists is great to give them the answers they want to hear, especially in situations where the existing evidence may admit a wide range of possible interpretations or public-policy implications. The biggest problem, of course, is that in this situation experts are certain to testify on both sides of highly visible public issues, and as they do so the myth of the objectivity of science is seriously eroded.[25] This is true not only for the cases in which technical uncertainty makes differences of professional opinion legitimate, but also in cases where the evidence is clearer. The decision maker finds it hard to distinguish between degrees of technical uncertainty and becomes disenchanted with all forms of expert advice. This problem is exacerbated when the policy prescriptions pointed to by scientific interpretations are obviously influenced by the institutional or professional interests of the organization or profession from which the scientific witness comes. In most cases these professional biases may be entirely sincere and unconscious, but the hearer who starts from a belief that science can give unequivocal answers to his questions soon becomes skeptical of the motives of the conflicting scientific advocates that appear before him.

Yet the scientist who tries to be cautious and not go beyond the existing evidence in his policy recommendations finds himself the target of impatient criticism by politicians and news media that want definitive answers because some decision has to be made. Such critics are unsympathetic to the scientist's retreat behind scientific objectivity, and refer contemptuously to "two-handed scientists" who cannot make up their minds. Thus, neither the political activist nor the cautious scientist helps improve the image of science in the political arena.

Basic research and graduate education were oversold to the public and the Congress, and the resulting reaction has been more severe than it might otherwise have been.

Some scholars concerned with the situation I have described have begun to advocate a much more formalized scientific judgment system for public issues, a system in which a rigorous effort is made to separate scientific issues from political or value issues, much as the courts attempt to distinguish fact from law. Arthur Kantrowitz has been an especially persistent advocate of this on many occasions, believing it essential to restoring the public credibility of science and scientists.[26] Several political scientists, commenting on the current science advisory scene, have advocated an adversary process for resolving public issues involving science.[27] Surprisingly enough, in the congressional-hearing process the advocates and opponents of different positions seldom confront each other directly or have the opportunity to cross examine each other on the scientific issues. Rather they appear at different times, leaving to the congressional staff or the news media the task of sorting out of conflicting technical views. Thus in fact the procedures advocated by Kantrowitz and others have seldom been tried. Although I am skeptical of the degree to which value questions and scientific questions can be separated in the kinds of science-related decisions that reach high public visibility, I feel there is a great need for institutional experimentation in this area, much more than has so far been done.

REFERENCES

1. H. Brooks, Harv. Bus. Rev. *50*:3, 110 (1972).
2. Cf. articles by B.J. Bok and L.E. Jerome in The Humanist, September-October 1975.
3. J.A. Moore, Daedalus *103*:3, 173 (1974).
4. Science *190*, 1073 (1976).
5. Science *187*, 1176 (1975).
6. T. Roszak, Daedalus *103*:3, 17 (1974).
7. B. Glass, Science *171*, 23 (1971).
8. C.B. Commoner, Saturday Rev. *53*, 50 (1970).
9. E.F. Schumacher, *Small Is Beautiful: Economics As If People Mattered* (Perennial Press: Harper & Row, New York, 1973).
10. G. Holton, Daedalus *103*:3, 65 (1974).
11. R. Nisbet, New York Times Mag., September 28, 1975.
12. J. Ben-David, *On the Traditional Morality of Science*. Newsletter 13 of the Program on Public Conceptions of Science. (Harvard University Press, Cambridge, Mass., 1975), pp. 24-36.
13. R.R. Nelson, Policy Sciences *5*, 375 (1974).
14. Science *74*, 386 (1971).
15. *A Report of Operation Breakthrough.* Technical Panel, Advisory Committee to Department of Housing and Urban Development. (National Academy of Sciences-National Academy of Engineering, Washington, 1974).
16. R. Lindsey, *Mass-Transit Woes Bring Aerospace Down to Earth*, New York Times, April 21, 1974; C.B. Burck, Fortune *92*, 104 (1975).
17. G. Eads and R.R. Nelson, Public Policy *19*, 427 (1971).
18. J. Steinbruner and H. Jacoby, *Clearing the Air* (Ballinger, Cambridge, Mass., 1974), pp. 29-33.
19. F.R. Anderson and R.H. Daniels, *NEPA in the Courts* (Johns Hopkins University Press, Baltimore, 1973).
20. U.S. Congress. House. *Technology Assessment Act of 1972*. (Report No. 92-1436. 92:2.) Washington, U.S. Government Printing Office, 1972.
21. D.P. Moynihan, *Maximum Feasible Misunderstanding: Community Action in the War on Poverty* (Free Press, New York, 1969).
22. *Program Budgeting: Program Analysis and the Federal Budget*, D. Novick, ed. (Harvard University Press, Cambridge, Mass., 1965).
23. D. Nelkin, Hastings Cent. Rep. *6*, 38 (1976).
24. *Report by the Committee on Motor Vehicle Emissions*. (National Academy of Sciences-National Research Council, Washington, 1973.)
25. H. Brooks, Proc. Amer. Philos. Soc. *119*, 257, (1975).
26. A. Kantrowitz, Amer. Scientist *63*, 505 (1975).
27. A. Mazur, Minerva *2*, 243 (1973).