correlation reported here ($r = -.75$) and those reported by Remmers *et al.* [(*6*), $r = +.266$] and Elliot [(*7*), $r = +.239$] may be due to the procedure by which they obtained their objective measure. Although the examinations were objectively scored in their studies, the instructors had prior knowledge of the test questions. In addition, the grading of lecture and laboratory notebooks by individual instructors introduced a subjective and nonuniform element into the objective measure of the amount learned. In any case, these authors did not obtain a significant positive correlation between the two variables. The confidence intervals (as roughly estimated from their data) about their correlations would include negative values. In fact, although the result reported here contradicts the conclusions commonly drawn from Remmers *et al.* and from Elliot, it is not necessarily inconsistent with the data they obtained.

The explanation for the negative correlation between the amount learned from an instructor and the students' evaluation of his teaching performance is not obvious. Perhaps students do not wish so much to maximize the amount learned as to reach an equitable compromise between the effort involved in learning and the perceived importance of what is being learned. Or, in short, perhaps students resent instructors who force them to work too hard and to learn more than they wish. It may be that as students learn more, they become better able to detect the weaknesses of their instructors. Many other hypotheses could be advanced, but it seems fruitless to speculate without further evidence. Similarly, information about the extent to which the present results may be generalized to different types of courses must await future experimentation.

A correlation in the vicinity of .7 accounts for about one-half of the variance in student evaluation of their teachers. What accounts for the residual variance? There is evidence that student evaluations, to a large extent, tend to reflect the personal and social qualities of an instructor, "who he is" rather than "what he does" (*8*).

How should good teaching be measured? The major defense for defining good teaching in terms of good scores on the student evaluation forms is based on an analogy between the student and the consumer—the student, as the primary consumer of the teaching product, is in the best position to evaluate its worth. However, the present data indicate that students are less than perfect judges of teaching effectiveness if the latter is measured by how much they have learned. If how much students learn is considered to be a major component of good teaching, it must be concluded that good teaching is not validly measured by student evaluations in their current form.

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Public Interest Science

The governmental and public advisory activities of scientists have great political impact.

Frank von Hippel and Joel Primack

Although scientists as technical experts make important contributions to the federal policy-making process for technology, that process remains basically political. At present, the primary recipient of technical advice on matters of public policy is the executive branch of the federal government. To the extent that this arrangement results in an informed executive branch dealing with a relatively uninformed Congress and public, a corresponding shift in power occurs. Indeed, it is not unheard of for the executive branch to abuse its near monopoly of politically relevant technical information and expertise. We cite below several case studies exemplifying the sorts of abuses that occur: politicization of advisory committees; suppression and misrepresentation of information, and analyses.

This leads us to the question of whether individual scientists can contribute significantly to a restoration of a balance of power between the public, Congress, and the executive branch of the government. We find, again on the basis of case studies, that a few scientists can be surprisingly effective in influencing federal policies for technology if they are sufficiently persistent and skillful and if various other circumstances are favorable. These success stories and the present high level of concern about the adverse side effects of technology among both scientists and the public suggest that the time is propitious for a much more serious commitment within the scientific community to "public interest science."

This article is divided into two main sections. The first deals with devices by which the executive branch exploits its scientific advisers for political advantage while concealing much of the information they have provided; the second discusses ways in which scientists

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can help bring into being counterbalancing political forces by providing the public and Congress with the information they need.

For brevity we refer below to scientists advising officials in the executive branch of the government as insiders and scientists taking issues to the public and Congress as outsiders. Of course the same scientist can and sometimes does find himself in both these roles at different times.

Abuses of the Executive Advisory System

Many thousands of scientists serve part-time on committees advising officials in the executive branch. It appears, however, that, if substantial political and bureaucratic interests are at stake, the dangers these insiders point out are often ignored. This is not surprising; it is one reason why our government was designed with checks and balances. These checks and balances are undermined, however, when executive spokesmen can use the authority of inside advisers to mislead the public and Congress about the technical facts or uncertainties that must be taken into account in the policy-making process.

Thus, for example, William Magruder, director of the supersonic transport (SST) development project, appeared before a congressional committee to allay fears about the SST sonic boom, airport noise, and stratospheric pollution. Magruder summarized the Administration's views on these issues as follows (*1*):

> According to existing data and available evidence there is no evidence of likelihood that SST operations will cause significant adverse effects on our atmosphere or our environment. That is the considered opinion of the scientific authorities who have counseled the government on these matters over the past five years.

Compare the above with the following quotations from the report of a panel of President Nixon's SST ad hoc review committee (*2, 3*) which included in its distinguished membership the President's science adviser. [The report was released 8 months after its completion, as a result of strenuous effort by Representative Henry Reuss (D–Wis.)]. Regarding the effect of the SST on the upper atmosphere, the panel noted that a fleet of SST's "will introduce large quantities of water vapor into the stratosphere," and concluded that much more research was needed before serious deleterious effects could be excluded. With regard to the impact of the SST sonic boom on the human environment, the panel concluded

> . . . all available information indicates that the effects of the sonic boom are such as to be considered intolerable by a very high percentage of people affected.

Finally, as to the impact of the SST engine noise, they stated

> . . . over large areas surrounding SST airports . . . a very high percentage of the exposed population would find the noise intolerable and the apparent cause of a wide variety of adverse effects.

In its adverse statements on the SST's environmental impact, the ad hoc committee report echoed many other reports available to the Nixon administration (*4*). Thus Magruder's statement is extremely misleading. Similar misrepresentations of scientific advice have been made by spokesmen for the federal executive branch in virtually all the other cases that we have studied (*5*).

Perhaps the most frequent means by which the public is misled in through the incomplete statement. Typically, an executive branch spokesman tells Congress that agency A, after consulting the greatest authorities, has decided to do X. The spokesman neglects to mention, however, that the experts have given mostly reasons why X might be a dangerous policy. The public cannot check what the experts actually said, because the reports are kept secret. Of course, Congress can ask several well-known scientists to appear before it and offer their views on the matters at issue in congressional hearings, but this is no substitute for requiring an executive branch agency to make available for public review and criticism the detailed technical basis for its decisions.

Examples of Abuses

There is a whole spectrum of devices by which the federal executive's advisory establishment has been used to mislead Congress and the public. Perhaps a few additional examples will indicate the possibilities:

1) In the final throes of the SST debate, an advisory committee report was released which stated that, with noise suppressors, the SST airport noise could be reduced to tolerable levels (*6, 7*). No report was issued on what these changes would do to the SST performance, however. Every indication is that the noise suppressors, whose weight was of the same order of magnitude as the total payload of the aircraft, would seriously threaten the already questionable economic viability of the aircraft (*7*). Thus, government officials can selectively make public advisory committee reports that present only some of the positive terms in a cost-benefit calculation.

2) A report on sonic boom effects by an advisory panel organized by the National Academy of Sciences–National Research Council (*8*), was so written that, when it was released, it stimulated a *New York Times* headline (*9*), "Sonic Boom Damage Called 'Very Small.'" In fact, simple calculations based on extensive government tests results lead to the estimate that, with 400 SST's flying supersonically over the United States, the sonic boom damage each year would be of the order of a billion dollars (*10*). What the advisory committee had meant to say was that the probability is small that a single sonic boom would damage a particular building, and therefore that experiments on sonic boom damage should be carried out in a laboratory with a sonic boom simulator. When a clarifying statement was eventually issued, after a petition from Academy members, it appeared only in the Academy newsletter and received no press coverage.

Thus advisory committee reports may be so written that they are seriously misleading, at least to the press. Political and institutional pressures may prevent the issuance of a proper clarification, or the press may ignore it.

3) In 1966 a report by an independent laboratory under contract to the Department of Health, Education, and Welfare indicated that 2,4,5-T (2,4,5-trichlorophenoxyacetic acid), a popular weed and brush killer, causes birth defects. This report was repeatedly sent back for "further study" for 3½ years (*11*) until it finally became public as an indirect result of a Nader investigation (*12*, p. 21). In the meantime, enormous quantities of this chemical were used in the defoliation of about one-eighth of the area of South Vietnam (*12*, p. 85; *13*).

It may give an idea of the amount of bureaucratic foot-dragging involved in this case to note that, when one of the chemical manufacturers suggested that an impurity, not 2,4,5-T itself, might have caused the birth defects, the experiments that had taken 3½ years to complete were repeated in about 6 weeks. Both 2,4,5-T and the contaminant were found to produce birth defects (*11*). When these results became public, the use of 2,4,5-T in Vietnam was banned, its domestic use was partially restricted, and further restrictions are now being debated (*11*).

The studies relating to the question of whether pesticides cause birth defects were undertaken partly in response to the public furor caused by Carson's *Silent Spring* (*14*). Nevertheless, even while the public was being assured that the government had undertaken to protect it from such possible dangers, the government was concealing relevant new information. Thus, when the government has exclusive access to certain information about a public health hazard, it can simply ignore it.

4) In October 1969, Secretary of Health, Education, and Welfare Finch was forced by law to ban foods containing cyclamates because cyclamates had been shown to cause cancer in animals. At the same time, he decided to overrule protests from the Food and Drug Administration and allow manufacturers of these products to continue to sell them as nonprescription drugs for the treatment of diabetes and obesity (*15, 16*). After announcing his decision, he called together an advisory committee which reported back that, indeed, Secretary Finch was right in overruling the FDA medical people. The committee concluded (*15*, p. 86):

> . . . the medical benefits in these instances [treatment of diabetes and obesity] outweigh the possibility of harm.

After the publication of a Nader study report on the background of Finch's decision (*17*), its legality was examined in a rather devastating congressional investigation. The advisory committee was then called together again, and, although it had received essentially no new evidence, it issued a new report on the safety and effectiveness of cyclamates. This time the committee contradicated its earlier statement by saying (*16*, p. 13):

> The literature provided to the group does *not* contain acceptable evidence that cyclamates have been demonstrated to be efficacious in the treatment and control of diabetes or obesity. [Italics ours]

Cyclamates were thereupon totally banned. In this example it appears that an advisory committee became so political that it adapted its advice to the political needs of the official whom it was advising.

Correcting the Record

It is natural to ask whether insiders cannot do something to curb these abuses. In fact, advisers have tried to set the record straight in a number of recent cases:

Richard Garwin, a member of the President's Science Advisory Committee, was chairman of a committee of scientists reviewing the SST project for President Nixon at the beginning of his presidency. Although his committee's report was kept secret its existence was not, and Garwin was invited to testify at Congressional hearings (*4*). In his testimony he expressed his personal criticisms of the SST, documenting them from publicly available sources.

Garwin explained his actions in the following words (*18*):

> I'm not a full-time member of the administration, and I feel like a lawyer who has many clients. The fact that he deals with one doesn't prevent him from dealing with another so long as he doesn't use the information he obtains from the first in dealing with the second. Since there are so few people familiar with these programs, it is important for me to give to Congress, as well as the administration, the benefit of my experience.

Kenneth Pitzer was chairman of a President's Science Advisory Committee panel charged with looking into the safety of underground testing of large nuclear weapons in November 1968. The panel concluded that there was a significant danger of earthquakes and resulting tidal waves being triggered by bomb testing in the Aleutians. They also commented (*19*):

> . . . the panel believes that the public should not be asked to accept risks resulting from purely internal government decisions if, without endangering national security, the information can be made public and decisions can be reached after public discussions.

The report expressing the panel's concerns was kept secret. Pitzer, however, helped make these concerns public (*20*).

Sidney Drell and Marvin Goldberger served on a committee advising John Foster, Director of Defense Research and Engineering, on the effectiveness of the Safeguard ABM system. When Foster misrepresented their committee's report as supporting the Administration position, they spoke up to set the record straight (*21*). Goldberger expressed their opinion of Safeguard rather pungently. He said

> . . . I assert that the original Safeguard deployment and the proposed expanded deployment is spherically senseless. It makes no sense no matter how you look at it.

Unfortunately, these examples appear to be the exceptions. It seems that advisers usually watch in silence when they know that the public is being misled. The authors of the National Academy of Sciences sonic boom study mentioned above, and also academy officials, actually resisted the issuing of a clarifying statement.

Two main reasons are given for this silence: (i) Most advisers have very little faith in the effectiveness of speaking out, and they fear that by going public they would lose their inside influence. (ii) There is also the argument that, since the President is elected by all the people, he has the ultimate responsibility for making national policy. In its extreme form, this "elected dictatorship" theory of government leaves the adviser with only the responsibility to see that the President and the officials in his administration are well informed.

The loss of effectiveness argument emphasizes the serious dilemma in which a frustrated inside adviser may be placed as a result of the executive branch's insistence upon loyalty and confidentiality. However, insiders should beware of exaggerating their supposed effectiveness, and of confusing prestige with influence.

The elected dictatorship argument obviously denies the whole system of checks and balances by which our democracy has been safeguarded. It also ignores the fact that the ultimate responsibility in a democracy resides with the individual citizen, and that denying him the information he needs to defend his own health and welfare effectively deprives him of the rights of citizenship. The writers of our constitution understood this very well. James Madison said (*22*):

> Knowledge will forever govern ignorance. And a people who mean to be their own governors must arm themselves with the power knowledge gives. A popular government without popular information or the means of acquiring it is but the prologue to a farce or tragedy, or perhaps both.

It is obvious that the responsibilities of government science advisers should be discussed widely, both within the scientific community and in the larger political community. Lack of such discussion leaves scientists unprepared when they become advisers and find themselves confronted with difficult and unfamiliar decisions—often in an atmosphere of great pressure. Science advising, no less than scientific research, needs a code of ethics. And this code should take into account the fact that we live in a democracy in which the ultimate responsibility resides not with the President, or even with the government as a whole, but with the individual citizen.

Before going on, let us try to rectify the misunderstandings that may have resulted from the discussion so far. We do not wish by our criticisms of the abuses of the executive science advisory system to diminish or obscure the many important and legitimate functions inside advisers perform (*23*). Their roles as independent critics and connoisseurs of technical policies and people are essential throughout the executive branch. The executive advising system also provides a tremendously important path by which information and ideas can flow rapidly through the government, and between governmental and independent scientists, outside the slow bureaucratic filter. Indeed, in our opinion it has been a serious weakness of the most recent administrations that they have failed to exploit adequately these potential strengths of the advisory system.

Public Interest Science

The executive branch of our government has not been acting in an unbiased manner in making available to the citizen the technical information he needs. Scientists must therefore make their expertise directly available to the public and Congress.

The idea that the public, as well as the government and industry, should have scientific advisers is an old one—as is the idea that the interests of the public should have lawyers to defend them. It was not until the 1960's, however, that public understanding of the insensitivity of governmental and industrial bureaucracies led to a substantial commitment in the legal profession to public interest law. It appears to us that the scientific community may now have reached a similar point. The growing public awareness of the dangerous consequences of leaving the exploitation of technology under the effective control of special industrial and governmental interests has led to a readiness within the scientific community to undertake a serious commitment to what we have termed "public interest science."

There is an important difference between the practice of public interest law and public interest science, however. In a legal dispute, once both parties have obtained a lawyer, they can hope to obtain a fair and equal hearing in front of a trained judge who gives their arguments his undivided attention, whereas in a public debate over an application of technology tremendous inequalities exist. The contending sides must speak to a distracted public through news media to which executive officials have comparatively easy and routine access. Moreover, an executive official speaks with the authority of his office, while an independent scientist is usually an unknown quantity to the public.

In view of these inequalities, it is interesting to find out whether the public interest activities of independent scientists can activate political and legal restraints on irresponsible actions of the executive branch. In working on this question, we have thus far examined the effectiveness of outsiders in informing the public about the negative aspects of the SST, the decision to deploy the Sentinal and Safeguard antiballistic missile systems, the program of crop destruction and defoliation in South Vietnam, and the regulation of pesticides. We have also studied the effectiveness of a local group of scientists, the Colorado Committee for Environmental Information, in bringing to public attention in 1968 through 1970 the dangerous practices of two federal agencies in Colorado.

Examples

In all these instances, the outsiders have had a surprisingly large effect, considering their small numbers, in bringing to public attention an aspect of the issue that concerned them. Consider a few examples:

1) Serious public opposition to the SST developed only after a few scientists, notably Shurcliff, made dramatically clear in press releases and advertisements that the sonic booms created by a fleet of SST's flying supersonically overland would be intolerable (*4*).

2) The residents of the Denver area did not realize that they might have a problem until scientists of the Colorado Committee for Environmental Information (CCEI) issued a public statement describing the possible consequences of an airplane crashing into the huge stockpiles of nerve gas stored near the end of Denver's busy airport. After trying in vain to reassure the public, and then to transport the nerve gas across the country to dump it in the ocean, the Army finally agreed to destroy it (*24*).

3) The U.S. program of defoliation and crop destruction in South Vietnam came to an end when a group of scientists sponsored by the AAAS brought back photographs and a detailed report of the devastation that resulted (*25*).

4) The deployment of an ABM system to defend the major cities of the United States became a public issue only after scientists in the Chicago area and elsewhere raised what most experts considered a minor issue—the possibility of the accidental detonation of an ABM (antiballistic missile) warhead in the metropolitan area it was supposed to be defending (*26*).

Of course, we could equally easily compile a list of cases in which public protests by scientists have had little effect on federal policy. Most technical issues cannot be taken directly to the public because there is little public resonance with the ideas involved. That does not decrease the importance of the issues that can be taken to the public, however.

The effectiveness of outsiders in influencing government policy seems to depend on many factors. For one, where outsiders have been influential, the dangers they pointed out usually threatened huge numbers of people personally. Their effectiveness seems also to have depended upon how important the policy being criticized was to the government. Consider the obsolete nerve gas, for example; leaving it at such a dangerous location was simple negligence that could be rectified by spending a little money when it became clear that reassuring statements would no longer suffice. On the ABM, SST, and pesticide regulation issues, however, the critics were attacking policies that governed the allocation of billions of dollars. Over these issues the battles have been rough and prolonged and have required the active involvement of large numbers of citizens in addition to scientists.

The effectiveness of the outsiders also often depends upon the timeliness of an issue. Thus, after Shurcliff and a few others had been denouncing the SST for years, the new environmental movement came to see it as a symbol of all that is destructive to the environment. Similarly, the ABM became a popular issue in part because the public had become concerned about the insatiable appetites of the military-industrial complex. And, after a few biologists and ecologists had been protesting for years about defoliation and crop destruction in South Vietnam, they were finally heard when the public had become disgusted with the United States' entire Indochina policy.

Our case studies give substantial encouragement that some issues can be taken to the public by scientists with partial success at least. It is not easy, however. Enormous persistence and skill are required, as well as a good and timely case, to be heard above the din that accompanies everyday living in this country.

Credibility

It is also necessary for the scientist to establish credibility—that is, that he is not a "crackpot." Credibility has sometimes come from the quotation of government reports that contradict the official line. It has come from preparing a compelling and well-documented case from the open literature, as Carson did in her criticism of pesticide regulation (*14*). It has come from a study sponsored by a scientific organization: an example is the AAAS study of the effects of defoliation in Vietnam (*25*).

Yet another technique for handling the credibility problem was applied quite effectively by CCEI (*24*). In two of the debates in which it became involved the CCEI publicly challenged the responsible government agency to establish the basis for its assertions. The Colorado group accompanied the challenge with a specific list of technical questions, the answers to which would make possible an independent determination of public safety. Finally, credibility–and also publicity—can be obtained if one can persuade Ralph Nader to take up the issue. The extent to which we all depend on Nader in these matters is a testimonial to the timidity of the professional societies, universities, and national laboratories.

The scientist's public credibility must, of course, be earned. A specialist who uses his authority as a recognized scientist to lend support to a political position without presenting the technical arguments casts doubt both on his political position and on his scientific authority. The standards of accuracy to which a scientist adheres in public statements should be no lower than those he strives to attain in his scientific work. It is also necessary for the scientist to maintain a sense of perspective; it is all too easy to exaggerate the significance of a subject on which a critic happens to be an expert. The danger of crying wolf is not merely that the next time a justified alarm may be ignored; it may also happen that the false alarm will be heeded and the nation stampeded toward a foolish or unnecessarily hasty action. Obviously, the proper ethics for outsider science advising deserves discussion within the scientific community no less than the ethics of insiders.

During and after each of the major technological debates of recent years there have been charges that scientists who participated as outsiders were politically biased and scientifically irresponsible (*27*). While there have certainly been a few instances that substantiate such charges, the vast majority of independent scientists who have argued technological issues before the public have been honest and accurate. A scientist's reputation is his most precious possession, and the scientist who misrepresents the truth or makes unsound technical judgments calls down upon himself the censure of his colleagues. In any event, technical arguments presented in public can be rebutted in public, in the usual self-correcting manner of scientific discourse. Indeed, it is unfortunate that the statements of executive branch officials are not subject to similar constraints. Apparently, the standing of these officials depends more on their loyalty than on the accuracy of their public statements.

As we have mentioned, the route of taking issues to the public is very important but also quite limited; many issues cannot be so treated. Other routes are available, however. Sometimes recourse to the courts is possible. Recent developments in the law, particularly the National Environmental Policy Act of 1969, make this approach increasingly effective. Taking advantage of the protection offered by the law requires more than public interest lawyers, however. It requires public interest scientists as well. The collaboration of scientists and lawyers in the Environmental Defense Fund is one notable example; another is the current collaboration between the M.I.T.-based Union of Concerned Scientists and a number of the leading environmental organizations in a legal challenge to the Atomic Energy Commission to establish an adequate basis for evaluating the safety systems of nuclear reactors (*28*).

Organization and Funding

Thus far there has been little funding for public interest science. Almost all who are involved do it as an unremunerative sideline. Perhaps this is good. Only recently the scientific community delegated its public responsibilities mostly to the insiders. As governmental regulatory agencies have repeatedly demonstrated, responsibility cannot be successfully delegated—it can only be shared. Large numbers of part-time outsiders are required to keep the system honest.

More than part-time people are required, however. The coordination of the efforts of part-time people and the lobbying to see that the issues they raise get a fair hearing rapidly become a full-time job. This is the function, for example, of Jeremy Stone, executive director of the Federation of American Scientists (*29*). Under Stone's leadership the FAS has been instrumental in establishing a new tradition of open adversary hearings before the House and Senate Armed Services Committees and in providing technically competent witnesses before many other congressional committees.

Examples of full-time public interest scientists are few and far between. Ralph Lapp could be identified as such a person. Like Ralph Nader, he supports his activities by writing and lecturing on the issues with which he is currently concerned. A number of academics seem also to have become nearly full-time public interest scientists. Universities have the advantage of having undergraduate and graduate students who are willing to commit great amounts of energy and idealism to a project (*30*), although, as Ralph Nader has shown, such students will go where the action is even if it is not at a university.

Foundations are beginning to show an interest in funding public interest science projects, and the federal and state governments may begin funding them in earnest if the field becomes more respectable—like public interest law. Nevertheness, it is doubtful that direct government funding will provide the kind of political insulation appropriate to some public interest science. Responsibility for some funding should be closer to the scientific community itself. Scientific societies could do some of it. Another possibility would be for universities and other research contractors to devote part of their overhead on research contracts to a fund for public interest science controlled by the scientists at the institution. This is in effect how law firms and medical doctors support their pro bono activities.

One need only look at the student-funded Public Interest Research Groups in Minnesota and Oregon (*31*) to see how varied the possible sources of support for public interest science are. The more diverse the sources of support, the more securely established public interest science will become as one of the responsibilities of the scientific community.

Summary

We have described some of the abuses that develop when policy for technology is made behind closed doors in the executive branch of the federal government. And we have tried to demonstrate that public interest science is no more quixotic than public interest law.

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21. *ABM, MIRV, SALT, and the Nuclear Arms Race*, Hearings before the Subcommittee on Arms Control, International Law, and Organization of the Senate Committee on Foreign Relations, 91st Congress, 2nd Session, March–June, 1970. Foster's citation of the committee report appears on pp. 442–444; rebuttals by Drell and Goldberger appear on pp. 525–580. Senator Fulbright was finally able to obtain a declassified version of the report and inserted it in the *Congressional Record* along with his comments on pp. S12901 ff., 6 August 1970.
22. James Madison, letter to W. T. Barry, 4 August 1822. We thank Paul Fisher, director of the Freedom of Information Center, University of Missouri, for providing us with this reference.
23. The functions of the advisory system have been widely discussed; see, for example, T. E. Cronin and S. D. Greenberg, Eds., *The Presidential Advisory System* (Harper & Row, New York, 1969). The essay by H. Brooks, reprinted in this volume, is especially useful.
24. A short case study of the effectiveness of the Colorado Committee in this and two other cases may be found in (*5*).
25. P. Boffey, *Science* **171**, 43 (1971).
26. A. H. Cahn, *Eggheads and Warheads: Scientists and the ABM*, thesis, Massachusetts Institute of Technology (1971).
27. A recent, well-publicized example of such an attack is the Operations Research Society of America report criticizing congressional testimony of several scientists against the Safeguard ABM system. [ORSA Ad Hoc Committee on Professional Standards, *Operations Res.* **19** (5), 1123 ff. (1971)]. The first part of the ORSA report purports to be a statement of ethics for operations analysts, but it provides little ethical guidance beyond urging loyalty to one's employer under almost all circumstances. The report's attack on the anti-ABM scientists focuses upon a very narrow technical issue, from the analysis of which the report then draws a broad and unjustifiable condemnation of the ABM critics. (For detailed criticism of the ORSA report, see statements of numerous technical experts collected and reprinted in the *Congressional Record*, pp. S1921–51, S2612–13, S3521–23 (17 and 29 February; 7 March 1972); and P. Doty, *Minerva*, in press.
28. R. Gillette, *Science* **176**, 492 (1972).
29. The Federation of American Scientists, 203 C Street, NE, Washington, D.C., is the only registered lobby of scientists. FAS has been traditionally interested in issues associated with nuclear weapons, but recently it has provided testimony before Congress on many other technological issues.
30. A good example of such a university-based program is the Stanford Workshops on Political and Social Issues. More than a hundred "workshop"-courses for academic credit at Stanford University have been sponsored by SWOPSI during its 3 years of existence, and these have produced more than a dozen comprehensive and authoritative reports on subjects like "Air pollution in the San Francisco Bay area," "Balanced transportation planning for suburban and academic communities," "Logging in urban counties," and "DOD-sponsored research at Stanford." Several of these reports have had considerable political impact [for SWOPSI's address see (*5*)].
31. For a discussion of the manner in which such groups can be organized, see R. Nader and D. Ross, *Action for a Change—A Student's Manual for Public Interest Organizing* (Grossman, New York, 1971).