Secrecy and Dissemination in Science and Technology

A report of the Committee on Science in the Promotion of Human Welfare

Previous discussions of the conditions essential to the very existence of science have stressed the negative effects of secrecy and security regulations. The position that secrecy is always detrimental derives from the definition of science as a unique social process which has a built-in mechanism of self-correction operating by means of the criticism of scientists' work by knowledgeable peers. The process of discovery is not complete until the knowledge of all peers has been brought to bear on the new assertions and no flaws have been found in the light of present knowledge (*1*).

We agree with this definition of science. But we take the position that science and technology should not be viewed in isolation, without regard for the claims of other parts of the social system, as do those members of the scientific community who believe that there are no circumstances in which restriction is legitimate (*2*).

It seems preferable to consider a range from full secrecy, when an item is known only to one person (a circumstance with which discussions of secrecy generally are not concerned, but which overlaps with privacy), to the full dissemination of scientific information to the widest possible audience, for example, through the mass media. In any specific case, the degree of secrecy can then be measured by the limitation on access to particular information. In moving along the scale from complete secrecy to the widest possible dissemination, it is necessary to consider the different mechanisms of communication and regulation.

This report was prepared at the request of the AAAS Board of Directors. During its preparation from October 1966 to November 1968, the following were members of the committee: Margaret Mead (chairman), American Museum of Natural History; Robert McC. Adams, Oriental Institute Museum, University of Chicago; Richard H. Bolt, Bolt Beranek and Newman, Inc.; James D. Ebert, Carnegie Institution of Washington; Martin Meyerson, State University of New York at Buffalo; Walter Modell, Cornell University Medical College; Robert S. Morison, Cornell University; Hudson Hoagland, (Board liaison representative), Worcester Foundation for Experimental Biology; William T. Kabisch, AAAS staff representative; Dael Wolfle (ex officio), AAAS executive officer; and Cynthia B. Snow, research and administrative assistant.

Effect of Secrecy on Research

We have had to recognize that there is very little available evidence for the assertion that scientific research cannot flourish under conditions of censorship and secrecy. The case most frequently cited is that of Nazi Germany where, however, it was not secrecy so much as the ill-conceived and inhumane nature of the experiments which made German science self-defeating (*3*). And although Soviet scientific progress has been uneven, achievements since World War II leave no doubt that a high level of scientific work can be attained in spite of restrictions on communication which Americans would consider intolerable.

A search of the literature and interviews with individuals who have been concerned with the problem have turned up very little evidence indicating deleterious effects of secrecy on basic research (*4*). A request by this committee for case studies, published in *Science* (*5*), produced very little material.

Indeed, some of those who did respond to our inquiry argued that, in a research and development establishment of the size characteristic of defense-connected enterprises in the United States, conditions exist in which there can be wide discussion with peers and adequate although classified publication, so that there is, in fact, no real impairment of any given scientific venture. This may well be so. But this argument ignores those persons outside security who work in the same fields, or in adjacent or apparently unrelated fields, who are cut off from information and who therefore can make no critical contribution. Kantrowitz, in his "Proposal for an institution for scientific judgment" (*6*), points out the great importance of criticism which is untouched by the passionate bias involved in a scientist's pursuit of his own hypothesis and by the partisan bias of scientists who are working in the same area. The widest possible evaluation, including that which comes from groups working within different national and cultural traditions as well as that originating in other fields of science, is necessary for the full functioning of the self-corrective and cumulative processes essential to the scientific enterprise. Provision for interchange within a restricted group, even a diversified one, can only partially meet these requirements.

Those who argue that limited dissemination is adequate also disregard the integral relationship of science and technology to a wide variety of social, economic, and political decisions, as well as the necessity of informing those who are concerned with governmental decision-making and with the exercise of fiscal authority over research and the uses of new knowledge. The report, "The integrity of science" (*1*), discusses in detail how the secrecy provisions connected with proposed large-scale experiments in space prevented—at least initially—both the dissemination of adequate advance information to other scientists and the carrying out of adequate pilot experiments (*7*). The case histories of projects Starfish and West Ford exemplify the difficulties facing scientific groups whose deliberations are bound by secrecy, when they are asked to advise on large-scale governmental actions which are undertaken for political or military rather than scientific reasons.

There are also other undesirable consequences of secrecy requirements. The involvement of the federal government in scientific research may lead to overextensions of authority in the regulation of research beyond the limitations set for reasons of national defense. Such extensions of authority may be either lateral or vertical.

Lateral overextension may occur when research which is essentially irrelevant to national defense needs is financed by defense budgets and when grants are awarded, as in Project Themis

(8), to encourage universities to become involved in, or contribute to, defense-related research. Research institutions originally set up to meet narrow, precisely defined defense needs tend in time to expand to include other research activities which would be carried out more appropriately by other agencies not concerned with considerations of national security (9). We recommend, therefore, that institutions organized to serve the needs of national defense do not expand their spheres of operations. Instead, a plurality of agencies should be maintained to support the different types of research which are funded through the federal government.

Vertical extension occurs when a federal agency imposes its regulative powers on state, local, and nongovernmental institutions. The regulations originally proposed by the Atomic Energy Commission in May 1967, and in revised form in December 1967 (10), exemplify this type of extension. The purpose of these regulations is to provide a mechanism for controlling the dissemination of information about developments in atomic energy, which comes within the definition of "restricted data" even when that information is developed privately, without contact with or support from government sources. The proposal originated in a concern that dissemination of information in certain areas of atomic energy research would weaken the efforts to prevent the proliferation of nuclear weapons. If this action is allowed to set a precedent, it will severely damage the necessary core processes of science in the United States (11).

Contrasts of Secrecy in Science and in Technology

In our discussions we have found it useful to distinguish between science and technology in terms of their principal aims. Science is that part of the scientific estate in which the central aim is the search for truth. In technology, in contrast, the central aim is the translation of scientific findings into usable products, such as a new material for constructing faster planes, a fertilizer that will double the size of a crop, or a drug that will cure a disease. It follows that institutions designed to facilitate the search for truth also differ in certain respects from those designed to facilitate the development of new technology. Recognition of this contrast opens the way to a resolution of the vexing problem of secrecy as it affects the training of students in graduate schools, on the one hand, and in professional schools, on the other.

Pure research, or basic science, is historically the province of the scholar, who is self-selected and self-propelling in following his individual choices and is relatively impervious to sanctions other than the approval or disapproval of his peers—scholars like himself who are knowledgeable in the same fields. We believe that students coming into graduate schools should be trained to embody the traditional values and loyalties of scholar-scientists. In order to accomplish this, the university setting must be as free as possible from the kinds of impediments that are imposed by industrial competition and government security controls.

However, students who enter graduate training in any applied field—whether it is one that involves technology proper or the application of science to problems related to political, social, or economic systems—become not only scholar-scientists, but also professionals, that is, practitioners such as lawyers, doctors, engineers, systems analysts, and political advisers. In the course of their training they must learn the canons of their particular profession: absolute secrecy where patents and industrial advantage are concerned; discretion in diplomatic matters where secrecy is essential during preliminary negotiations so that the negotiators are free to change their minds; security in matters of defense; confidentiality toward clients and patients; and loyalty to employing institutions where institutional aims are at stake.

By making such distinctions between education for scientific scholarship and training for professions, we can more readily deal with the anomaly presented by contradictions in the claims made by different university departments or faculties. For example, departments devoted to pure science may reject, in the name of academic freedom, any involvement with an outside institution that requires secrecy. However, in one and the same university, a department or school of engineering or business or part of the medical school may insist that academic freedom includes the right to engage in contractual research in which participants must comply with the kinds of restraints to which their academic colleagues object. It is doubtful whether the phrase "academic freedom" should be applied to both cases (12).

Matters of Privacy

In considering scientific research and professional responsibility, it is necessary to take into account not only matters of secrecy but also matters of privacy. For example, the scientist who works with human subjects in any way is bound by the ethical requirements of the particular locus of his research, including the kind of community from which his subjects are drawn, the canons of legitimate experimentation, and the protection of his subjects from unacceptable pressures of public opinion, the law, and so on. Where pure research necessitates the keeping of detailed records which are available to a group of knowledgeable peers, the protection of the privacy of individuals and communities requires that adequate precautions be taken against the wider dissemination of such identification. In many forms of medical and social research this may mean publication only in esoteric journals, the restriction of papers to small or closed scientific meetings, the careful disguise—or the sacrifice of full specification—of subjects, and the full protection of basic data over time.

At the same time it is essential to break down certain associations between secrecy and privacy that are common in contemporary thinking. For example, it is popularly assumed that anything one is asked to regard as "private" is, *ipso facto*, disgraceful, and that secrecy is necessary primarily to protect the individual from the exposure of some aspect of his life which is disreputable. In the minds of an uninformed public, objections to the use of lie detectors on job applicants have been extended to the use of any form of psychological testing to screen applicants for jobs or children for class placement. Further, public agencies respond to political pressures arising from adverse publicity, especially publicity about scandals relating to experiments and research on the young, the indigent, the institutionalized, and members of minority groups. This may lead to the introduction of crippling restrictions on research involving human subjects. In fact, respect for the dignity and safety of human subjects not only is entirely compatible with, but is also essential to, good research in which trust between experimenter and subject is a necessary condition (13).

Privacy is also necessary for the protection of the early stages of pure research in situations in which the highly competitive nature of modern science makes the research worker wary of premature disclosure (*14*). The demand for priority publication often results in the publication of uneven and incomplete work. If the scientific community would demand that publication be withheld until the work was more complete and elegant, this would encourage and protect the right to secrecy, that is, to privacy, during the early development of a research lead.

It is also possible that secrecy which is connected with competition among research groups—whether they are working within nations divided by hostilities, in parallel industries, or in the research institutes of different universities—may lead to productive excursions into research which would not have been undertaken had the work of rival institutions been known. Phantom rivalry, that is, the unverifiable attribution of some research direction to a competitor whose actual work is protected by the walls of secrecy, may advance rather than impede discovery.

Dissemination of Findings

There are other impediments to the process of the effective criticism essential to science besides the restrictions formulated in the name of security or privacy. In today's multinational scientific community, very few discoveries are submitted to all those scientists sufficiently knowledgeable to criticize the findings and even fewer reach those peers in more distantly related fields whose research would benefit by the findings. These failures can be attributed most immediately to the sudden, massive increase in the size of the scientific community, of scientific societies, and of scientific meetings. They must also be attributed to the plethora of published material in combination with the inadequacy of available methods of classification, search, and retrieval; contrasts between the resources of rich and poor societies; and the number of modern societies which are separated by barriers of language, culture, and ideology. In consequence, increasingly arbitrary choices must be made by program committees, translation services, editors of scientific journals, and publishers of scientific books.

Positive steps are necessary to overcome these impediments so as to assure that the cumulative and self-critical processes of science function more effectively. We need to review the present system of publication, distribution, and translation. The development of sophisticated retrieval methods, designed to take into account the culturally patterned capacities of different users, is one answer to the problem of full dissemination (*15*). At present, the coexistence of institutions, many of which overlap or duplicate each other in their research interests, seems to be the best available protection against communication failures.

There is also another block to the adequate dissemination of scientific knowledge which is related to the explosive growth of science, information, and the world population. This is the fragmentation of science into such narrow specialties that the essential interaction among adjacent disciplines is made exceedingly difficult. There is an urgent need for the further exploration and development of methods of cross-disciplinary, cross-national, and cross-ideological communication (*16*).

Institutions which fund research can also make positive contributions. The complex mechanisms governing awards of fellowships and grants by funding agencies and program emphases of foundations play a conspicuous part in determining whether the scientific process is facilitated or impeded. These in stitutions can discourage faddishness in research directions. They can encourage work within unfashionable and neglected research areas and emphasize interdisciplinary research (*17*).

Summary

It is clear that in the contemporary world there are, and will be, frequent demands for secrecy in the handling of research in connection with national defense, national economic self-interest, industrial competition, the need to protect politically sensitive planning and negotiation, and the need to provide privacy during the early stages of work by scientists and research groups. Whenever restrictions on the dissemination of information are put into effect, there will be delays in the communication of research findings, in the operation of the self-corrective scientific process, and in the initiation of steps that lead to further discoveries.

In the short run, the question of whether such restrictions are bearable or even useful or whether, on the contrary, they impose intolerable burdens and limitations on scientific research is one which must be balanced against the needs of the whole society. In the same way social priorities must be weighed when research involves decisions about the allocation of scarce resources or limited manpower. And it must be recognized that, in the long run, any decision which harms or hampers science will be detrimental to society. When restrictions on disclosure interfere with the core scientific process, the price is paid not by the scientific community alone but by the whole society.

In the United States, safety for the scientific enterprise depends on the full functioning of our political and social system—the effective working of mutual checks and balances that operate between different parts and different levels of government, the recognition and the regulation of economic competition, and the support of a plurality of public and private institutions in which different scientific and technological tasks are carried out. At present there is a trend toward a disproportionate concentration of power and authority in response to almost unmanageable complexity. In our view it is not secrecy as such that threatens the integrity of the scientific process, but excessive and inappropriate uses of secrecy which are the outcome of the present overconcentration of power.

Protective measures against the extension of regulations limiting disclosure are necessary, but they are not enough. It is equally essential to develop methods of dissemination and critical appraisal appropriate to the exponential growth of science and technology. Our task is to define, protect, and institutionalize the processes of science and technology so that they will contribute to the well-being of the whole of mankind.

References and Notes

1. This is substantially the position taken in the 1954 statement by the AAAS Board of Directors on "Strengthening the basis of national security," *Science* **120**, 957 (1954); by this committee 4 years ago in "The integrity of science," *Amer. Sci.* **53**, 174 (1965); and by the participants in session I, "Science and Secrecy," of the symposium on Secrecy, Privacy, and Public Information, AAAS, *Program of the 134th Annual Meeting*, p. 51 (1967). This symposium was co-sponsored by this committee and the Scientists' Institute for Public Information and arranged with the assistance of the Institute's associate director, Robert E. Light, to provide background for this report. The following papers from this symposium have been published: O. Ruebhausen, *Record of the Assoc. of the Bar of the City of N.Y.* **23** (1968); B. Com-

moner, *Scientist and Citizen* **9**, 173 (1967); and C. C. Gordon, *ibid.*, in press.
2. In writing this report, we have kept in mind the known relationships between science and society, including the scientific practices of the U.S.S.R., mainland China, and the emerging nations which are now striving to develop their participation in scientific research. See *Soviet Science*, R. C. Christman, Ed. (AAAS, Washington, D.C., 1952); W. Hirsch, *Social Forces* **40**, 15 (1961); *Sciences in Communist China*, S. H. Gould, Ed. (AAAS, Washington, D.C., 1961), W. S. Dillon, in *Encyclopedia Americana* (Americana Corp., New York, 1968) vol. 1, p. 302; and ———, *J. Mod. Afr. Stud.* **4**, 98 (1966).
Developments in any of these scientific communities can have rapid repercussions even in those countries which are ideologically divergent, and all statements containing an element of generality must be made with the expectation that they may be translated into Russian, Chinese, or Indonesian, that they may be discussed at Pugwash-Coswa conferences, and that they may form the basis for intramural battles in different bureaucracies over policies of support and application of science and technology. We are also aware that we are speaking of the United States at a particular time and in the light of specific circumstances, all of which are relevant: the conflicts over the conduct of the war in Vietnam; the changing relationships between federal spending, scientific research, and the development of technology; the spreading student revolts; the crisis in American scientific education, particularly at the graduate level; and the struggle to adjust an increasingly productive and automated economy to meet the recently accentuated needs of the submerged portions of our population.
3. W. Hirsch, *Social Forces* **40**, 15 (1961); G. L. Mosse, Ed., *Nazi Culture: Intellectual, Cultural and Social Life in the Third Reich* (Grosset & Dunlap, New York, 1966); S. Goudsmit, *Alsos* (Schuman, New York, 1947); D. Irving, *The German Atomic Bomb* (Simon and Schuster, New York, 1968); articles by E. Rabinowitch, W. Heisenberg, and H. Suess, *Bull. At. Sci.* **24**, 32 (June 1968); W. R. Harris, *Tyranny on Trial: The Evidence at Nuremberg* (Southern Methodist Univ. Press, Dallas, 1954), pp. 423–435; L. E. Simon, *German Research in World War II* (Wiley, New York, 1947).
4. The most detailed work dealing with the problems of science and secrecy must be mentioned: W. Gellhorn, *Security, Loyalty, and Science* (Cornell Univ. Press, Ithaca, N.Y., 1950).
5. See News in Brief, *Science* **155**, 679 (1967).
6. A. Kantrowitz, *ibid.* **156**, 763 (1967).
7. Shortly after the discovery of the Van Allen belts—atomic particles which surround the earth and are held in place by the earth's magnetic field—the United States conducted three high-altitude nuclear explosions to study the effects on radio communication. The chief motivation was concern with the disruption of military communication. When these tests were announced (6 months *after* they had occurred) and when a new series was announced, scientists and, particularly, radio astronomers voiced their concern with the way the experiments were being conducted; much of the information about the experiments was secret. When the "Starfish" explosion took place in July 1962 it caused damage to some satellites and generated a long-lived belt of atomic particles which interferes with observations of natural radiation belts. The proper conduct of the Starfish experiments would have allowed for collection of information about the natural radiation belts and open discussion of the potential effects of the nuclear explosions.
A second example is Project West Ford in which pertinent information about a proposed experiment in space was only gradually released for review by the scientific community as a whole. The U.S. Army Signal Corps wanted to study the possibility of establishing orbits of fine copper wires (dipoles) around the earth to provide an invulnerable communications system. A first attempt to orbit the dipoles was canceled on the advice of a scientific advisory committee because of the lack of sufficient safeguards. It was agreed that a small, temporary orbit of dipoles would be established to provide a chance for scientists to study the effects on astronomical observation. However, when the first experimental shot was made, sufficient safeguards against malfunction were not made, and it was only a mechanical failure that prevented the establishment of a long, rather than short-lived, orbit of dipoles. Finally, in 1963, a belt was established in a short-lived orbit to provide a chance for observations and firmer conclusions on the possible effects of a larger scale belt on future astronomical research.
8. L. J. Carter, *Science* **155**, 548 (1967); E. Langer, *ibid.* **156**, 48 (1967). Project Themis is designed to provide funds for program research in universities not receiving large amounts of federal financing. According to Donald M. MacArthur, deputy director of the Directorate of Defense Research and Engineering, Project Themis will help to develop centers of excellence "capable of improved assistance to the Department of Defense in the years ahead." The university will receive 100 percent of the cost of the program during the first year, 67 percent the second, and 33 percent the third, thereby forcing the university to gradually assume financial responsibility.
9. See the discussion of the Institute for Defense Analyses, *Science* **160**, 744 (1968).
10. Atomic Energy Commission, *Federal Register* **32**, 6705 and 20868 (1967).
11. H. P. Green, *Bull. At. Sci.* **23**, 15 (October 1967) and **24**, 41 (May 1968); Association of the Bar of the City of New York, Committee on Atomic Energy, *Memorandum on AEC Proposed Regulations* (26 Mar. 1968); S. Novick, personal communication, June 1968: "The principal effect, and presumably the principal intention, of the proposed regulations will be to prevent research by private persons in certain areas without the closest supervision of the AEC. In a sense, the result would be the incorporation into the structure of the AEC of all research in the areas listed in proposed Part 26. This would not necessarily mean the end of such research, even in those areas where the AEC refused to issue dissemination permits, it would simply mean the end of private research. Although, the halting of private gas centrifuge research by private firms has already been accomplished with considerable publicity, this research apparently is continuing under AEC contract and direction.
"The intended result of the regulations, then, is a preemptive government monopoly of research in several areas which, the AEC has made clear, it may add to or extend at any time. At present the categories which have been marked for preemption seem to be reasonably narrowly defined, but since the basis for determining what falls within these categories is classified, it is of course difficult to tell just how widely they extend.
"The prospect of a spreading AEC monopoly of research, whose limits would be defined solely by the Commission according to secret criteria, is disturbing. Research in the private sphere will continue to progress and to develop new possibilities of weapon design and manufacture, as unforeseen or even unwanted consequences of nonmilitary research. The temptation, indeed the pressure, to expand the scope of the AEC's control of research will always be present. The ultimate extent of control of research the AEC claims under these regulations is unforeseeable."
12. The University of Pennsylvania was a case in which both positions on academic freedom were taken. R. J. Rutman, *Sci. World* **11**, 23 (1967); E. Langer, *Science* **155**, 177 (1967); E. S. Herman, R. J. Rutman, J. Wishner, W. Gomberg, *BioScience* **17**, 524 (1967).
In any event the whole question of a university as an autonomous community of scholars is bound to come in for sweeping revisions during the next few years, as we confront the anomaly of an autonomous private institution which derives more than half its funds from state or federal sources, subject to a great variety of pressures from different parts of the society it serves on the one hand, and increasing demand for student participation on the other, with students also linked with groups outside the university.
13. "Ethical Aspects of Environmentation on Human Subjects," *Daedalus*, in press.
14. J. D. Watson, *The Double Helix* (Atheneum, New York, 1968); W. C. Hagstrom, *The Scientific Community* (Basic Books, New York, 1965).
15. M. Mead, in *Information*, in press; R. B. Fuller, *Education Automation: Freeing the Scholar to Return to His Studies* (Southern Illinois Univ. Press, Carbondale, 1963).
16. M. Mead and P. Byers, *The Small Conference: An Innovation in Communication* (Mouton, Paris, 1968); M. Mead and R. Modley, *Natur. Hist.* **77**, 56 (August–September 1968).
17. J. R. Platt, *Science* **154**, 1132 (1966).