National Science Board

Report of the NSB Committee on Openness of Scientific Communication

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National Science Board Resolution re Report of the Task Committee on Openness of Scientific Communication

The National Science Board unanimously accepted the report and recommendations of the NSB Committee on Openness of Scientific Communication as contained in *NSB-88-215,* and requested the Director to report back to the Board on proposed implementation plans at the February 1989 meeting.

December 2, 1988

ACKNOWLEDGEMENTS

We are grateful to the following people who appeared before the Committee as expert witnesses:

Professor William J. Baumol, Department of Economics, New York University and Princeton University

Dr. David Blumenthal, M.D., Senior Vice President, Brigham and Women's Hospital, Boston, MA

Dr. Mark Frankel, Director, Office of Scientific Freedom and Responsibility, American Association for the Advancement of Science, Washington, DC

Dr. John C. Crowley, Vice President, Association of American Universities, Washington, DC

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Mr. Gerald Mossinghoff, President, Pharmaceutical Manufacturers Association, Washington, DC

Professor Dorothy Nelkin, Department of Political Science, Cornell University

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Honorable M. Bruce Smart, Former Assistant Secretary of Commerce

Mr. Tom Wajda, Director, Office of Maritime and Land Transport, Bureau of Economic Affairs, U.S. Department of State, Washington, DC

Dr. Mitchel B. Wallerstein, Associate Executive Director, Office of International Affairs, National Research Council, Washington, DC

A number of the above witnesses also provided constructive reviews of the draft manuscript. We are also indebted to several other knowledgeable individuals who provided thoughtful review comments. These include Dr. John H. Moore, Deputy Director, Mr. Charles H. Herz, General Counsel, and Mr. Leonard L. Lederman, Head of the Special Analytical Studies Section, of the National Science Foundation; Dr. Rosemary Chalk, Study Director for Government-Industry Cooperation in Biomedical Research, Institute of Medicine; and Dr. Deborah Runkle, Senior Program Associate, Office of Scientific Freedom and Responsibility, American Association for the Advancement of Science.

Special thanks are also due Mr. Thomas Ubois, Executive Officer, National Science Board, for his wise advice and counsel and to the staff of the National Science Board Office, especially Ms. Andrea McIntyre, for their helpful assistance. Finally, we acknowledge the insightful editorial advice of Ms. Connie Bart, Office of the President, Cornell University.

OPENNESS OF SCIENTIFIC COMMUNICATION

FUNDAMENTAL PROPOSITION

Our fundamental proposition is that open scientific communication is:

- An indispensable tool for creating verifiable, shared bodies of scientific knowledge;
- A determinant of the rate of scientific and technological progress, which is dependent upon information and data developed by others;
- A necessary condition for efficient and proper use of public and private research funds;
- A primary force in enhancing cultural, social and economic well-being; and
- An ideal consistent with and supportive of the values of an open democratic society.

Exemplary ethical and professional standards and behavior by researchers, research directors, and sponsors are a necessary condition for maintaining openness, for an open system must transmit valid or verifiable information. Conversely, an open system provides incentives for proper ethical behavior and high professional standards.

SOCIAL CONSTRAINTS ON OPENNESS

In principle, all who believe they can benefit from access to information, once produced, ought to be able to get it at the incremental cost of transmission. There are, however, valid reasons for withholding and controlling information and for allowing limits on open dissemination. Such grounds include national security, the conduct of diplomacy, individual privacy, commercialization of intellectual property, and international competitiveness.

In accommodating these diverse interests, we recognize it will sometimes be necessary to make trade-offs between openness and control. What our fundamental proposition means, then, is that maintaining openness generally has a superior social claim over other objectives deriving from economics or national security. Restrictions on openness should be approached as exceptions, rather than norms. Any restrictions government or other institutions impose on the free flow of information must meet high standards of proof of their necessity.

Openness and National Security

During the post World War II era, the application of national security criteria to scientific information has periodically posed a significant strain on the principle of openness. But recognizing that extensive application of security provisions such as those contained in the Export Administration Act would result in significant losses in the production and use of scientific information, and these, in the long run, would translate into security and economic losses, the government has now established general guidelines and policies to maintain openness.

The Commerce Department, with the advice of scientists from universities and industry, has redesigned its general license for technical data available (GTDA) which provides for the export of domestically open scientific and technical information. It has decided that there will be no restrictive changes in how this information is treated. The Department has not yet made the revisions final and published them, however.

The Department of Defense has stated that it will only classify university-based fundamental research in exceptional cases. Current government policy, as stated in National Security Decision Directive 189 (1985), specifies that security classification is the sole means of restricting publication of federally funded, fundamental academic research.

Since science and technology change quickly, disputes over national security relevance are bound to come up again. Settling disputes arising from new interpretations and applications of policy is costly and time-consuming to all parties. Further, bargaining usually leads to some de facto loss of openness.

We believe that the clash between openness and national security concerns has abated for the time being. However, we also believe that actual practice and behavior should be monitored and documented at a high policy level by the cognizant agencies of government. We also believe that the Commerce Department should make its revised rules on domestically available information binding and public.

Information and Industrial Competitiveness

U.S. technical peers frequently appropriate open scientific and technical information produced in the United States. This increases foreign competitiveness in both domestic and international markets in the short run. It imposes a cost on some U.S. industries in profits and employment, although there may, of course, be the offsetting benefits of U.S consumers getting higher quality products at lower cost. At the same time, the United States obtains benefits from appropriating open information produced abroad.

In the long run, scientific and technical information will naturally flow from the more technologically advanced nations to the newly industrializing countries whose technological and economic bases are still emerging. Indeed, in the nineteenth century, the United States was a newly industrializing country, and it depended on capturing and commercializing information produced abroad. On the one hand, information produced in the United States and captured abroad creates new competitors.

On the other, new competitors also represent new markets for goods and services produced in the United States, if the United States exploits these markets effectively.

There is little evidence that the cause of the nation's current trade and productivity problems is the transfer of basic scientific information to rival firms in other nations. Indeed, the United States still remains a strong "first mover" in the introduction of new products and processes. But abroad, larger numbers of capable second movers now exist who are able to compete on price or quality.

Patents, trademark and copyright laws, and other mechanisms to protect intellectual property are essential if American firms are to invest the substantial sums required to transform interesting research results into commercially viable products and processes. But U.S. trade policies that restrict the international flow of basic scientific information, along with commercially relevant technical information, fail to recognize the increasingly international character of scientific information or the growing research capabilities of other nations. In the long run, as the research capabilities of other countries grow, there is more information for the United States to acquire if only it makes the necessary effort. There is no inherent reason why the United States cannot be both a good first mover and a good second mover.

We believe, first, that the United States must work harder to maintain and enhance its domestic capabilities for innovation. We believe, next, that the United States must improve its capabilities for capturing and commercializing information produced abroad. We believe, finally, that appropriate intellectual property laws are essential at home and abroad to protect the development of useful products and services. However, nations benefit most, over the long run, when they all contribute to and share in the exchange of scientific knowledge.

REQUIREMENTS FOR OPEN SCIENTIFIC COMMUNICATION

At least four key elements are required to ensure an open system of scientific communication: an effective publication system, an open academic environment, supportive government policies, and a responsible scientific community.

An Effective Publication System

The publication of scientific journals remains an effective way to disseminate and store information, ensure quality in research, and convey recognition and prestige to individual investigators and research teams. Rising subscription prices, the limited acquisition budgets of many libraries, and substantial prepublication costs incurred by smaller journals are causing strain, however. Some of these problems may be ameliorated through the growth of electronic publishing and communication, but new ones will arise, especially in the areas of quality control, professional recognition, and equality of access.

In view of the growing volume of information being generated both in this country and abroad, the nation also needs more effective ways to translate and disseminate scientific literature from other nations and more authoritative surveys and overviews of research fields and topical areas.

We believe the nation's scientific communication system is meeting most of the purposes for which it was intended. The proliferation of new fields and subfields, the growing importance of foreign research journals, and the implications of electronic publishing technologies must be addressed, however, in order to ensure the future integrity and utility of the system.

An Open Academic Environment

Universities believe that freedom of inquiry, the open exchange of ideas, and relative freedom from external pressures are essential if they are to serve society through open production and verification of knowledge. With substantial research funding now available from defense and corporate sources, universities have balanced their traditional insistence on openness against the proprietary and/or national security concerns of those who sponsor their research.

Academic research has benefitted greatly from Defense Department support for investigations in such important fields as engineering, computer science, and mathematics. Prepublication review, sometimes negotiated with defense sponsors, has so far not led to significant delays or restrictions on open publication. Most institutions, however, decline to carry out classified research or do so through affiliated research institutes, often separated organizationally from regular teaching and research.

Similarly, corporate support of university research has advanced knowledge in biotechnology, materials, microelectronics, and computers without unduly compromising either the interests of sponsoring firms or universities. Many universities have been able to retain the right to open publication of research results while giving corporate sponsors time to file for patent protection. Such arrangements rarely pose a serious threat to the openness of scientific communication because the delays are typically short – often only sixty to ninety days. They also rarely pose a threat to commercialization since the relevent information disclosed in the research publication is typically quite similar to that contained in the patent filings. In the case of industrially supported research, some model agreements already exist that provide reasonable protection for openness, and these can be used as a starting point in individual negotiations. For example, the Government-University-Industry Research Roundtable published a model agreement in 1987.

We believe industrial and military support generally enrich the content of university research and teaching and extend the contributions that academic institutions can make to the rest of society. We also

believe that special care must be taken to preserve the balance between openness and the protection of other legitimate social interests.

Supportive Government Policies

Historically, the Federal Government has made scientific information widely available on the principle that the public should have free and open access to any information produced with its resources except when necessary to protect military secrets, proprietary rights, or individual privacy. The benefits of following this principle have been substantial. Open dissemination of research sponsored by the U.S. Department of Agriculture, the National Aeronautics and Space Administration, and the National Institutes of Health, for example, has been widely credited with the enormous success of American agriculture, commercial aviation, and public health.

The National Science Foundation encourages open communication of the research it supports by providing funds for publication and travel and by requiring special dissemination activities at selected research facilities and centers it supports. Several other federal agencies, including the National Institutes of Health, the Department of Education and the Department of Commerce have succeeded in instituting effective dissemination systems, including automated data bases, although these remain secondary to publication in journals.

A distinction must be made, however, between nonexclusivity in research, which is appropriate and necessary, and the exclusivity necessary for developing new products and processes, which is also appropriate and necessary. Every country strikes a balance between the two through its patent system and its laws on trade secrets and intellectual property. However, the balance can change depending on relative costs and benefits. For example, at one time the Federal Government required that all patentable discoveries funded by federal grants have nonexclusive licenses. Very few companies were then willing to develop the potential drugs, therapeutics, and other products and processes, because their investments in development could not be protected.

During the past three decades, successive administrations have attempted to achieve more private sector commercialization of scientific and technical information produced by the Federal Government. The Patent and Trademark Amendment Act of 1980, the Stevenson-Wydler Technology Act of 1980, and President Reagan's 1983 memorandum extending title rights to most federal contractors all attempt to make commercialization more attractive. In some cases, efforts to commercialize the results of internally generated research, such as that produced in Department of Energy national laboratories, have opened up previously unexploited technologies. However, the Federal Government's attempts to develop and disseminate new technologies for private sector use have generally been less successful than the efforts carried out by the private sector itself.

We believe that current efforts to commercialize research carried out at academic institutions must balance non-exclusive rights to scientific information necessary for intellectual progress, and exclusive rights to information necessary to obtain marketable new products and processes. Federal policies should be sensitive to this distinction.

In addition, we believe that federal efforts to commercialize the results of internally generated research can help bring previously unexploited technologies into public use. However, the Federal Government, in general, is not the most appropriate agent for developing commercial products and processes.

A Responsible Scientific Community

Open scientific communication depends, above all, on the ethical and responsible behavior of the individual scientist. Documented instances of scientific misconduct are relatively rare compared to the size of the research enterprise, although some cases of fraud and misconduct are, no doubt, resolved privately. Nonetheless, recently reported cases raise serious questions about the scientific community's ability to enforce high professional and ethical standards. The community assumes that unethical behavior is an anomaly and that the system is inherently self-correcting. The self-correcting mechanisms may not be strong enough in the face of private incentives and opportunities provided in highly competitive research systems.

Misconduct by university researchers can assume many different forms. In addition to fabrication and falsification, misconduct includes plagiarism, denying or unduly delaying access to scientific data, samples and experimental software and hardware, unwarranted co-authorship, indefinitely withholding publication for reasons of personal or commercial advantage, and ignoring wrong-doing by colleagues. Not in the class of misconduct, but costly to the scientific enterprise, is the habit of running up numbers of publications by fragmenting findings and of rushing to publish every finding, whether significant or not, in some journal.

A principal reason for unethical or improper behavior is the system of incentives and rewards created by the intensely competitive nature of scientific research. The need for prestige, professional advancement and research funding can induce some researchers to misrepresent or manipulate their work for their own advantage. The benefits of a competitive research system seem clear and need to be retained. But universities have latitude to adjust incentives and rewards and some universities now base tenure and promotion decisions more on the quality of a scientist's best work rather than on the total number of publications. For example, Harvard Medical School only considers ten publications in its promotion and tenure decisions to the full professor level.

Some federal agencies, including the National Science Foundation and the National Institutes of Health, require universities to have systems in place for addressing misconduct fairly and effectively and provide for agency intervention in cases which cannot be resolved on an institutional level.

We believe that scientific misconduct represents a serious potential threat to the integrity of science. In the current era of public accountability, even the perception that professional standards of scientific conduct are eroding is unacceptable and must be addressed directly and openly.

RECOMMENDATIONS

With very few exceptions, we assert that the national interest will be served best if the results of research carried out in our universities and publicly sponsored laboratories are made available to all who wish access to them. To this end, we recommend the following:

For the Federal Government

• MONITOR IMPLEMENTATION OF CURRENT POLICY OF GENERAL OPENNESS TOWARD UNIVERSITY-BASED RESEARCH. The government should retain high-level monitoring and oversight procedures to be sure that applications of classification rules and export controls remain consistent with a policy of openness.

• EMPHASIZE GENERIC RESEARCH. Federal sponsorship of research and development should emphasize the production of generic scientific and technical information rather than information likely to be of direct or specific commercial use.

• REVIEW PATENT AND PROPERTY RIGHTS POLICIES AND PRACTICES TO ASSURE OPEN SCIENTIFIC COMMUNICATION. The Federal Government should periodically review its policies and practices on patents and property rights to ensure that they strike a reasonable balance between rapid dissemination of basic knowledge and the exclusivity required for that knowledge to be utilized.

• CARRY OUT A COMPREHENSIVE ASSESSMENT OF THE NATION'S SCIENTIFIC PUBLISHING AND DISSEMINATION SYSTEM. The assessment should cover the impact of electronic publishing systems, including their economics and changes in publication practices. Impacts on openness should receive special attention.

• REQUIRE RECIPROCITY IN ACCESS TO FACILITIES AND CENTERS AND SEEK SYMMETRY IN INTELLECTUAL PROPERTY RIGHTS. Participation in U.S. research centers or consortia should be open to all nations who want to participate on a reciprocal basis. International science agreements should provide the United States rough "quid pro quo" in access to foreign laboratories, facilities, and data bases. Agreements should provide for symmetry and consistency in intellectual property rights as well.

For the National Science Foundation

• PLACE ADDED EMPHASIS ON OPEN SHARING OF INFORMATION BY ALL NSF AWARDEES. NSF expects that significant research conclusions be submitted for publication in an appropriate journal in a timely manner; that authorship truly reflect the contributions of those involved; that, in most cases, primary data, samples and other supporting materials that are the basis for publication be made available upon request. NSF should pay for any data clean-up, documentation, dissemination and storage that may be required.

• ASSESS ACTUAL INFORMATION POLICIES AND PRACTICES. The Director of NSF should carry out an assessment of current information transfer and dissemination practices in all NSF programs and take any corrective measures necessary to satisfy the dual objectives of maximum scientific openness and maximum utilization of research results.

NSF should publicize its interest in receiving rigorous proposals for data and information integration and for scientific evaluation and assessment activities. The agency should provide the resources necessary for this work.

• FURTHER ENCOURAGE INTERNATIONAL EXCHANGE OF SCIENTIFIC INFORMATION. The NSF should support more, longer-term interactions between U.S. scientists and engineers and foreign research institutions and encourage unrestricted travel of American and foreign scholars for professional purposes. It should also facilitate translation and domestic distribution of foreign scientific literature. Parallel efforts should be undertaken by the private sector and other federal agencies.

For Universities

• DESIGN POLICIES FOR MAINTAINING OPENNESS WHEN MILITARY OR CORPORATE SPONSORS ARE INVOLVED. Universities should develop, implement, and disseminate comprehensive policies for dealing with potential restrictions on scientific communication arising from military or industrial support. These should preserve the prime function of the university as a creator and transmitter of knowledge while safeguarding the independence of the faculty and the interests of the students.

• DEVELOP AND PUBLICIZE POLICIES FOR DEALING EFFECTIVELY AND FAIRLY WITH ALLEGED SCIENTIFIC MISCONDUCT. Universities should expand upon the procedures now required by NSF, NIH and other federal agencies to ensure the integrity of all research, regardless of the funding source. The necessity of maintaining the highest standards of scientific integrity should be widely publicized and discussed within the academic community.

Universities, through their various associations, should develop and disseminate guidelines for ethical conduct involved in research and graduate training.

Professional Societies

• DEVELOP AND DISSEMINATE CODES OF ETHICS APPROPRIATE TO EACH DISCIPLINE. Professional societies should continue to develop and disseminate codes of ethics for each discipline. National organizations such as the American Association for the Advancement of Science and the National Academies should assist in developing these codes. The societies should reinforce the codes by intensive educational activities.

Principal Background Materials

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NATIONAL SCIENCE BOARD
WASHINGTON, D.C. 20550

March 4, 1988

MEMORANDUM TO MEMBERS OF THE COMMITTEE ON OPENNESS OF SCIENTIFIC COMMUNICATION

Dr. Rhodes, Chairman
Dr. Duderstadt
Dr. Hess
Dr. Hosler
Dr. Nordtvedt
Dr. Powell

Subject: Appointment and Charge of the Committee on Openness of Scientific Communication

This is to confirm your appointment to the subject committee. Your charge is to consider the issues associated with "Openness of Scientific Communication." You should use the attached background paper as a starting point and framework for your committee's deliberations; you should feel free to develop and modify this charge as necessary. Dr. Harvey A. Averch, Senior Staff Associate, Office of the Director, will serve as Executive Secretary to your committee.

In the course of your work, you are encouraged to consider the use of the following mechanisms: (1) engage outside experts who would serve as consultants to the committees and be full participants in committee work; (2) solicit the views of appropriate individuals in the field, e.g., through committee visitations or hearings; and (3) utilize Foundation resources to provide special analyses and literature compendia. Please concentrate on concrete "deliverables" for full Board consideration and presentation to the Director as guidance for Foundation management.

Your work should begin at the March 1988 meeting of the National Science Board. You should plan to provide brief, interim reports to keep the full Board apprised of your progress. A final report should be submitted to the Board by the time of the November 1988 NSB Meeting.

Roland W. Schmitt
Chairman

Attachment

OPENNESS OF SCIENTIFIC COMMUNICATION

Issue: There is an apparent conflict between the desire to encourage open communication and broad dissemination and sharing of research results, on the one hand, and the desire to withhold results for reasons of competitive advantage or national security, on the other.

Background: There is broad, but not universal, recognition that science flourishes best in an atmosphere of openness where there are no secrets and research results are shared freely and promptly with others. The Foundation has always encouraged prompt publication of results, and in some cases has imposed specific requirements for public access to data produced in the course of NSF-sponsored research.

Recently, two threats to this open approach have arisen. One is external and results from attempts to restrict publication, control attendance at scientific meetings, deny access to research facilities, and otherwise limit the free flow of unclassified scientific and technical information. These attempts have been made in the name of national security and also in the name of industrial competitiveness.

A second threat is internal and results from heightened awareness of commercial opportunities on the part of researchers and research institutions. Some academic investigators, with or without the active participation of their sponsoring institutions, are withholding research data, at least temporarily, in order to exploit a potential commercial competitive advantage.

Questions:

1. What are current NSF policies regarding dissemination of research data? (Staff)
2. What specific instances of direct external restrictions have occurred and what specific effects can be cited? (Staff)
3. Is deliberate withholding of data by researchers a common practice? Does it present a serious problem?
4. How can electronic databases and communication networks best be used to enhance dissemination and exchange of research results? Are there risks involved?
5. What are the risks and benefits of free flow of scientific and technical information?
6. What changes to NSF policies, if any, should be made to encourage more open scientific and technical communication?
7. What national policies concerning open communications are appropriate?

Deliverables: 1) an NSB "White Paper" recommending national policies regarding restrictions on scientific and technical communication; and 2) NSF policies on dissemination of and access to research results.

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

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