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On the Professions

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"Voluntary and Involuntary Secrecy in Science and Technology"

Fay Sawyier, Editor, CSEP, Illinois Institute of Technology

On March 23rd there was a Seminar on "Openness and Secrecy in Science" jointly sponsored by the AAAS and the Center for the Study of Ethics in the Professions (CSEP) and moderated by Dr. Vivian Weil, Senior Research Associate at the Center. The morning session was focussed on the history within science of valuing secrecy as against openness and vice-versa; the afternoon was oriented to First Amendment issues emerging out of governmentally enforced secrecy. For details concerning the seminar, contact either Dr. Weil or Rosemary Chalk of the Committee on Scientific Freedom and Responsibility of the AAAS.

The subjects discussed at this seminar were important and the comments and discussion illuminating. Readers of this issue of PERSPECTIVES will find a range of reflections on the topic, ranging from Pythagorean guardedness about the incommensurability of the diagonal of a square with its sides, to some reassuring data about on-going United States-Soviet relations and exchanges. One additional preliminary observation should be mentioned: commenting on an argument by one of the morning's speakers to the effect that one should examine whether or not secrecy was good for science, the philosopher Arthur Fine observed that when one constructs essentially functionalist arguments (or inquiries) it is wise to bear in mind that there may be other "entities" with whose survival and progress we may properly concern ourselves and that, unlike the celebrated remark about General Motors, what is "good for" science may not be good for the country, let alone good "simpliciter."

Planned upcoming issues of PERSPECTIVES include another one about architects, a "reply" in effect to the last issue, an issue about socializing into the major professions, an issue focussed on some layers of the problems emerging out of medical (or bio-) engineering and an issue concerned with toxic waste disposal. The titles and availabilities of past issues may be obtained by writing to the Editor, and as always your comments and questions are encouraged.

"Secrecy in Pure Science"

John W. Snapper, Assistant Professor of Philosophy, Illinois Institute of Technology

It is a common belief that science ought to be an open, public activity. Creative scientists should publish their theories and discoveries so that all researchers have easy access to new ideas and developments. Popular belief might begrudgingly admit a few exceptions. We may wish, for instance, to keep methods for making bombs secret for the sake of public safety. Some may argue further, though this is more controversial, that national security sometimes justifies secret research. Even more controversially, some argue that business practice justifies trade secrecy. The tendency, however, is to explain away these exceptions as belonging to applied technology. Thus the demand for openness in the theoretic sciences is saved.

I suggest that the high value placed on openness in science ought to be qualified, even beyond those situations mentioned above. I do this by looking at four famous anecdotes concerning secrecy in mathematics. These are chosen in part because they involve important theoretic results in perhaps the "most abstract of the sciences" and cannot be dismissed as simply applied technology. The four anecdotes concern Hippasus, Tartaglia, Newton, and Gauss.

(1) Some version of the Pythagorean theorem, as we

learned it in school, was common knowledge in ancient Greece. The Pythagoreans, however, tried to keep certain consequences secret, including the fact that the length of the diagonal of a square cannot be measured in units used to measure the sides of the square. Legend has it that Hippasus, who divulged the secret, either was executed by drowning or willfully perished at sea rather than let a ship on which the secret was known make a safe port.

(2) The solution by radicals to second degree equations of the form ax2+bx+c=0 is now derived as a lower school exercise. A solution to a third degree equation ax3+bx2+cx+d=0 is, however, much more difficult to derive. In the 15311's Tartaglia found a general solution to a significant class (perhaps all) of these equations. He then showed his solution to Cardano, swearing him to secrecy. Cardano's publication of a solution in 1545 created an acrimonious dispute that remains notorious to this day.

(3) An equally nasty debate broke out between the supporters of Newton and the supporters of Leibniz as to who discovered the infinitesimal calculus in the late 17th century. Regardless of the merits of this silly debate, it is clear that Newton had certain techniques in the 1660's that he did not make public for 40 years. It is often claimed that he withheld the techniques in order to maintain a scientific advantage over (to be able to find new results faster than) other researchers of his time.

(4) In the 1830's John Holyai worked out the principles of hyperbolic geometry. This is the first truly non-Euclidian geometry in the sense that it falsifies Euclid's parallel postulate (that there is only one line parallel to a given line through a given point). This, then, resolved a theoretic problem that had been famous since the time of Euclid. When informed of this result, Gauss applauded Holyai's ingenuity, but admitted that he had known the result since 1792. Gauss had kept the secret, he said, to avoid "the howling of the Boetians." That is (since Hoetian jokes were the ethnic jokes of the time), he wished to avoid the controversy that the new crazy geometries would create among his narrow-minded colleagues.

Although the details of these anecdotes are not historically clear, the stories do tell us something about the tendency of leading mathematicians to withhold important theoretic results. I will now briefly develop these stories in such a way as to justify the secrecy. Although somewhat controversial, these sketches are all historically plausible. I argue that although the apparent reasons for secrecy differ from case to case,yet in each case the need for secrecy may be viewed as following from the nature of mathematical research. These are not cases of aberrant mathematicians holding back results for immoral reasons, but of leading mathematicians working on famous results.

I. Hippasus

The story of Hippasus' death is more legend than history. It is, however, entirely plausible given the nature of Pythagorean mathematics. It is fairly clear that the Pythagoreans withheld their theoretic results. (A small number of commentators doubt this. See Thomas Heath, History of Greek Mathematics, ch. III.) It seems reasonable that the incommensurability of the diagonal would have been kept secret because of its significance to the Pythagorean blend of moral reform, mathematics, and philosophical cosmology. The Pythagoreans had worked out a complex theory of numerical relations and ratios, and developed a theory on which those ratios underlay the structure of the universe. Moreover, the cosmos was seen as built on a geometric basis, with an emphasis on certain elementary shapes such as cubes and pyramids. That the diagonal of a square is incommensurable shows that a basic aspect of an elementary shape cannot be expressed by a recognized numeric relation. This rift between geometry and number theory either destroys the cosmology or becomes a religious mystery. In any event, we can easily see why the result may have became esoteric doctrine studied only by the inner circle of Pythagorean mathematicians.

To modern commentators it may look as if Pythagorean secrecy follows from a confusion of pure mathematics with religious mysticism. Hut the view fails to appreciate the motivation for research in pure mathematics. The Pythagoreans were among the first to do pure, as opposed to applied, mathematics. (There were some applied mathematicians: Archytus, a friend of Plato, is said to have applied Pythagorean methods to pragmatic mechanics. This was viewed by both the Pythagoreans and Plato as an improper turn away from abstract study.) The Pythagoreans arguedthattheoretic proof should be preferred to observational verification. They placed a new emphasis on pure science, of the sort that popular belief now says should be kept open. Since their

study is not simply pragmatic, it became a puzzle why one would be interested in those proofs.

It remains, as always, difficult to explain to a non-mathematician why certain abstract results are significant while others, equally difficult to establish, are of no interest. In antiquity this is explained by the fact that mathematics is part of the philosophical cosmology. The philosophical interest in cosmology justifies both the interest in pure mathematics and the choice of which parts of mathematics are worth pursuing. It turns out that the justification presented here for keeping the incommensurability of the diagonal secret is closely tied to the justification of the whole Pythagorean study into pure mathematics. The secrecy is not abberant, but follows from the nature of the study.

II. Tartaglia

The general outline of Tartaglia's dispute with Cardano is clear. There is no doubt that Tartaglia attempted to keep his solutions secret. (We may question the extent of Cardano's culpability. He may have believed either that he had an independent source for the results, or that he had significantly improved and changed Tartaglia's methods.) To understand the point of Tartaglia's secrecy, we must recognize that in 16th century Italy, even theoretic knowledge without technical application had special professional significance for those privy to it. In 1535, Tartaglia had enhanced his reputation in a mathematical duel in which the contestants, without divulging method, solved cubic equations presented by their opponents. This sort of challenge only makes sense in an intellectual tradition that emphasizes secret knowledge passed on to select students. Although the custom was changing, Tartaglia was responding to a tradition in which a master's reputation depended on the amount of secret information he could pass on.

Later commentators have ridiculed the "ill-bred" Tartaglia (the destitute son of a mailman) for lacking the true spirit of mathematics and selfishly refusing to promote open research. That criticism shows an historical parochialism. Both abstract science and applied technology are now viewed as creative endeavors in which researchers are applauded more for innovation than for mastery of established principles. But in the earlier "guild" tradition, both scholars and technicians were viewed as the preservers of knowledge. Knowledge accumulated, not discovery, was the basis of reputation. In that tradition, Tartaglia's secrecy is reasonable.Still it may be argued that we ought not now be impressed by a misguided tradition of secrecy in 16th century Italy. But from one point of view, Tartaglia's attitude is still relevant. He viewed his results much as we may now consider trade secrets. His attitude follows from a refusal to draw a distinction between pure mathematics which is only of value as knowledge for its own sake and applied mathematics which may be withheld as a trade secret. In this Tartaglia may be right. It is notoriously difficult to maintain a clear distinction between applied and pure research. Tartaglia's attitude demonstrates the fact that we cannot distinguish between pure and applied research by looking at the topic of research but only by looking at how industry views it: it is applied if it is called applied. Although the practice of trade secrecy is itself controversial, Tartaglia's secrecy is no more to be faulted than that practice in general.

III. Newton

Newton's reason for withholding his theory of fluxions is far from clear. He was, in fact, just generally slow to publish. He may simply have been shy and have wished to avoid the controversies that his work would inevitably create. But he did show his work to selected colleagues. (And according to Newton's followers, Leibniz too saw this work.) Any discussion of Newton's motives for withholding the theory of fluxions is highly controversial. I consider, however, two possible motives. (1) As suggested above, he may have wished to maintain an unfair advantage over his uninformed competitors. Or (2) he may have hesitated to publish his work in anything less than final form. We tend to see the first as unscientific selfishness and the second as, at worst, over-timidity. But I suggest that the difference is not all that great. They may both follow from fear that others may pre-empt your work by carrying your preliminary results to completion before you.

Mathematics is highly competitive. And those mathematicians who, as Newton did, keenly feel the competitive pressure are often placed in a quandary: publish partial results and risk letting others carry them to completion before you, or hold back partial results while seeking elegant or important geDeralizations and risk letting others step in to take the credit for that work you have completed. Not long ago, it was common

practice to publish intermediate results in code while doing further work. Then the decoded paper could be used as evidence to establish priority. Since competition in scientific research is so central to present scientific practice, we should recognize this need for secrecy as a part of scientific practice and not a perversion of it.

Newton is said to have been secretive, jealous of his reputation and scientific authority, possessive about his results, incapable of accepting criticism, and unwilling personally to enter into a public debate over intellectual issues. On this view, his failure to publicize the theory of fluxions is symptomatic of a refusal to enter into the spirit of the scientific enterprise. But there is a much more favorable view of the situation. Newton's early work on fluxions is crude, speculative, and certainly begs several scientific questions that were seen as important in the 17th century. We may view Newton as holding back his speculations while seeking an acceptable justification for them. That Newton felt the need for this exercise is clear from his later attempts to provide a justification for the cosmology expressed in his Principia. Even in published form, Newton's theory of fluxions now seems sloppy (and certainly differed from Leibniz's calculus). We should then praise Newton's attempts to clear up the foundations before publication. My point here is that these two views of Newton's reticence merge into each other. It is then misleading to deplore his reticence without also seeing it as part of good scientific practice.

IV. Gauss

The story of Gauss's secret discovery of hyperbolic geometry is the best documented of the four anecdotes. His early work is recorded in his diaries. And his justification for the secrecy appears in his correspondence with Bolyai's father, a respected mathematician in his own right. On Gauss's assessment, early publication of work on the crazy new geometry would either have been rejected as "non-geometric" or have created a mathematical controversy that would only have detracted from his other research. He may well have been right. As early as the 1730's, Saccheri had described such geometries and then rejected them as absurd. There is some reason to believe that Saccheri formulated his results this way in a sly attempt to present non-Euclidian geometry without arousing the wrath of those "Boetians" that scared off Gauss. But whether Saccheri accepted the non-Euclidian geometry or presented it as part of a reductio ad absurdum, his attitude adds credence to Gauss's fears.

There are many examples of theories rejected as absurd at one time and later accepted as dogma, even in the areas of supposedly undoubtable, provable mathematics. Before the 19th century, for instance, the notion of an infinite number was rejected as absurd, since it entails that a set may have the same number of elements as some of its proper subsets. In the 19th century, however, this property of infinite cardinals became not only the starting point for modern set theory, but definitional of infinite cardinality. Such reversals and the occasional ostracism of those who press radical reversals before the scientific community is ready to accept them, have become a cliche in recent philosophy and history of science. Since Kuhn's studies, reversals have been seen as unavoidable events in the history of science. Although in Kuhn's terminology they are not part of "normal" science, we certainly cannot dismiss them as mistakes or avoidable aberations in the advancement of science. Therefore, although we may be disappointed by Gauss's cowardice, we can understand and perhaps even applaud his foresight to hold back the radical results while he paved the way to their acceptance with his other brilliant work.

I have suggested various reasons for withholding innovative results in mathematics ranging from recognition of their cosmological significance to a political sense of how to present radical results to a conservative community of scholars. These are good reasons, well founded in scientific practice.

Still I do not think we should be overly impressed by these examples. They are more popular anecdote than rigorous argument. And there are excellent arguments that can be presented against them in favor of openness in science. Even Tartaglia must have felt the appeal of openness when he did publish his results not long after Cardano. All the same, the values of openness are not obvious and are too often affirmed complacently and unreflectively. Although openness may be a general value in science, there are also conflicting values that lead to secrecy.

"Buying, Selling and Trading Technology"

Carol Truxal (©1984 IEEE)

The existing system of controls for regulating the flow of militarily sensitive technology out of the West has few defenders. Many observers find the controls-executed or under study by 44 Government groups in at least 10 different departments to be confusing and cumbersome. Sporadic enforcement of the controls has aggravated the confusion: even the U.S. Department of Defense concedes that in the past "spasms of control" have too often taken the place of "consistent, sensible procedures." business millions of dollars a year in export licensing delays-even though the vast majority of all high technology exports are to allies. Furthermore, when controls are applied to technical information as well as products, they can inhibit researchers from publishing papers and conversing with foreigners, stifling the scientific freedoms that help maintain Western leadership in high technology. Information controls may stifle public debate over socio technical problems and conceal official misdoings.

A variety of Government bodies are now working to modify the current system of controls and to draft a policy on technology transfer (see "Needed: a Government-wide policy," p. 62). While this work proceeds and arguments about controls continue to rage, engineers may today encounter these controls in their work and be subject to one or more of the following restraints.

I. Classification authority

Classification is a judgment call, and the call may be challenged. Anyone may request that any classified document be reviewed for possible declassification. Last year about 85 percent of all such reviews resulted in declassification.

In an executive order that became effective in August 1982, President Ronald Reagan made significant changes in the Government's powers of classification. Previously, in deciding whether to declassify a document, the Government had to weigh not only the impact on national security but also potential benefits to economic trade, scientific research, and the public's right to know. Now the Government does not legally have to take those latter benefits into account.

In addition, President Reagan's executive order permits documents to be classified for an indefinite length of time, and it mandates that when there is doubt whether a document should be classified, the document should be safeguarded as if classified until a decision is made (which must occur within 30 days).

The executive order also states that agency heads are now allowed to reclassify information that has been declassified, provided it is done in the interest of national security and the "information may reasonably be recovered." The American Association of University Professors and similar organizations have objected to the executive order, claiming that it will lead to an excess of classification and stifle exchanges among researchers.

In March 1983, the President issued another executive order, which would require that perhaps 125,000 Government employees with access to classified information agree to prepublication review of their manuscripts. The Congress has acted to delay this provision of the executive order until April 1984.

II. Exports of dual-use technology

U.S. companies wishing to export sophisticated commercial products-computers, magnetic tapes, lasers, instruments containing microprocessors, or the like-need export licenses from the U.S. Department of Commerce. The Export Administration Act authorizes the Department to control the export of products and technology that could aid the military advancement of potential U.S. enemies and thus endanger national security. In simple terms, the Commerce Department controls dual-use (that is commercial and military) products and technologies; the Department of State controls arms, munitions, and related technologies.

III. Controls on dual-use information

To violate the Export Administration Act and face up to 10 years in prison or a $250,000 fine, engineers need not cart a computer across a national border: they can simply walk up to a podium at an IEEE conference at which certain foreign nationals are present and begin to speak.

The IEEE, the American Association for the Advancement of Science, and other professional organizations are concerned that the use of export laws to control scientific exchange has a chilling effect on research, particularly because the export laws are vague about what is and is not allowed.

Will some engineers, faced with ambiguous laws, choose simply to avoid certain areas of research or to stop speaking at conferences?

IV. Controls on militray goods and technology

The Commerce Department is not the only body authorized to control high-technology exports. Under the Arms Export Control Act, the State Department is authorized to control the export of arms, munitions, and military technologies, and it does so through the rules known as the International Traffic in Arms Regulations.

Like the Commerce Department, the State Department controls the export of information as well as equipment. "Export" can mean speaking at international conferences, talking with foreign scholars, or conversing with overseas colleagues. Regulations apply to exchanges with all foreigners, not just members of communist countries,and responsibility for knowing when to seek a license rests with the person releasing information.

V. Controls on Defense Department contracts

The DOD is now developing new procedures regarding contracts, conferences, and other information controls under a steering group headed by the Deputy Under Secretary of Defense for Research and Advanced Technology, Edith Martin. In fact, the DOD issued a new policy for university research contracts last fall. The policy stated that before a university signs a contract, the DOD technical sponsors must decide whether the fruits of the research are apt to fall into the limited area of truly sensitive information. If not, the contract will state that researchers must send papers to the DOD for review at the same time they submit them to a journal or conference organizers. If the research is apt to be militarily sensitive and is 6.1 research, the contract will require that a review copy be sent to the DOD 60 days in advance of submission. After reading the review copy, the DOD can advise-but not insist-that the investigator refrain from publication.

VI. Controlling nuclear information

Last April the U.S. Department of Energy (DOE) proposed regulations that would create a new category of controlled information, called Unclassified-Controlled Nuclear information (UCNI). All information that the department designated as UCNI could be shown only to people-such as Government workers, Government contractors, or in some cases people who have received special permission from the DOE-with an established "need to know" to perform their official duties.

What information could be marked UCNI? Documents, correspondence, presentations, telephone conversations, or reports containing "operational information concerning the production, processing, and utilization of nuclear materials," as well as information concerning the design, manufacture, use, or safe-guard of nuclear weapons or components of nuclear weapons could receive the UNCI designation. This might include many thousands of documents now in the open literature; moreover, the proposed regulations appear to give the secretary of energy a free hand in designating any other unclassified nuclear information as UCNI if he so desired.

The DOE received so many objections to the proposed rule that it held three hearings on the topic in the fall and has stated it may redraft the regulations.

VII. Controlling inventions

When George Davida, professor of electrical engineering and computer science at the University of Wisconsin in Milwaukee, filed a patent application in 1977 for an encryption device for computer security that he and a graduate student had invented, he received in the mail not a patent but a secrecy order. The order informed Dr. Davida that he should not discuss or publish any information about his device, or he could face up to two years in prison and a $10,000 fine. Dr. Davida had developed his invention under National Science Foundation funding and without any access to classified material.

Inventors who want their orders rescinded can request reconsideration from the agencies that issued them. If still dissatisfied, the inventor can appeal to the Secretary of Commerce. Inventors may also sue for damages caused by secrecy orders. Litigation can be drawn out, however; only a handful of claims have been settled in the last 40 years. David Pelton Moore, one of the early inventors of a solid rocket propellant, received a secrecy order in 1956. In 1977, a court ruled in his favor on the issue of abandonment and/or forfeiture of his invention. A further suit-claiming unauthorized Government use of his inventiondid not reach trial until 1980. Mr. Moore was then 102

years old.

VIII. Restricting foreign visitors

William Schneider, the under secretary of state for security assistance, science and technology, announced last May that the State Department had begun carefully reviewing visa applications so it could deny entry to foreigners who appeared to be planning to visit the United States to gain strategic technology illegally. In some cases, as an alternative to outright denial of a visa, a foreigner may be allowed to enter the United States if he agrees to restrictions on his activities, such as foregoing visits to certain laboratories, research facilities, or industrial sites. Although the State Department says the new policy is aimed primarily at foreigners intending to visit industrial sites, some academicians are concerned that it will be used to control the visits of scholars.

IX. Voluntary controls

There is no doubt that new visa policies, executive orders, and contractual controls will have a great impact on technical exchanges, but possibly greater still may be the inhibitory effect of the Government's campaigns to publicize the dangers of technology transfer. A Government-wide public-education drive on the technology-transfer problem is in full swing. The Department of Defense is developing a briefing for industry leaders on Soviet acquisition of U.S. Technology. The U.S. Department of Justice has advised all U.S. Attorneys to prosecute vigorously all export-law violators and to seek news-media coverage of the prosecutions to strengthen the program's deterrent effect. The net effect of these efforts is that many companies and engineers are voluntarily controlling the transfer of technology-sometimes in excess of the controls required by law.

Critics of the recent technologycontrol policies-including both academic researchers like Stephen Unger and corporate executives like Robert Schmidt of Control Data Corp., contend that the best way for the United States to counter any Soviet Technological inroads is to encourage a vigorous and open scientific enterprise-that is, to "out-innovate" the USSR.

To probe further for an influential and comprehensive look at U.S. information controls and recommendations for improving them, see "Scientific Communication and National Security," a 1982 report by the Panel on Scientific Communication and National Security, formed by a joint committee of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Information controls of importance to computer and electrical engineers are summarized and recommendations are made in a February 1983 Interim Report of the Massachusetts Institute of Technology Committee on the Changing Nature of Information.

IEEE Spectrum has published articles on industrial and academic views of information controls ("Technology transfer at issue: the academic viewpoint" and "Technology transfer at issue: the industry viewpoint," May 1982, pp. 64 and 69, respectively) and an industry-Government round table on the technology transfer ("The dilemma of technology transfer," September 1982, p. 66). Science has covered these issues thoroughly, including Colin Norman's "The administration Grapples with Export Controls," June 3, 1983, and a June 17, 1983, article entitled "Musical Chairs at OSTP."

Among the professional groups now working on information-control issues are the IEEE Committee on Technology Transfer, the Committee on Academic Freedom and Tenure of the American Association of University Professors, and the Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science. The last-named committee has recently embarked on a project on openness in scientific communication, which will include a series of seminars to be held around the country in 1983.

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"Scientific Freedom, National Security, and the First Amendment[1]"

James R. Ferguson, U.S. Attorney, Chicago

It is now apparent that the

American scientific community is approaching a critical point in its relations with the federal government. Until recently, the conduct of most scientific work in this country proceded on a well-founded assumption that it would remain free from official intrusion or state regulation. Since 1979, however, the federal government has frequently acted in the name of national security to impose restraints on important aspects of the scientific endeavor. Most notably, in an effort to curb the export of "militarily useful" technologies, the Administration has applied the existing set of export controls to domestic scientific symposiums, university research programs, and the presentation of scientific papers.

This effort to restrict the dissemination of applied scientific knowledge has sparked heated debate .. . . The debate has thus far addressed the government's effort to control the export of applied scientific knowledge as a broad question of public policy. It seems likely, however, that the major issues in the controversy will soon be tested under narrower, legal principles in a court of law. If so, the government will almost certainly rely on one of two congressional statutes as authority for its restraints on the transmission of technological knowledge.

One statute, the Arms Export Control Act[2], empowers the State Department to license the export of all military articles listed in the International Traffic in Arms Regulations[3]. As defined by those regulations, the relevant articles consist not only of warmaking devices such as aircraft and explosives but also for "any information" used in the production of military arms. Equally important, the regulations broadly construe the term "export" to include the noncommercial transmission of information in domestic settings such as scientific symposiums.

The other statute is the Export Administration Act of 1979[4], which differs from the arms regulations in two respects. First, it authorizes the Commerce Department to license the export of "dual use" technologies that are subject to both military and civilian applications. Second, it deals principally with the export of technologies to "controlled countries" such as the Soviet Union, Poland, and East Germany. Like the arms regulations, however, the Export Administration Act restricts the domestic release of any information used in the production of commodities having a military value[5]. Furthermore-and again like the arms regulations-the Export Administration Act imposes stiff criminal penalties on those who willfully violate its licensing requirements.

In these statutes Congress has provided considerable authority for governmental restraints on the export of "militarily useful" technologies. This fact alone, however, will not end the legal inquiry in cases where the government has invoked the statutes to restrict the open, domestic communication of applied scientific knowledge. On the contrary, in such a case, a major issue will arise concerning the validity of the legislation under the free-speech clause of the First Amendment.

To resolve this type of issue, the Supreme Court has consistently relied on a well-defined analytical framework designed to determine whether the state's interest in regulation is sufficiently important to justify an abridgment of First Amendment freedoms. In the rest of this article, I will examine the ways in which the Court's mode of analysis can accommodate the difficult First Amendment issues arising from the imposition of restraints on the open, domestic communication of technological knowledge ....

Rejecting the notion that all speech is absolutely immune from official regulation, the Court has determined the degree of protection to be accorded to various categories of expression by looking to the major values that underlie the free-speech guarantee. These values, according to the Court, can be summarized in three propositions. First, the right of free speech advances the citizen's interest in self-fulfillment by enabling him to realize his full potential through the free expression of opinions, beliefs, and ideas. Second, the guarantee of free speech serves an important social function by promoting the widest possible circulation of socially useful information. Finally, the right of free speech is essential to a democratic form of government, for it ensures that all information bearing on various policy issues is fully disseminated to the public.[6,7]

Though the Court has not yet adjudicated the issue, it seems clear that scientific communications contribute to each of these interests and thus warrant as much protection as political tracts, literary works, or any other variety of speech. Indeed, a system of free scientific expression not only enables

scientists to draw on the work of colleagues but also tests the validity of hypotheses against current data and opposing views. In these ways, it promotes the discovery of scientific truth and fosters the intellectual advances that contribute to the collective wisdom.[8]

In the case of technical data, however, more difficult questions arise. For example, does technical information having only military uses warrant the same degree of constitutional protection as political speech or basic scientific knowledge? In all likelihood the Court will answer in the negative, for it has previously held that analogous "lesser" forms of expression do not stand on the same constitutional footing as more traditional varieties of speech . . . . At this point, a crucial issue will arise: given the strong constitutional presumption in favor of free speech, just what burden of proof must the state carry to justify its imposition of restraints on the information? Or, to put it in legalistic terms, what standard of review will the Court apply to the government's stated justification for the challenged restrictions?

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To determine the relevant standard of review, the Court will focus on two broad questions. First, does the government have a possessory interest in the underlying information? If so, the Court will apply a mere "reasonableness" standard to any governmental restraints imposed on government employees in an effort to preserve the secrecy of the data. Thus, for example, in *Snepp v. United States 444 U.S. 507* (1980), a recent case involving a book published by a former CIA agent, the Court broadly upheld the state's power to impose "reasonable restrictions" on the dissemination of governmental information obtained by government employees. In addition, the Court pointedly noted that this general principle applies "even in the absence of an express agreement" between the government and the employee.

In like manner, the Court will probably sustain any reasonable restraints imposed on the

dissemination of information resulting from the government-funded research of private parties ....

On the other hand, if the state attempts to regulate the dissemination of nongovernmental information by private parties, the Court will apply a far more demanding standard of review. In such a case, the weight of the state's burden will be determined by a second line of judicial inquiry focusing on the precise way in which the government has restricted the free-speech right.

On this issue, there are two major possibilities: either the state has imposed a "subsequent punishment"usually in the form of criminal penalties-on individuals who have already published the restricted information, or it has blocked the dissemination of the data by issuing a "prior restraint." In the case of a subsequent punishment, the Court will uphold the action only if the state can demonstrate a "compelling" interest in regulation[9]-a burden of proof that stands as the modern analog of the well-known "clear and present danger" test formulated by Oliver Wendell Holmes.[10] In the case of a prior restraint, the Court will apply an even more demanding standard of review, since the government is seeking to block the timely dissemination of information and ideas. Indeed, on the evidence of the so-called *Pentagon Papers* decision (*New York Times v. United States*) 403 U.S. 713 (1971) the Court will uphold the restraint only if the government can show that a "grave" and "irreparable" harm will almost surely result from publication of the data in question.

"Where Russians and Americans Meet"

James Cracraft, Professor of History, University of Illinois at Chicago

Over the last few years, official U.S.-Soviet relations have deteriorated sharply, which has had an adverse effect on scientific and cultural exchanges between the two countries as well as on trade and tourism. But on further investigation it turns out that the damage has been limited, and that in some respects unofficial U.S.-Soviet relations show signs of improving. This must be welcome news to anyone who deplores the present political stalemate and hopes for a restoration if not expansion of the wider U.S.-Soviet dialogue.

Citizen concern about the continuing arms race is certainly a major factor here. In May 1983, for instance, 26 leading Soviet scholars formed a "Committee for the Defense of Peace and Opposition to the Nuclear Threat" with the purpose of propagating their views within the larger Soviet scientific community and of establishing contact with Western scientific organizations interested in arms control.

Similarly, the Committee on International Security and Arms Control of the National Academy of Sciences in Washington has been conducting twice-yearly discussions of the technical aspects of arms control with a corresponding group from the Soviet Academy of Sciences-most recently in Moscow in the fall of 1983.

The U.S. State Department reports that scientific exchanges conducted under various official U.S.-Soviet agreements dating back to 1972 are currently running at 20 to 25 percent of their 1978-1979 level. Yet this still means that a total of between 300 and 500 U.S. scientists will have gone to the Soviet Union in the academic year 1983-1984, primarily in three- or four-member delegations investigating everything from agriculture to zoology, while some 250 of their Soviet colleagues will have come to the United States. Moreover an agreement to exchange information in the field of housing and other construction was recently renewed, and it is expected that another-between the National Bureau of Standards and the appropriate department of the Soviet Academy of Sciences-will be signed shortly.

In December 1983 a Soviet spacecraft-Cosmos 1514-was launched, carrying three U.S. biomedical experiments in its scientific payload. Also in December a group of Soviet, U.S., European and Japanese scientists met in Japan to discuss ways of jointly studying Halley's Comet over the next three years. The Soviet scientists agreed to take part in all phases of the study, leading a U.S. participant to describe the meeting as "one of the most successful we've ever had with the Soviet Union."

The International Research and Exchanges Board (IREX) in New York, a private organization supported in part by the American Council of Learned Societies (ACLS) and the National Endowment for the Humanities,

has been administering academic exchanges with the Soviet Union for the past 25 years. Currently some 24 U.S. doctoral candidates and junior faculty in the humanities and social sciences (versus 45 to 50 in the late 1970s) are spending the academic year in the Soviet Union under the auspices of IREX and the Soviet Ministry of Higher Specialized Secondary Education. Their 20 Soviet counterparts arrived in the United States in the wake of the Korean Airlines tragedy only to be sent home by the Soviet Embassy out of concern for the physical safety; but 18 of them returned late in January-proof of Soviet commitment to the exchange-and are now in place on various U.S. campuses.

Another forum for private U.S: Soviet discussion is provided by the International Institute for Applied Systems Analysis (HASA) in Vienna, which has been concerned with energy, food supply and other long range international problems. Founded in 1972 under U.S.-Soviet aegis and with members from the academies of science or other non-governmental institutions of 17 countries, including several in both Eastern and Western Europe, HASA faced a crisis in March 1982 when the Reagan Administration told the National Academy of Sciences that it would no longer pay for U.S. membership in the Institute-a sum equal to one fourth of its annual budget. With the National Academy's blessing a committee of the American Academy of Arts and Sciences headed by Harvey Brooks of Harvard undertook to raise the needed funds from private sources, an effort which to date has met with considerable success. In January 1984 HASA hosted a weeklong conference on science and public policy which was co-chaired by Brooks and Academician N.M. Emmanuel of the Soviet Union and attended by two other Soviet specialists-who are said to have presented most interesting case studies-as well as by U.S. and European scientists and policy analysts. HASA plans to initiate a major international research effort on the biosphere later this year.

Other private initiatives that could be mentioned here include the Carnegie Corporations effort to promote joint U.S.-Soviet study of the problems of crisis management between the two countries and the series of meetings on arms control and academic questions planned for 1984 by the U.S. and Soviet United Nations Associations. But equally noteworthy are the attempts to foster understanding undertaken by a wide array of non-governmental, nonacademic, non-policy oriented groups as well as by ordinary citizens.

Representatives of the New England Society of Newspaper Editors went to Leningrad in the summer of 1983 and negotiated with the Soviet Union of journalists an exchange of reporters who would work directly for publications in each other's country for about three months. By February 1984 three New England reporters fluent in Russian had been selected and it is hoped to begin the exchange in September. Meanwhile, columns on daily life by journalists in one country are being printed by newspapers in the other.

Of course ordinary tourists make up the great bulk of U.S. visitors to the Soviet Union these days, as they have since the 1960s. In 1976 Soviet visas granted such visitors totalled 65,864; by 1980 the number had fallen to 12,922; but in the first ten months of 1983 it had risen again to 38,256. (U.S. visas granted Soviet visitors fell from a total of 11,960 in 1976 to about 8,000 in 1983-approximately 2,500 of which were pleasure rather than business or official visas.) Estimates for 1984 put the totals back at their 1976 levels, if not even higher, at least for the U.S. side-a reflection both of the determination of growing numbers of ordinary citizens to seethe Soviet Union for themselves and of the steady improvement of Soviet tourist facilities and programs.

The rise on the Soviet side will be slower, to be sure, just as the total of Soviet visitors to the United States will remain much lower-a function not only of the familiar political constraints but of the ruble's miserable rate of exchange. For the overwhelming majority of Soviet citizens a trip to the United States is simply unaffordable, while for the ordinary U. S. citizen participation in a ten-day or two-week group tour of the Soviet Union is one of the best travel bargains available.

Exchanges involving hundreds of scholars and specialists, visits by thousands of ordinary tourists each year: both qualitatively and quantitatively there is life in unofficial U.S.-Soviet relations, and even some improvement. May it continue!

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"At the Center"

One of the rewarding and also demanding features of working at the Center is the opportunity for CSEP staff and faculty to explore a broad and rich mix of issues associated with professional activity. While some of our work places us in the traditional scholarly role of probing and detached observers, quite often we are also facilitators, convenors or collaborators. Engaging practicing professionals in dialogue or joining them as partners in research or education contributes to bridging the gap between academics and practitioners and also heightens our understanding of and appreciation for their view of the world. This cannot help but inform and improve the usefulness of our assessment of the moral dimension of professional practice. The following account of some recent and ongoing CSEP projects is illustrative of the range of issues and activities involving CSEP faculty and staff.

With a grant from the Illinois Humanities Council the Center will organize and conduct a series of workshops on ethical issues in health care for the elderly. The workshops will be held in community centers throughout Chicago and will involve educators from the disciplines of law, philosophy, religion, literature and anthropology and practitioners from the fields of nursing, medicine and allied health care professions. In addition to providing the elderly with an opportunity to share their views on critical life experiences, the project will help to establish a network of teachers, scholars and practitioners with a shared commitment to a humanistic approach to health care.

Two projects on science and secrecy both funded by the National Science Foundation and the first funded also by the National Endowment for the Humanities are underway at the Center. In collaboration with the American Association for the Advancement of Science, the CSEP co-sponsored a March seminar in Chicago, which brought together representatives from the academy, the professional societies, government and business to examine the ethical and legal issues associated with openness and restrictions in scientific and technical communication. Papers presented at the seminar, which is one of several to be organized by the AAAS at other sites during 1984, will be part of a larger series to be published in Science, Technology and Human Values. The current PERSPECTIVES reflects this seminar.

In a second project on science and secrecy the Center will organize a 1985 research conference on the ethical implications of trade secrecy patents and related property controls for science and technology. The aim is to compare these control practices with respect to how they work to advance or inhibit research and how they influence the practice of science and the structure of our research institutions, while promoting or threatening certain values or interests of individual researchers and their institutions.

Invited review essays, case studies, and essays of ethical analysis will be presented at the conference. Scholars, research managers, scientists, engineers, and others interested in the project should contact the Center and ask for one of the two principal investigators on this grant. In the unsettling environment of divestiture, Illinois Bell contracted with the Center to organize and conduct a workshop on "Value Conflicts in Managerial Decision-Making" for middle and lower level managers. The two half-day sessions included presentations by Center staff on the dynamics of organizational behavior and the factors involved in moral decision-making. A series of case vignettes, based on interviews of employees by the workshop instructors and on feedback from the participants following the first session, were used to illuminate moral dilemmas in the workplace. The workshop is part of the Center's outreach program for business and industry.

At the request of two different professional groups involved in development and fund-raising activities, the Center organized two panels on the ethical issues associated with philanthropy. The panels at the December Great Lakes District Conference of the Council for the Advancement and Support of Education and the April Conference on Managing Philanthropy sponsored by the Chicago Chapter of the National Society of Fund-Raising Executives included development professionals, a representative from foundations and a CSEP staff member. The discussions focused on a set of cases prepared especially for the two panels, and at both meetings the Center distributed a bibliography of materials on ethics and philanthropy included among its library resources.

The Center is in the early stages of organizing a Chicago-area clergy ethics study group which will include scholars in professional ethics, clergy educators, practicing clergy and lay persons involved in church affairs. Several faiths and denominations will be represented. The group will assess issues of professional responsibility relevant to the clergy and explore various models or strategies for professional development. From the group's efforts will emerge an education and research agenda for further discussion and evaluation by a much larger number and wider range of participants.

Proceedings of the March, 1982 Conference, hosted in Chicago by CSEP under a grant from the EVIST program of the National Science

Foundation, are now available upon request. Produced under the editorial supervision of Vivian Weil, Director of the Conference, the volume bears the title of the Conference, Beyond Whistleblowing: Defining Engineers' Responsibilities. Included are revised versions of the refereed papers, commentators' replies, an introduction by the editor, and a bibliography.

Appearing in the order of presentation at the Conference, the papers focus on issues of individual moral choice for engineers and ethical aspects of institutional practices and public policy decisions which involve engineers. Topics covered include legal protection for whistleblowers, engineers' rights and responsibilities and their foundations, the implications of government regulation with respect to the responsibilities of engineers, ethical aspects of risk assessment and the use of cost-benefit analysis in decision making, creating an ethical work environment, and the responsibilities of professional societies. The volume also contains essays geared to teaching and to engineering education. These papers focus on a case history, engineering codes and moral theory, and the connection of engineering education and the workplace.

The editing and publication of the 334 page volume was made possible by the grant from the National Science Foundation. Information about obtaining copies for libraries, journals, or individuals can be obtained by writing Vivian Weil, CSEP, IIT Center, Chicago, IL 60616 or by calling CSEP at (312) 567-3017. Persons interested in learning more about any of these projects are invited to contact the Center.

"Announcements"

Workshops and Conferences: A workshop on Teaching Philosophy and Public Policy will be held at Trinity College in Washington, D.C. on June 27-29,1984. It is being sponsored by the Center for Philosophy and Public Policy at the University of Maryland. For more information, contact Lori Owen at this center in College Park, Maryland 20742. Phone: (301) 454-6604.

The Institute for Business Ethics at DePaul University and The Society for Business Ethics will present the Second Annual Conference and Workshop on Business Ethics July 23-27, 1984 at the Lincoln Park campus of DePaul University in Chicago. Please contact: Robert Cooke or Paul Camenisch, Business Ethics Summer Conference/Workshop, DePaul University, Schmitt Academic Center, 2323 North Seminary, Chicago, Illinois 60614. Phone: (312) 321-8217 or 321-8228.

Call for Papers: The next issue of the journal Philosophy in Context will be devoted to medical ethics, and the editor is especially interested in papers concerning ethical decisions regarding critically ill infants. The deadline is July 1, 1984. Contact: Richard M. Fox, Editor, Department of Philosophy, Cleveland State University, Cleveland, Ohio 44115.

New Graduate Program: The Philosophy Department of Loyola University of Chicgao has established a new Masters Degree Program in Ethics, designed for professionals working in areas involving moral values. Three areas of specialization are available: Moral Development, Business Ethics, and Health Care Ethics. Further information is available from Thomas Wren, Philosophy Department, Loyola University of Chicago, 820 N. Michigan Ave., Chicago, Illinois 60611. Phone: (312) 508-2297.

The Center for the Study of Ethics in the Professions at the Illinois Institute of Technology was established in 1976 for the purpose of promoting education and scholarship relating to ethical and policy issues of the

professions.