SCIENTISTS, SECRECY AND NATIONAL SECURITY

by

Richard L. Garwin

IBM Thomas J. Watson Research Center
P.O. Box 218
Yorktown Heights, NY 10598

(914) 945-2555

(also
Adjunct Professor of Physics
Columbia University)

October 19, 1982

Presented at the symposium marking the 65th birthday of
Walter Munk

La Jolla, California

The involvement of scientists with secrecy must go back to ancient times. Not so long ago it was common to publish results (which presumably one hoped were both important and correct) in encrypted form. This would ensure one's priority without giving the scientific competition the benefit of one's contribution--an ancient analogue to the appliance store that offers to match any price. You just buy the appliance there and if you find a lower price someplace else they'll reduce theirs. It doesn't do much for the economy and it didn't do much good for science either. But if one or one's group is an infinitesimal fraction of the scientific enterprise, it doesn't do much harm to science unless one considers the collective phenomenon associated with the adoption of such a policy.

Imagine though the effect on the science of oceanography if Walter Munk had published in anagrams or in purposely obscure journals instead of in accidentally obscure prose.

Yet there is a place for restraint in communication. The researcher with substandard facilities and a heavy teaching load may be reluctant to share his brilliant ideas for detecting magnetic monopoles or explaining the extinction of dinosaurs for fear that some more fortunately placed scientist will obtain the results first; and the hapless graduate student with a promising idea for her thesis is another example.

Little do these scientists know the depths of protection afforded them by the general tendency to reject all but conventional wisdom.

Strangely, one can find in well-placed renowned scientists, a resistance to talk freely about their on-going work (not associated with Walter or Bill Nierenberg). One can even imagine doing first-rate science without writing it down or publishing it, but such a practice is about as enduring as a species which has not invented a means of reproduction.

If science is the understanding of nature (meeting the test of prediction), technology is the knowledge of materials and processes toward useful ends. It may be very much in the interest of a community or a nation or the human race, to gain some scientific understanding or technological power, and still not be rewarding to any individual to do so. For a scientist to spend his life to understand and cure the common cold (even assuming he has the average of five colds per year) is hardly a rational investment, unless he feels some fraction of the benefit to the hundred million or billion other beneficiaries. And even if he should feel it, he had better be of independent means in order to do the research.

Centrally planned societies have no trouble aggregating benefits and paying researchers, but they tell them what to do. In the Soviet Union the only scientists who can publish are those who are paid by the State and assigned work. Philanthropists in our society see this dilemma and have often provided large amounts of money (amassed in more-or-less respectable ways) to combat disease or poverty. Democratic administrations tend to regard this as subversive of the will of the people and as tax expenditures which should be subject to the annual decision of congress, while Republican administrations tend to eliminate federal funding either preemptively or as the result of the availability of private funds. No one loves philanthropists; it's a good thing they have money with which to console themselves.

In recent years Republican administrations have also been suspicious of foundations which tend to benefit people who, if they were of any merit, would have been rich.

But faced with the prospect of paying hundreds of dollars to cut down and burn a diseased elm tree (if you should be so fortunate still to have an elm tree) a homeowner might still pay $50 for a cure which might take many years of scientific work to understand the Dutch Elm fungus and its vector. If the manufacturing and delivery cost of the cure is small enough to be preferable to allowing the death of trees, it might be produced, but how will the scientific investment and the acquisition of the knowledge of technology be repaid? If the support was public, the public benefit is enough; but if the support is to be private, there must be an expectation of recovery of costs. We have two mechanisms in this country--trade secrets and patents.

A trade secret is exemplified by the Coca-Cola formula, some years ago the process of developing color film, or sometimes the existence of a fancy tool for diamond machining or of a particular bug in genetic engineering. Patents are quite different. They repay the total revelation of information (meeting the test that anybody skilled in the art can practice the invention) by a 17-year absolute right to keep others from practicing the invention or selling the product of the invention in this country. A trade secret is not pro-

tected against chemical analysis of the product or against inadvertent disclosure, but it is protected by the laws of ownership of property against theft, espionage, and the like.

So there is a lot of commercial secrecy-- that is, trade secrets-- in oil companies, about the performance and the release date and the name of a product, about the interest rate decisions of the Federal Reserve Board and so on. Even in patents some secrecy is mandatory in the United States, because revelation prior to one year before applying for the patent is an absolute bar to the issuing of a patent, and in most foreign countries the problem is greater because any revelation prior to application voids the patent.

So temporary secrecy and rights of exclusion are essential if support of science and technology is not to be entirely from public funds and by public decision. Still the scientific and technological contributions of industrial laboratories-- Bell, IBM, Philips-- are not negligible even though they have some requirements for pre-patent secrecy and occasionally even for the close-holding of know-how as a trade secret.

My thirty years in industry however, persuades me that it is possible for even such a large organization to understand its debt to open communication and to provide as much as possible of its results to aid the development of science and technology, and incidentally to enhance the reputation of the organization and its ability to attract capable (we hope, occasionally, outstanding) scientists.

But of course my topic is the intersection and not the union of scientists, secrecy and national security. Otherwise it would be enormous in scope. Nations have secrets not only about their intentions (which even they may not know), but also about their capabilities or lack thereof (which again they may not know).

Our ignorance of the capabilities and intentions of potential adversaries can be extraordinarily costly and maybe even dangerous. Well-known examples are our ignorance (at the time) of the famed missile gap of the Kennedy campaign of 1960 and again our ignorance of the Soviet program to put offensive nuclear-armed missiles in Cuba in 1962-- the Cuban Missile Crisis. According to the book by George Kistiakowsky, the Eisenhower administration in 1960 had full confidence that the Soviet Union at that time did not have the hundreds of ICBMs claimed by the Democrats in their campaign, but only a few. But they could not tell even trusted government advisers associated with John Kennedy. The decision not to share this information led to the deployment of 1000 Minuteman missiles as a consequence of the campaign rhetoric, even though Robert McNamara as Secretary of Defense told President Kennedy that 500 would be more than enough but that the congress would never let the administration deploy so few.

Obviously scientists have been involved in creating the systems of high capability which help to penetrate the secrecy with which nations try to hide their capability and intention. And to penetrate even the privacy of individuals. Some examples are given in Solzhenitzen's book, The First Circle, in which scientifically trained political prisoners in the Soviet Union worked on techniques for identifying speakers overheard on telephone lines.

Naturally scientists have also been involved in protecting secrets. One instance is the invention of systems of encryption-- one of which is the Data Encryption Standard (DES), approved by the National Bureau of Standards and available in the United States in computer chips or software for the protection of non-defense information.

Some security is desirable and necessary even in non-military activities. Envelopes and encryption and rules of behavior are supposed to keep unauthorized individuals from transmitting supposedly valid orders for electronic funds transfer or from learning in advance of the decision of a major corporation to bring out a product at a certain price on a certain day, or from learning of the decision regarding discount rates for the next period, or even from learning that your home has been vacated for the evening so the burglars can visit. A society of totally free information exchange would be very different from the one we have now.

On the international scene, the Soviet Union and the United States have formally accepted the acquisition of certain types of information by national technical means, namely information required to verify the undertakings of the SALT I and the SALT II agreement.

Well I can't speak further about these matters, but they involve directly only a small fraction of the scientific community. My real topic before we go on to discussion (which I encourage) is the role of secrecy in scientific work and its effect on national security.

First, national security like wealth should be measured on an absolute scale, not relative to another nation or individual. It does the individual little good to take measures to ensure that he is wealthier than his neighbor if such policies result in his being poorer than before. Enhancements of national security by spending more money to deploy more forces may make one more secure than the opponent (but probably don't) but the resulting decline in overall security may cause an absolute loss in one's own. And besides national security has a lot more to it than military capability and even than protection from invasion or conquest. At present in the United States, information relating to the atomic energy is born SECRET under the Atomic Energy Act of 1954, no matter whether that information is the result of government or industrial or individual effort. But classified information relating to national defense in general is treated totally differently and can be created only in government-sponsored work. Under the law there are some few exceptions such as cryptography or information about troop movements but in general, as regards non-atomic energy information, penalties are prescribed only when an individual has an intent to injure the United States and communicates with a foreign power. Nevertheless, actions have consequences, and many individuals recognize potential damage which could be caused by publication of certain unclassified information and they keep it to themselves.

However the criminal law is one instrument, and civil or contract law is another. Increasing use is being made of contract provisions of employment or of access to information classified TOP SECRET, SECRET or CONFIDENTIAL (according to whether the unauthorized release of information will cause extremely serious damage to the US national security or foreign relations or lesser amounts of damage). Access to properly classified information is for government purposes only and its based on the certified reliability of the individual, as determined by having an active clearance, and on a certification of need-to-know. Of course these conditions can be interpreted more-or-less strictly.

Such a system has obvious benefits and hazards for the nation. For one, it retards scientific, technological or operational capabilities of potential adversaries (yes, there is science applied to operations, not just to creating new things). It creates or preserves uncertainty as to our capabilities and status. It reduces public criticism of the merits, management, or conduct of the program (which must be regarded by those involved as a benefit).

But it has hazards. It retards the same scientific technological operational capabilities of allies and allied services-- things which are classified by the Air Force and not necessarily available to the Navy and especially vice versa. It creates uncertainty as to our capabilities and status and so it impedes the work of scientists (especially young ones or those new to the field), and by reducing public access and criticism it eliminates one of the strengths of the democratic system in doing those things which are best for the country because they can't be openly evaluated. Secrecy impedes the work of the program itself and of the cleared scientists involved, because it creates impediments to access-- it may take six months or a year for people to get clearances-- difficulties of document distribution, inability to work at home. It raises the cost (probably doubles the cost of many programs). It reduces or eliminates the benefits of competition and it substantially impedes the cross benefits from the scientific results and tools developed in the program. And in a large technologically advanced economy like ours, secrecy very much impedes the use of scientific and technical results by industry in support of the civil economy and thereby reduces the potential of the technology and the economy to support defense and security programs.

Here I want to make a personal remark rather than an analytical comment. As a matter of personal choice I find it exceedingly distasteful to work in a field in which I do not have free access to the status of science and technology. There are recurrent suggestions from funding agencies and program managers to the effect that a scientific inquiry should not be fettered by knowledge of the status of the field, but my judgment is that scientists protect their ignorance very well without such barriers. I don't want to waste my efforts reinventing the wheel, or worse-- constructing tenuous chains of analysis which could have been disproved at an early stage by comparison with experiment or observation. To the extent that there are others who feel the same way, sponsors of research will impede progress in their field buy not granting full access when they sponsor work in a field. And putting people to work without full knowledge of the field increases the hazard of unwanted information transfer. How can one protect material one invents if one is not told that it duplicates or improves on highly classified information?

Not everything about secrecy is bad. The benefits and costs of classification depend on the scale of the program and whether it's localized or distributed. There are some big successes, for instance, the wartime effort at Los Alamos and the Manhattan Project in general I think has to be counted as a success. My own access to this work began in 1950 when I spent the first of many summers at Los Alamos. I was very much impressed with the internal program of publication which was begun in 1943 at the laboratory. As one new to the field, I spent days in the library, read progress reports of the various groups, scientific papers written by the participants for their colleagues and successors, emphasizing to me that publication is communication not only in space but in time.

But there's always a large overhead in secret work. Security officers, guards, classification guides, safes, clearance passing, counseling, mail registry, receipts, delay, inability to communication with the person who could be of greatest help. In a day of science dependent on remote computer terminals for access to computation, to data and results, the lack of modern infrastructure for classified distributed work is crippling; and we would need-- should have (because secrecy will be with us) dial-up encrypted telephones, satisfactory encrypted remote-access terminals certified for classified work, more efficient mail express service authorized for classified mail, and the like. Not to have such systems thoroughly impedes the government efforts to improve its situation.

In summary, a large project located at one site can operate efficiently even though the results are secret. But if that science is not to lose much of its value in other fields, there must be (and usually is not) a concerted effort to declassify, excerpt and publish broadly what can be published.

Science is underfunded even in enlightened societies because one imagines that particular science may contribute in a particular field. But algorithms and tools and instruments and insights are more widely beneficial, and any economic analysis will result in more scientific work than we do. To the extent that these indirect contributions are inhibited or delayed by secrecy, the value of science and scientists is reduced.

The United States is extraordinary among nations in having academic scientists deeply involved part time as consultants in classified programs. Some, like Walter Munk, may work in classified fields allied to their university work and have both judgment and incentive to publish as much as can be permitted. Others may work in fields very different from their normal academic work and serve to contribute, and to transplant tools, but they have no occasion to prepare publishable papers on their classified research. I believe that the scientific technological and industrial health of the United States is clearly linked with the freedom of the individual scientist to choose and change the place of work, with the lack of restraint on dissemination of scientific results, and with the involvement of outside scientists in classified work. In the Soviet Union none of these conditions obtain. And in several advanced countries, academic scientists are hardly involved at all in classified work.

In the United States (at least since 1969 with the great ABM debate) we are much more open in the discussion and choice of weapon systems; this has forced more fervid misrepresentations on the parts of various agencies to accomplish what was formerly done simply by assertion. It is not necessarily a gain.

The present is a time of great peril. Persons who seem to have been appointed to government positions primarily because they know nothing (except they know they don't like the Soviet Union) recognize that the Soviet Union benefits from US science and technology and wish to eliminate this benefit. But too many of them don't distinguish actual knowledge of US weapons and tactics from technologies of wide application or from scientific results which have within them the prospects of contributing to weapons to countermeasures to medicine to industry to consumer goods across the spectrum. They argue from the undisputed fact that the Soviet Union pays a lot of attention and money to penetrating military security and obtaining plans and test results and equipment from AWACs radars (plans for countermeasure suits of the F-16 fighter and so on), and that Soviet workers spend a lot of time in libraries looking up publications. They argue from that to the conclusion that publication and dissemination of scientific results in the United States should be restrained. They are wrong.

Last month a committee under Dale Corson convened by the National Academies presented its report on technology transfer to the Soviet Union. A subgroup had access to classified information and presentations about the problem. The committee concluded that the United States' government should take more seriously its responsibility to protect properly classified data in order to reduce the availability of

countermeasures to US weapons and to reduce the ease with which the Soviet Union can build modern weapons based on US technology. But they strongly assert the lack of evidence for damage to the United States caused by Soviet acquisition of unclassified scientific or technological results. Their report recognizes, but does not quantify the damage to the United States science technology and industry which would accompany constraints such as excluding Soviet (and here do we mean Soviet nationals, Soviet agents, Soviet sympathizers?) from university courses, colloquia and buildings and from restricting the distribution of unclassified results of US government-sponsored research.

Last month, the Department of Defense forced retraction of 120 papers from the Society of Photo-optical Instrument Engineers conference. These papers had been reviewed and approved for publication by the contract authorities. This action of the Defense Department makes a political statement, but the first fruits of such actions will be a reduction of the flow of technical information within the US technical industrial community, adding to the natural disinclination of engineers to use the technical results of anybody else. U,S. commerce and industry will suffer. especially small technical firms. The cost to the Soviet Union of obtaining this information might be raised slightly, but only a bit because of the economy of scale available to them because they want so much information. The cost may even be lowered if the US does part of the job for them of identifying and categorizing information of particular value, without actually classifying it.

Don't think it can't happen here. A few new laws can destroy the system of openness which has served the US and world science so well. Even though your representatives in Congress know better, they may find it politically compelling to vote restrictions on the free publication of scientific information. One need only look for confirmation to the aftermath of the 1973 Roe v. Wade Supreme Court decision affirming a woman's right to choose abortion, and the recent years of battle to reverse or circumvent that decision.

New restrictions will have effect even if rarely enforced by penalties, because the vast majority of corporations (including universities) will not knowingly act outside the law. The irony, is that in their dislike of the Soviet Union these advocates of information restraint will transplant here some of the most detested and counterproductive aspects of Soviet society, in the same way that others cannot countenance our different choices of weapons and insist that if the Soviet Union has large ICBMs, or if they have 40,000 tanks we have to have them also. I suppose we are behind in the prison-camp race.

We celebrate the 65th birthday (but really the scientific exuberance) of Walter Munk and his influence on many fields of science directly and through his colleagues and his students. He is also a fine example of contributions to the national security in his science published openly and in reports properly classified. To attempt to deny the Soviet Union access to his open scientific results would have hurt us more than it hurt them.

The question of waging economic warfare against the Soviet Union in peacetime ought really to be put to the American citizenry because that is what some in the administration want to do.

Now on the economic scene, one could quote Rudyard Kipling

> "they copied all they could follow
> but they couldn't copy my mind
> and I left them sweating and stealing
> a year and a half behind."

That's good for technology but it might not be good, for instance, in the dissemination of knowledge about nuclear weapons, because there is a declining utility of information about nuclear weapons. When somebody can make a rather poor, not very advanced nuclear weapon it is almost as great a threat to world peace and to US security as if they can make a fine modern one. So in addition to restricting information eventually one has to make decisions as to actions to be taken in the event; we badly need a policy for what to do to deter the acquisition of nuclear weapons. Information security does not solve all problems.

QUESTIONS

VOICE: If I can be facetious perhaps, there seems to be a very good solution to one of those problems, and that is that we should all go out and get published more and more in journals.

RLG: I think refereed journals are very important so that we don't waste our time reading things which should not have been published. Yes, there are a lot of ways to deny anybody else information and that is one of them. Eliminating the information is another and the real problem is to transfer information adequately, to encourage to people to use information which is available in order to benefit our society, while denying some critical information to the other side.

VOICE: Do you have a rule-of-thumb for what ought to be classified?

RLG: Certainly if you build systems which are for military use and whose effectiveness depends on the lack of information on the other side, then that information should be classified. It should also be <u>available</u> in a proper community, because one needs to know the inadequacies of our systems in order to improve them; and one needs to know what information the other side may be looking for in order to have proper security measures. As one goes back to techniques which are involved in weapons, for instance metal-forming techniques for fighter aircraft, or computers which are going to be used in aircraft, one has to analyze whether keeping that information secret really reduces our wealth more than it impedes the other side-- taking into account the ability of the other side (whatever that other side may be at that time or might be in the future) to make use of the information. Sometimes it isn't lack of information which keeps them from making advances, it's just the inadequacy of their organization.