Lewis M. Branscomb lecture
Kennedy School of Government
Harvard University
Dec. 17, 2001

Research Universities and National Security: Can Traditional Values Survive?

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I have long admired Lew Branscomb as a scholar, an individual and a friend, so that I consider it a singular honor to be presenting the Branscomb lecture this year. His productivity in both quality and volume is becoming legendary (perhaps only exceeded by Harvey Brooks), enough so that I have begun to worry about his serving as a role model. As far as I can see the older he gets, the more active and productive he is. Very discouraging for the rest of us.

I have been fortunate, as have most of you, to have spent my professional career in one of the nation's honored research universities. That has meant that I have been embedded in a university committed to excellence in teaching and research, to unfettered association with students and colleagues from many nations, to freedom to publish and exchange information according to my preferences, to independence from government dictation of views, and to the pursuit of knowledge as I, and my student and faculty associates, thought most interesting. These values, as I think they may be called, have not always been in evidence nor do they all have a long-enough history in the U.S. to qualify as "traditional." But I think they may fairly be said to dominate the value systems of the major research universities in this country over at least the past several decades. And, I believe their acceptance in the universities and in the society at large, has been the primary reason for the preeminence of American universities in the postwar years. In turn, that preeminence has fueled the dynamic flowering of American society and economy, and helped to bolster its security, from which we have all benefitted. My guess is that all of you here today share that view.

I submit that these values, especially after the horrific events of Sept. 11, are under threat. I have substantial doubt that they can survive without major amendment. Previous threats based on national security and economic competitiveness grounds, for example the attempts to build walls around scientific information in the 1980s to prevent transfer to the Soviet Union, or to constrain technological contacts with the Japanese in the early 1990s, were serious, but patently self-defeating responses to the perceived dangers. It took strenuous effort to counter those threats, but ultimately they were successfully resisted.

But over the past decade and especially in the last few years and with greater emphasis in the past three months, national security issues have taken a more complex form that has created a quite altered set of pressures. These issues, coupled with the emergence of social and ethical questions raised by the implications of new technologies, by intensified and often controversial relations with industry, and by developments within the research universities themselves, have gradually altered the environment in which the universities operate. They have added up now to what I believe may prove to be a major change in that environment especially, but not only, in the relations between the universities and the Federal Government. Some of the problems may be avoided through sensible policies (on both sides), but others I fear will prove to be more significant challenges to the universities. I should note that my view is more pessimistic than others engaged in these issues, but I cannot help but be concerned about what seem to me to be possible developments in the future. More on that later.

What has changed? Are the effects so compelling as to justify the degree of threat I imply? Perhaps I am unduly worried.

The change with the most immediate implications lies in the national security realm, in particular the greater attention given to the danger of proliferation of military capabilities to potentially hostile states or to non-state actors. It is that subject I will concentrate on today, in part because I believe the full magnitude of this subject as it impinges on the universities is not yet appreciated. That is not to diminish the importance of other questions surrounding the research universities, but they have received much recent attention while security issues have not been prominently on the agenda.

The concern over proliferation was largely focused on nuclear arms-related issues during the Cold War, but has grown to include other subjects and a much wider range of potential targets. With ironic nostalgia, we look back with some "fondness" for the time we were confronted with a single protagonist against which our forces and capabilities could be measured. Now we face a host of potential adversaries able to use technologies in ways that can undermine the dominance and deterrent value of our military power. The direct result is a growing concern, especially in the government but legitimately of concern to us all, about the export from the U.S. to foreign countries or individuals of scientific and technological information that can be used for military purposes.

The danger is not limited to "rogue" states or terrorists, but also to nations such as India and Pakistan whose military adventures, now with nuclear weapons available, could seriously affect U.S. security. China is also viewed by some as a target, especially by those who believe it will inevitably be the state most likely to challenge U.S. predominance in the future.

The primary arena in which this concern over the export of information has so far been encountered by universities is in the implementation of the rather arcane International Traffic in Arms Regulations (ITAR). Major problems have been raised for research universities involved in the space sciences; my fear, and I am afraid my expectation, is that the problems will soon spread to many other fields.

The major development that has led to the recent difficulties came in March of 1999 when responsibility for export licensing of commercial satellites was moved from the Department of Commerce's Bureau of Export Administration to the State Department, pursuant to the Strom Thurmond National Defense Authorization Act. Commerce has responsibility for licensing under the Export Administration rules which are primarily concerned with commercial transactions, while State administers the ITAR, responsible for armaments listed on the U.S. Munitions List (USML). Commercial satellites of all kinds are included on the USML, and since 1999 scientific satellites are specifically listed as well. The Congressional action was precipitated by two incidents in which commercial satellite manufacturers were accused of aiding the Chinese with information that would be of value to them in their ballistic missile program. The ITAR consists of the regulations that control the export of USML items; the specific mandate "authorizes the President to control the export and import of defense articles and defense services" that are designated on the Munitions List.[1] [2]

[1] ITAR §120.9

[2] ITAR §120.1

Fundamental research is excluded from coverage of the ITAR.[3] The definition of fundamental research is basic and applied research, the results of which will be published and disseminated without restriction, whether the restrictions come from government or corporate sponsors. There are often ambiguities about what meets the criterion, especially when the research is to be carried out with technologies that are on the munitions list. Obviously, this ambiguity impinges heavily on space science since space technologies are required in the conduct of the research. The State Department has been resisting efforts to issue general guidelines, or to cede authority to NASA, to decide when projects carried out by universities can be considered to be free of ITAR jurisdiction. As a result of complaints from universities and from NASA, a proposed revision of the ITAR to allow greater flexibility and assurance to the researchers has been in the works for more than a year, with disagreement stemming primarily from the Defense Department and, presumably, State. Even though the NSC and OSTP have been directly involved in attempting to reach agreement, the latest information is that there is as yet no resolution.

When a project falls under the ITAR, a license is required before information can be shared with foreign nationals, including foreign students. State is responsible for issuing the licenses, with applications overall numbering more than 45,000 per year, only a small number in space science or technology. With a relatively small staff, processing is often slow, though the Department has been trying to increase the staff and speed the process. Even when licenses are granted, they can be quite narrow in the permission given as to what is allowed and what is not, thus potentially quite restrictive in the give and take of design and sharing of information.

Even when a project might be seen as falling under the fundamental research exclusion, another part of the ITAR mandates that a license is required when there is provision of "defense services," a kind of catch-all regulation defined as providing assistance to foreign persons in the processing or use of "defense articles," i.e. those items on the Munitions List. That includes the "design, development, engineering, manufacture, operation, demilitarization, destruction, processing or use of defense articles." Any "technical data" relating to these is also included.[4] In fact, the ITAR is a complex document, at times internally inconsistent, and in any case requiring legal interpretation.

It should be noted that it is irrelevant that the controlled information is not classified. The sensitivity of the information is determined by whether or not it falls within a general category on the Munitions List, not whether it is classified. Individuals, universities or corporations found to have violated the ITAR are subject to criminal penalties, including fine and imprisonment. There have been examples of legal investigations and fines of corporations, not yet, to my knowledge, of faculty or universities.

This situation has created considerable unrest in the space science arena, with many costs: proposed projects have been delayed; some potential foreign collaborators have decided not to try to work with Americans; discussions at some international scientific meetings have been seriously constrained or aborted altogether; questions have been raised about foreign graduate student participation; projects that involve university/company collaboration have been delayed or canceled; universities that have limited administrative staffs know little of the rules and of their penalties; and relations between some universities and NASA have been compromised. Attempts in some cases to restrict university students and postdocs on

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[3] ITAR §120.11

[4] ITAR 120.9

specific projects only to American citizens (requests initiated by government agencies or by corporations) have created serious problems at universities committed to nondiscrimination among students and faculty. In some cases, a climate of fear of possible consequences, or simply of complications in relations with graduate students, has led individual faculty to withdraw from projects that in the normal course of events would continue unimpeded.

It was the Congress that took the initiative to escalate the issue after the space satellite incidents with China. Recently, there have been attempts by some in the Congress, notably Representative Boehlert in the House and Senator Bingaman in the Senate to ease the effect of having moved the space satellite responsibility from Commerce to State. Rep. Boehlert asked President Bush in a July, 2001 letter to reissue President Reagan's 1985 National Security Decision Directive (NSDD) 189 that essentially reiterated the policy that fundamental research was in the national interest and should be open to all; when information was sensitive, it should be classified. Some progress has been made as National Security Adviser Condoleezza Rice on Nov. 1 of this year stated in writing that NSDD 189 was still in effect.

Notwithstanding that positive step, the climate at the working level in the government in the administration of ITAR has become considerably more conservative in the concern over the "leakage" of information than it had been even a decade ago. That change predates the events of Sept. 11. It appears to result not only from a belief that information is reaching undesirable hands, but also a sense that the U.S. has to protect its technological lead from all challenges, even when comparable capability already exists elsewhere. Those attitudes are buttressed by a legal mandate that raises the specter of stringent liabilities for bureaucratic errors. I must add that it also seems to stem from a lack of appreciation or understanding of, or sympathy for, the nature of the research process in the universities.

Here it should be acknowledged that at the senior levels of the government in the White House and among many in the Congress, in contrast to the working levels outside the science agencies, there appears to be appreciation for the problems the universities face and for their importance to the nation's economy and security. There has been sympathetic receptivity to initiatives from the universities for amelioration of the stringency of the ITAR, though so far there has been no actual change. Moreover, the actions of some departments, especially Justice with regard to foreign students, make the overall picture far less positive. As does the apparent public support for those policies.

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This leads me now to step back from the immediate experience of ITAR and take a broader look at what has changed and what has not in several of the dimensions of the issues that affect the role of the research universities. Let me start with what has <u>not</u> changed and turn first to some of the pertinent elements of the policy processes for science and technology.

First, I would single out the continuing predominant national nature of the scientific and technological enterprise. For all that there are ever more evident international aspects and effects of science and technology along with a growing role of multinational industry in the support of R/D, the majority of policy decisions about support of science and technology are made in a national context, strongly influenced by national polities and economies and, in the case of government support, determined in a national political and budgetary process. And I see no prospect this will change. The American research universities thus have been and will continue to be dependent on the U.S. government, notwithstanding their self-image as serving the global community at large. MIT, perhaps somewhat atypical, received approximately three-quarters of its research support last fiscal year from U.S. government agencies.

A second element worth noting for our purposes is that the nation's dependence on technology to undergird economic health continues unabated. This is equally true with regard to national security, not least because of the "new" technological challenges posed by the use of "primitive" technologies by those who planned for and hijacked the planes on Sept. 11. Looking ahead, it is reasonable to assume that even if the technologically-based security competition of the Cold War is muted, national security will continue to be a major spur to technological development, but increasingly focused on new subjects, many of which are esoteric today but not likely to remain so.

Notwithstanding the larger role of the private sector in the postwar years in setting technological goals, another continuing element is the central role of the public sector, of government, in determining our technological future. Through R/D support, regulation, subsidy, patent policy, standards, trade agreements, tax policy, weapons requirements, international goals, mandated commitments, and the policy process generally, the government continues to have a major influence on the direction of R/D and on which technologies actually see the light of day and thrive.

I would reluctantly add as a continuing factor that raised above of a posture of skepticism, or ignorance, or cynicism, about the research universities that is prevalent in the less scientifically oriented parts of the government, both in the Executive and the Congress. The rapid growth of public expenditures on R/D and the frequent rhetoric about the value of the universities might seem to belie that observation. But too often a deeper understanding is absent as regulations and accounting details whittle away at university independence and finances, as earmarks grow outside the peer review process, as knowing smiles belittle descriptions of the values inherent in the conduct of the universities and, as discussed above for the ITAR, as little credence is given to the significance of open communication in the sciences. Perhaps I exaggerate these attitudes and, as I noted before, the senior political levels of government may prove in fact to show real appreciation of the importance of the values that underlie the research universities. But, I worry.

In addition to these elements in the policy process, there are a host of what I would call "bedrock" attributes of science and technology that are unchanging, often ignored or misunderstood, and yet are relevant to the issues we now face. These will be obvious to this audience or at least so self-evident as to appear to be clichés. Some may be a bit overstated to make a point, but I believe are basically correct. Others are likely to be contentious. They are rarely seen as a group, however, and I believe offer an important perspective that is often overlooked in a policy process. Moreover, it is appropriate to deal explicitly with technology in a talk honoring Lew Branscomb (who may well disagree with much that I have to say, even though he may have been the inspiration for the ideas).

The first, and clearly relevant to the overall theme, is that all technologies are dual use. That is, they can be used or adapted for civil or military purposes, for peaceful or coercive goals. There are no technologies that are inherently and only peaceful. Obviously, there are gradations in that some technologies are a product of a weapons development program with overwhelming application to military purposes, and others that can be used with hostile intent only with considerable difficulty. What is most striking today is the extent to which some of the most exciting developments in science exhibit this dual character. That is clear in the developments in space technologies essential for the space sciences. Molecular biology and its technological offspring in biotechnology are also prime examples. (It is worth noting that in the course of rejecting recent negotiations to implement the BW convention, the administration raised the explicit possibility of applying export controls to biological agents as an alternative to spot inspections.)

It is relevant as well that not only are technologies dual use, but the direction of technological development tends toward reducing the cost of performing a given function. That is another way of describing increased productivity; in this case it means that the cost of weapons for particular purposes decreases unless countermeasures change the equation of their use.

A third attribute is that scientific and technological knowledge inevitably spreads. Barriers can delay, but not prevent the transfer of knowledge to those with the capability and interest to gain access to it. There may be some limited exceptions, for example in the promulgation of technical codes or operational plans where draconian measures are used to protect secrecy. But, those are not only limited but also rarely constitute scientific or technological knowledge. A more important exception is that knowledge usually referred to as know-how, or tacit knowledge as described in Beyond Spinoff , for which Lew Branscomb was a prime mover and author. Tacit knowledge refers to that knowledge held by individuals or organizations as a result of experience rather than design, and not usually transcribed or transcribable. For most scientific and technological knowledge, however, what is available today in laboratories or companies in one country will eventually be available in all, with obvious implications for military capability.

However, even if knowledge inevitably diffuses, this does not mean that the effective transfer of knowledge is easy. In fact, it is downright difficult, and that to me is another core truth. In a trivial sense (for our purposes) some technologies can be easily transferred, for example providing radios or automobiles or stinger missiles to societies that do not have them. But to transfer the technologies with the knowledge of how to manufacture them, or to repair them, or even to maintain them is what proves to be so difficult. The history of measures to transfer knowledge from North to South, from West to East during the Cold War, from subsidiaries to headquarters of multinationals, even from the laboratory to the production line within one building of a company demonstrates the difficulty. The short recipe for effective transfer is that there must be roughly equal competence and interest on both sides of the gulf; the recipient must be competent to understand and work with the technology, must have incentives to want the technology and must have the resources needed to adapt the technology to the local situation. Thus, the simple availability of knowledge is but one part of a complex process that determines the potential for misuse.

We can also add that most technologies that are possible in fact are never developed or survive once developed. Harvey Brooks explained that well in his use of the biological evolution metaphor: what technologies are "selected" depend on the economic and political environment in which their development could or might take place. For our purposes, the important point is that political action can help to deter the development of undesirable technological capability, for example, the many fewer states that have acquired nuclear weapons compared to those that have the ability to do so.

A final bedrock attribute worth singling out here that remains unchanged is that the most significant applications of a new technology may be far from the goals sought in the original development of the technology. There are countless examples, one of the more striking being the application of the knowledge embodied in the transistor to the development of integrated circuits and all that followed, rather than simply as a replacement for the vacuum tube. A corollary is what can be called the synergism among technologies. That is, the interaction of technologies that may come from widely different disciplines (e.g. materials science, biology and communications) to produce new capabilities not expected on the basis of the individual fields alone. In short, we can never be sure where the most significant applications of specific technologies will be found nor in fact what those technologies will be.

There are other "bedrock" attributes not as immediately relevant, for example that technology cannot solve all problems, or that technologies can never be "perfect," always reflecting a tradeoff between performance and cost, or that there are always externalities that accompany the use of technology.

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But, let me turn from what has not changed to what has. We can quickly identify those developments that are most pertinent to our subject.

The most obvious is the one that inspired the subject of this talk: growing concern over the spread of militarily-relevant technology. That is, of course, not a new concern. Aside from the extensive attention to proliferation of nuclear weapons and missiles in the post World-War II years, it has been to varying degrees a focus of American foreign policy. The Reagan Administration in the 1980s devoted considerable policy attention to the problem, as they saw it, of dangerous leakage of scientific and technological information to the Soviet Union. Now, political developments combined with the attributes of technology described earlier bid fair to make the issue again a central focus of policy.

Clearly, the inherent dual use nature of any technology coupled with the breadth of numbers of state and non-state actors willing and able to use technology for aggressive purposes serves to put a spotlight on the issue. Moreover, the growing technological competence of a larger number of states, including many still considered to be "less-developed" (e.g. Pakistan, North Korea), means that more are in a position to assimilate even advanced technology successfully if they can gain access to it. The decreasing cost of weapons, or the equivalent in their increasing capability without corresponding increase in costs, emphasizes the danger inherent in the issue. Thus, the concern over the transfer of scientific and technological information to states or non-state actors and the routes by which that transfer can take place has become a steadily larger presence on the policy agenda.

Another structural change that has taken place, a product of the nature of technology and the scale factors it induces, is the growth of large systems on which societies and economies have come to depend. The global energy and financial systems and the world-wide web are prime illustrations. Dependence breeds vulnerability. Technology can be employed to reduce vulnerability through safeguards and redundancy, but only at the penalty of performance and cost; total invulnerability is not possible.

The inherent developments in technology that serve to expand the dimensions of size, distance, and power lead inexorably, for economies of scale reasons if no other, to deployment of technologies in larger settings than the nation-state and to effects that have an unavoidable international impact. Globalization is a phenomenon broader than the effects of technology alone, but technology has been a major factor in its emergence. However it is defined, it has changed the playing field for the research universities, not only for government and industry.

Finally, there is the closer relationship in many scientific fields between the results of the laboratory and their technological applications. In parallel, many more technologies are now deeply science based than ever before. Both of these developments have the effect of making not only technological but scientific information more directly relevant to potential military applications and thus contribute to the rising concern over the diffusion of scientific as well as technological information to other nations.

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What of the research universities themselves? How have they evolved in response to changed circumstances and to changed needs and opportunities? In what ways is that evolution relevant to the elements I have just been enumerating and to the new political situation they and the nation face?

By most measures, the major research universities have been prospering over the last decade. The booming economy of the 1990s has brought substantial increases to the endowment of most, even the State universities, greatly easing the financial strains at the beginning of that decade. At the same time, public sector support for R/D has continued to increase, though not in real terms for the physical sciences. The relaxation of the policy challenges of the Cold War and of the technological competition from Japan, along with greater financial security, has made it easier for the universities to preserve those core values of open exchange of information, independence, free association with scientists and students from any nation, and a commitment to quality research and teaching. It cannot be said that the importance of those values is widely understood by the public, but at the same time the nation has been proud of the accomplishments of these institutions that are the envy of so many in other nations.

The universities have changed, however, in ways that, in combination with continued patterns from the past, have already put them in conflict with the newer security dangers the nation faces.

The most obvious and relevant development is what can be termed the internationalization of the universities. All of the major research institutions, and many others for that matter, have established a wide variety of international ties, including overseas campuses, strategic research and teaching alliances with universities abroad, special training programs targeted at specific countries, and other variations. Many have also reached out for financial support to companies and governments abroad. MIT, for example, has a major teaching alliance with the University of Cambridge, financed largely by the UK government. It has a research consortium with the University of Tokyo and the Swiss Federal Institute of Technology, and a teaching program with the National University of Singapore financed by the government of Singapore. Several years ago it started a program to prepare and place MIT students as interns in industrial and government positions in Japan; that has now been expanded with similar programs involving China, France, Italy and Germany. Many of the research consortia developed to support specific areas of research now include foreign companies and foreign government agencies as sponsors. There is more, but I suspect many other universities equal or surpass MIT in the extent of foreign ties and interactions.

The motivation for this expansion abroad has several roots. Most significant is that it is a recognition by the faculty of the changing face of the scientific and technological landscape as high competence in science and technology becomes widespread throughout the world and as more subjects must be confronted on an international or global scale or can benefit from such an approach. It often reflects the desire of governments and institutions abroad to tap the knowledge and experience of these successful U.S. universities and perhaps to replicate their success. It also is a result of a commitment on the part of the leadership of the research universities that a quality education must include greater understanding and involvement with the larger community outside the U.S.. And, of course, it also represents a new source of financial resources for the universities.

Another striking development of the research universities is their closer ties to the private sector in the U.S. and abroad. That is not wholly new, but it has grown proportionally as a source of research support for the universities more rapidly than either public sector or endowment income. At MIT, industrial support for research now constitutes more than 15% of the research budget. Some of that is in direct support of particular projects, some is as part of research consortia supporting specific fields, and some is the income from patents arising from research, the last being a rapidly-developing interest (though not producing much income) on every campus. These enhanced corporate ties raise a host of important ethical, conflict of interest, and process issues for the universities, most of not direct relevance to our topic. One of those that is relevant for us is the fact that some of this corporate support comes from companies based abroad and that, in any case, the multinational character of many US-based companies means that foreign-based companies or subsidiaries can have direct access to the research. MIT even has an Industrial Liaison Program that in return for general financial support provides staff assistance to its member companies to provide information about and access to faculty and student research. The majority of the close to 200 companies in that program are now foreign. Another relevant consequence of the attempt to deepen the ties to industry, whether domestic or foreign, is the pressure that is sometimes raised to accept restrictions on information flow. To the extent that compromises on openness of information are made with industry for financial purposes, there is clearly an erosion of the values the universities try to protect when government wants to impose controls for security reasons.

Finally, there are the foreign students that are populating American universities generally and the research universities particularly in apparently ever-greater numbers. The Institute of International Education reports that there are now close to 550,000 foreign students in the U.S., an increase of about 35% in the last 15 years. Approximately 60% are enrolled in natural science and engineering fields, including health (20% study business). More than 50% of engineering doctorates are awarded to foreign students and about 25% of doctorates in science. Most foreign students receiving doctorates plan to stay in the U.S., either in academia or in industry. In several engineering departments at MIT, the proportion of foreign students equals or exceeds 50%.

It is reasonably obvious why citizens of other countries come to study in the U.S., and a mark of the recognition of the reputation and quality of American universities. In turn, foreign students and postdocs are welcome in the universities for their contribution to the quality and output of research. High-technology industry in the U.S. has come to depend on the continued availability of highly trained and qualified engineering and science graduates, including those from abroad. It is also true that in some fields that are no longer popular with Americans, foreign students fill the rolls of departments that would otherwise have little education function or research capability. And, since foreign students often pay full tuition, they can constitute a desirable source of income for the universities.

Whatever the motivation, the universities have been free to determine their own policies regarding admission of foreign students, their selection of fields of study, and the oversight they exercise over the student's research experience. The Federal government as of now controls student movement only through the visa process at the time of entry or when visas require extension. The Immigration and Naturalization Service (INS) does not yet have the ability to track individuals beyond that, though a new system dubbed SEVIS (Student and Visitor Information System) is under development and may be completed next fiscal year if the budget is approved. Today, the INS does not know where more than 3 million foreign nationals are who have overstayed their visas (not necessarily all who came as students). Clearly, foreign students and postdocs raise security issues that by and large the universities have been able to finesse, usually arguing that it is up to the government not the universities to monitor them through the visa process. Can this stance continue?

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Putting all of these elements together indicates serious trouble ahead. The progress of science and technology and their unavoidable relevance to weapons conspire to enormously broaden the subjects that can be thought of as threats to security, and that expansion will continue long into the future. The focus of government attention until now has largely been on obvious military or nuclear-relevant fields, more recently extended to include any space technology. But, what we have seen Sept. 11 and its Anthrax aftermath vividly demonstrate how any knowledge can used for destructive purposes and thus be a candidate for restrictive measures. Coupled with the skepticism, or lack of understanding, in at least some parts of the government about the universities, policies that result in severe restrictions on information flow, on foreign students, and on international contacts among scientists may well emerge. The President and Attorney General Ashcroft have already announced new programs to track and monitor foreign students, and on Nov. 13. the Justice Department announced its intention to call in 5000 individuals with temporary visas for questioning even though they are legally in the U.S.. Many of those, undoubtedly, are students.

Meanwhile, the research universities have been moving in the opposite direction, or at least orthogonally, as they expand their international activities, set up collaborative research programs with foreign scientists and institutions, welcome more foreign students, develop closer ties with American and foreign corporations, and jealously guard the freedom of the campus and the open dissemination of information.

A clash seems inevitable.

The issues involved are genuinely more difficult than in the past. It is no longer enough to argue, as the universities did during the Cold War that the best way to be ahead technologically of the Soviet Union, the single antagonist, is to stay ahead. And, to do that, the most effective strategy was to play to the proven advantage over the Soviet Union of open, unfettered research and teaching, and a commitment to excellence. That worked both in practice and in the policy process, leading to clear technological dominance over the Soviet Union, the ultimate demise of the Soviet threat, while successfully submerging administration attempts to build walls around knowledge or to discriminate among students based on nationality.

The new danger is equally real, but may well be much more difficult to confront over time. Technologies that can be used for hostile purposes by states or non-state actors are becoming more prevalent, especially as technologies developed for benign application can be deadly in the wrong hands.

Some are sophisticated and difficult to operate; some are ultimately simple to acquire, to replicate and to conceal. And, for scientifically competent states, a great variety of advanced technologies, also created for peaceful purposes such as the control of research satellites, can be an assist for military hardware goals.

The danger is genuine and the concern justified; it can not and should not be ignored. In any case, the political process will not allow it to be ignored.

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What should be the response of the research universities? For one, I believe it is imperative to lay out clearly the appropriate role of the universities in support of the nation's goals: why it is essential for national security that the universities continue to maintain leadership in science and technology, and why certain kinds of restrictions that may appear reasonable on security grounds in fact will actually hamper national security. At first glance, that is not a self-evident argument to make in an era in which relatively primitive technologies become deadly weapons. But it remains valid in light of the many national purposes a robust scientific and technological enterprise serves. Even in the security area, many capabilities that will be characteristic needs in the future require continued technological leadership, for example, development of technologies of countermeasures, monitoring, interdiction and protection.

Within that context, it is necessary to understand where the universities' interests lie before unwise and costly regulations emerge from the government. That understanding should lead to specific suggestions from the universities about how to respond to the genuine issues the nation faces. It would be a better posture to support and to advocate proposals made by the universities than to have to argue against regulations coming from the administration or the Congress.

Which are the principles guiding university behavior that are most likely to be challenged? I believe there are three areas that will receive intensive and priority attention: the commitment to openness in dealing with the research enterprise, a call to undertake classified research, and policies toward foreign students. The first is already under attack in the ITAR situation I discussed earlier. So far that is only seriously being applied to space science, but there are rumblings of its application in physics and it is certainly only a matter of time before it is applied to biology and biotechnology. The ITAR includes specific reference, for example, to biological agents. The AAU, the National Academy of Sciences, and individual university presidents have been bringing attention at high government levels to the problems implementation of the ITAR has created and what effects may result. They have been met with sympathetic understanding, but not yet with results.

It is not a problem that can be "completely solved" in the sense that there will always have to be a residue of limitation that recognizes that the transfer of some technologies is not in the U.S. interest. But, the ITAR is excessively comprehensive and its implementation is slow, cumbersome, and lacking clear guidelines that would enable scientists and universities to know in advance how the regulations apply to their work or to proposed interaction with foreign scientists or foreign students. It also introduces an element of fear and distrust aimed at the government as a result of the long delays, the apparently arbitrary rulings, and the threats of personal liability if the regulations are violated, even unintentionally.

These are aspects of the ITAR that ought to be able to be corrected, though the evidence of the past couple of years would not support that proposition. Still, it seems to be appropriate, in fact urgent, that the research universities mount a consideration of this issue, perhaps jointly with relevant government agencies, with the goal of producing guidelines and/or modified regulations that both can live with. A useful starting point would be the proposition that information that is sensitive should be classified, or otherwise not subject to restriction, though that would undoubtedly require legislative change. Another would be a more commodious interpretation of fundamental research that did not require actual publication of results, but accepted a criterion of openness of the research and of the information resulting from it. A third would be a process that can provide definitive judgments, in advance, as to whether a particular project might be covered under the ITAR.

The second issue likely to arise is an interest in having the universities apply their competence to "solving" at least the more technical aspects of the terrorist danger. Inevitably, some of that research would include classified elements. I doubt that the public would understand an uncompromising stance that such research is unacceptable for the leading centers of science and technology.

I would argue that this is exactly the position the universities should take for research on their campuses. It is much more uncertain whether they should be willing to accept projects off campus at locations at which faculty and students are under no obligation to take part. MIT's Lincoln Laboratory and the University of California's management of the DOE weapons labs, though at times controversial, demonstrate it is a model that can work.

The other certain issue that will be raised is the policies toward foreign students and scholars. There are many dimensions, but one of the more likely will be an attempt to impose restrictions on whether foreigners can work on government supported research either in general, or in specific fields, certainly a step to be stoutly opposed. Another may be a requirement for the universities to exclude altogether nationals from a wide range of countries, or to discriminate among them according to their country of origin, again either in general or in specific fields. If there is to be discrimination among foreign students and scholars that clearly must be a government not a university responsibility, presumably to be exercised in the visa process. And a third will be a requirement that universities monitor foreign students and report on them to the INS on matters such as their choice of research subject, their movement within the university not required by their specialty, their plans after graduation, and perhaps other general information. This is a distasteful prospect, but one that is likely to be backed up by specific legislation or executive authority. The universities are going to have to decide how much, if any, of these policies they are willing to live with. It is easy to say none are acceptable, but a purist position will be difficult to maintain. There should be some middle ground which needs to be thought through. It would be far preferable to take the lead to discuss what is in fact acceptable, rather than to wait until undesirable regulations are promulgated by those who see a major security problem but have little understanding of the reasons behind the values the research universities hold dear. (I am pleased to report that discussions out of the limelight have been proceeding among university and government representatives to deal with questions that will arise during implementation of the new national tracking system–SEVIS--being created under the INS. I am told the prospects are good for a consultative process, including university representation, that will be more likely to protect student and scholar rights.)

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My subtitle is "can traditional values survive?" My answer is a qualified yes. But I believe the nature of the new security threat to the nation when confronting these values leads to considerable uncertainty. We must be in the lead in proposing how to manage the new challenges and dangers we and the nation face. Universities are resilient, but it still would not be hard to damage the resource they represent, a resource absolutely critical to the vitality and security of this nation.

Lew Branscomb understands this well; he has demonstrated that throughout his career in government, in industry and in academia, for which we are all in his debt.
12/16/01