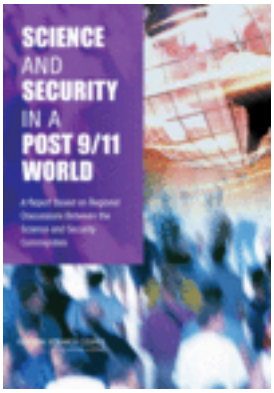

Science and Security in a Post 9/11 World: A Report Based on Regional Discussions Between the Science and Security Communities

Committee on a New Government-University Partnership for Science and Security, National Research Council

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SCIENCE AND SECURITY IN A POST 9/11 WORLD

A Report Based on Regional Discussions Between the Science and Security Communities

Committee on a
New Government-University Partnership for Science and Security
Committee on Science, Technology, and Law
Policy and Global Affairs

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PREFACE

After September 11, 2001, the National Academies organized the scientific community to identify ways in which scientists and engineers could be of most use to the country. A number of meetings and workshops were held and reports were issued advising the government on a range of subjects that included nuclear, radiological, and biological threats; human and agricultural health systems; chemicals and explosives; and information technology infrastructure. Recognizing that a robust national science and engineering research enterprise is critical to our Nation's overall economic well-being and security, the National Academies also took a close look at how the events of September 11th might affect our research universities and institutions and organized a two-day symposium in Washington, D.C., in December 2001.

During those deliberations, it became clear that over time there would be a need to assess the effects of new and proposed legislation and regulations—as well as the enforcement of existing requirements—on the conduct of research and the training of scientists at U.S. academic institutions. Subsequently, the House Committee on Science and Technology, under the leadership of Representatives Boehlert and Gordon, asked the National Academies to organize regional meetings on university campuses to gain a better understanding of whether concerns about our country's need to protect itself from terrorist threats had resulted in policy changes that were altering our ability to attract the best and brightest scientists and engineers and to undertake and conduct leading-edge research (see Appendix A). Those meetings formed the basis of this report and the recommendations of this committee. As such, this is not a typical report of the National Academies. Rather, it is a combination of fact-finding and discussion that aims to accurately reflect the discussions held with members of the research and security communities and the committee's deliberations.

In the course of this project, we sought to hear from individuals with intimate knowledge of the security threats posed by the open and free flow of information and the movement of individuals among universities across the globe and from leaders in science and engineering research. Our report is an attempt to bridge the legitimate concerns of the national security community with the need to maintain open and vibrant research universities. We are deeply indebted to the members of the committee, who brought a range of

experience from the national security and research communities, for their thoughtful contributions to our discussions and to this report.

We also would like to thank all the wonderful speakers who made presentations to the committee, and our hosts, President Susan Hockfield of the Massachusetts Institute of Technology, President Wayne Clough of the Georgia Institute of Technology, and President John Hennessey of Stanford University, and their staff Eugene Skolnikoff, Jilda Garton, Arthur Bienenstock, Pat Cooke, and Michelle Green, who assisted in organizing the three regional meetings. Additionally, we would like to thank Ruth Berkelman, Emory University, and the Southeast Regional Center for Excellence for Biodefense and Emerging Infections for their contributions to the regional meeting held at the Georgia Institute of Technology. Finally, we would like to thank the study staff—Anne-Marie Mazza, Elizabeth Briggs, Kathleen Magee, the consultant writer Kathi Hanna, and editor Sara Maddox—for all of their hard work in support of the committee.

JACQUES GANSLER AND ALICE P. GAST
Co-Chairs

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James R. Baker, Jr., *University of Michigan*; Hon. Stewart A. Baker, *Department of Homeland Security*; Timothy D. Bereznay, *Federal Bureau of Investigation;* Suzanne Berger, *Massachusetts Institute of Technology;* Ruth L. Berkelman, *Emory University;* Gary K. Bertsch, *University of Georgia;* Hon. Lincoln P. Bloomfield, Jr., *Palmer Coates LLC and Akin Gump Strauss Hauer & Feld LLP;* Joanne P. Carney, *American Association for the Advancement of Science;* George M. Church, *Harvard University;* Raymond J. Clark; *University of California, San Diego;* Rachel Claus, *Stanford University;* Michelle Van Cleave, *Office of National Counterintelligence;* G. Wayne Clough, *Georgia Institute of Technology;* Richard Compans, *Emory University School of Medicine;* Stephen E. Cross, *Georgia Institute of Technology, Georgia Tech Research Institute;* Robert Cook-Deegan, *Duke Institute for Genome Sciences and Policy Center for Genome Ethics Law and Policy;* Dennis M. Dixon, *Bacteriology and Mycology Branch Division of Microbiology and Infectious Diseases HHS/NIH/NIAID;* Hon. Sue E. Eckert, *Brown University;* C.W. Francis Everitt, *Stanford University;* Peter A. Freeman, *National Science Foundation;* Frank Gaffney, *Center for Security Policy;* Jilda Diehl Garton, *Georgia Institute of Technology;* Hon. Paul Gilman, *Oak Ridge National Laboratory;* David J. Goldston, *House Committee on Science, U.S. House of Representatives;* Gigi Kwik Gronvall, *University of Pittsburgh;* John Hamre, *Center for Strategic and International Studies;* Elisa D. Harris, *University of Maryland*; Siegfried (Sig) Hecker, *Stanford University;* John L. Hennessy, *Stanford University*; Susan Hockfield, *Massachusetts Institute of Technology;* Sheila S. Jasanoff, *Harvard University,* Richard A. Johnson, *Arnold & Porter, LLP*; Wendy J. Keefer, *Bancroft Associates PLLC*; Donald Kennedy, *American Association for the Advancement of Science, Stanford University*; Genevieve J. Knezo, *Library of Congress*; Gary LaFree, *University of Maryland;* Lisa M. Lee, *Centers for Disease Control and Prevention;* Richard K. Lester, *Massachusetts Institute of Technology;* Carol D. Linden, *Department of Homeland Security;* Gretchen L. Lorenzi, *Federal Bureau of Investigation;* Hon. John H. Marburger, III, *Executive Office of the President;* Grace L. Mastalli, *Department of Homeland Security;* Hon. David McCormick, *Department of Commerce;* Gary W. Miller, *Emory University;* Patrick Mulloy, *U.S.-China Economic and Security Review Commission;* Hon.

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Acknowledgment of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: Nancy Connell, New Jersey Medical School; Gerald Dinneen, Honeywell Inc., (Retired); Sidney Drell, Stanford University; Gerald Epstein, Center for Strategic and International Studies; David Goldston, Princeton University; Robert Hardy, Council on Government Relations; Robert Sparks, California Medical Association Foundation; Myron Uman, consultant; Mitchell Wallerstein, Syracuse University; and Nancy Wray, Dartmouth University.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Anita Jones, University of Virginia, and Alexander Flax, consultant. Appointed by the National Academies, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

CONTENTS

SUMMARY

The tragedy of September 11, 2001, the subsequent anthrax attacks, and ongoing terror threats internationally have markedly changed national and international security. As concerns about threats and terrorist activities have become global, so have the rapid transfer of information and communication. The confluence of the globalization of business and the revolution in information storage and transmittal has changed the landscape upon which to build national and international security. This requires a re-examination of the security measures developed during the days of the Cold War to assess whether those tools are still appropriate and to determine how they are affecting the current science and technology enterprises.

During the regional meetings that were held as part of this effort, the committee heard presentations from a number of governmental officials concerning security threats confronting the United States. While these individuals were not always able to offer concrete examples of the reality of these threats, they clearly perceive vulnerabilities to which we should be sensitive. They discussed concerns that have several dimensions. First, the United States' porous borders could allow terrorists to enter the country and attack U.S. citizens. Some of these terrorists might pose as (or in fact be) students in order to gain entry and find cover in a university community. Hence, it is argued that there is a need for programs to police the entry of students and to verify their activities. This situation differs from that of the Cold War because of the number of countries that are terrorist spawning grounds, and because, unlike during the Cold War, those who seek to penetrate U.S. borders under false pretenses are not spies, but rather terrorists on missions of destruction.

Second, there is concern that terrorists might use U.S. advanced technology against us. The presence of dangerous pathogens or other research materials that could be used as weapons pose a potential vulnerability at some universities. Moreover, there is concern that terrorists aspiring to apply advanced technology to the development of weapons might develop the technical capability to do so through a university education. This situation also differs from that of the Cold War because the Soviet Union was a sophisticated adversary, at least with respect to weapons technology, while the terrorist community is not. Hence, it is argued that

there is a need for special programs to screen foreign students from a range of countries who might be pursuing studies in "sensitive" fields.

Third, a more generalized concern is present about state actors and their access to advanced technologies of military significance. That is, because the U.S. military edge is built on the skillful application of advanced technology, there is concern that other countries might benefit militarily from access to scientific or technical information available in the university environment. This too differs from Cold War days, first, because of the diverse group of countries that might be judged to be potential adversaries; second, because research in some areas (e.g., biotechnology) is now far closer to application than it has been in the past; and third, because in some fields the civilian applications of technology available at universities may be ahead of military applications for that same technology.

Finally, concerns are present arising from the reality that America's economic well-being is founded on the maintenance of its scientific and technological edge and that foreign countries could seek to penetrate U.S. universities (as well as U.S. businesses) for the purpose of obtaining early access to technology in order to supplant U.S. capabilities and reap the economic gains for themselves. This too differs somewhat from Cold War days because the world is increasingly "flat," with individuals from most anywhere able to connect, collaborate, innovate, and compete. As a result, many countries now seek to exploit advanced technology as an engine of economic growth. Especially in the case of China, experts who spoke before the committee sometimes were vague regarding whether they were more concerned about traditional security-related espionage or more competitive economic espionage where high technology research data are concerned.

In the committee's view, none of these concerns should be dismissed or disregarded. And indeed, the committee was aware that the university community has responded to concerns raised by the September 11th terrorist events by strengthening current policies and implementing new policies stemming from recent federal regulations. The committee concluded, however, that these concerns do not justify the use of extreme measures that could serve to significantly disrupt the openness that has characterized the U.S. scientific and technology enterprises. The committee reached this conclusion because some policies that would aim to minimize the threats described earlier also could pose significant risks to the nation's ability to remain economically and militarily secure.

The success of U.S. science and engineering has been built on a system of information sharing and open communication, not only among U.S. institutions, but also with the international science and technology communities. The global scientific enterprise thrives on the movement of students and scholars across borders and among institutions. For more than 50 years, U.S. research universities—the envy of the world—have welcomed and fostered the talents of both foreign-born and U.S. students in the service of national and economic security. Foreign-born scientists and engineers come to the United States, stay in large numbers, and make significant contributions to America's ability to achieve and maintain technological and economic leadership. Given the current diminishing rates of new scientific and engineering talent in the United States—the subject of other reports and a topic of national concern—the size of the U.S. research and development effort cannot be sustained without a significant and steady infusion of foreign nationals. We must continue to encourage U.S.-born citizens to pursue science and engineering degrees and at the same time remain open to the benefits that foreign-born, but U.S.-trained, scientists and engineers bring to our country in terms of technological and economic growth.

Charge to the Committee

With encouragement from the House Committee on Science and Technology and the White House Office of Science and Technology Policy (OSTP), the National Science Foundation and the National Institutes of Health requested that the National Research Council's Committee on Science, Technology, and Law establish an ad hoc Committee on a New Government-University Partnership for Science and Security.

The committee was charged with organizing three regional meetings to:

1) bring together faculty and research administrators, government officials from research and national security agencies, and congressional members;
2) focus on:
    a. restrictive clauses in federal contracts and grants,
    b. the dissemination of scientific information,
    c. sensitive but unclassified information, and
    d. the management of biological agents in academic research; and

3) issue a report identifying the committee's findings from the workshops and the committee's recommendations.

Each regional workshop addressed all four topics, although with different emphases, depending on the research focus of a particular host institution/region.[1]

Response to the Charge

The committee was composed of individuals with a wide array of experiences in academic and government service, including individuals who served or are currently serving in senior government or committee positions with the following organizations:

- Central Intelligence Agency
- Defense Science Board
- Department of Defense
- Department of Energy
- Department of State
- National Nuclear Security Administration
- National Science Advisory Board on Biosecurity
- National Security Agency
- National Security Council
- Nuclear Regulatory Commission
- Senate Armed Services Committee and Intelligence Oversight Committee
- U.S. Air Force
- U.S. Commission on National Security for the 21st Century, and
- White House Office of Science and Technology Policy

The committee assiduously sought the advice of senior representatives of the security and intelligence communities, as well as the views of the

[1] Regional meetings were held at the Massachusetts Institute of Technology, May 15-16, 2006; Georgia Institute of Technology/Emory University, June 5-6, 2006; and Stanford University, September 27-28, 2006. Unedited transcripts from the meetings can be found at *www.nationalacademies.org/stl*. See Appendix E for the meeting agendas.

academic research community. This advice was at every point placed in balance with an understanding of the intricately linked connections between scientific knowledge, economic progress, and national security.

In its deliberations, the committee fully recognized the legitimate concerns of those tasked with securing U.S. borders. Interestingly, even with such a divergent range of committee expertise and speaker/participant input, an overwhelming consensus was apparent that to keep the country secure and to maintain our freedoms, we must strive to keep U.S. universities open—welcoming students and scholars from around the world and participating in international research—while limiting access when warranted and placing appropriate restrictions on narrow and well-defined high-risk areas.

In the view of the committee, U.S. leadership in science and technology—leadership that has been gained in part through the interchange of ideas within the international community—is central to achieving national security in the economic and defense context of the 21st century. The political leadership of the United States must understand, and in turn must help all Americans understand, that as a nation the United States has no exclusive ownership of ideas or knowledge and that scientific discoveries and technological advances made in the United States often rely on knowledge created outside our borders. Although prudence requires close stewardship of the most harmful and dangerous products of human ingenuity, unnecessarily closing ourselves off from the world in a futile effort to protect ourselves will only isolate us from an increasingly integrated and competitive global community. The unknowable nature of when, where, and what the next threat will be requires that our country continue to rely on a broad-based talent pool as well as on fundamental, long-term research programs. The important advances that are made as a result of such long-term research are critical to maintaining our economic competitiveness and to meeting the challenges of future technological threats and human health concerns.

The task of achieving the appropriate balance between the need for rapid, open communication among scholars and the safeguarding of information that could be used to do us harm is a challenging one, and it is one that requires the continual and sustained attention of the scientific community. The committee believes that the nation can and must strike this balance so that our extraordinary creativity and productivity can continue to flourish and propel us into a prosperous future.

In this report, which reflects the key issues that were raised during the regional meetings, the committee discusses the background for the concerns that persist in these areas and makes recommendations for addressing them. It also calls on the university community and government to seek a new and enduring partnership dedicated to communication and an ongoing search for solutions. The committee's efforts are by no means the first to try to shape a reasonable policy for moving forward in the complex worlds of science and security. In general, the findings and recommendations in this report build on and emphasize the importance of these prior efforts.

Conclusions and Recommendations

The following recommendations focus on the need for an enduring university-government partnership to provide a sustainable balance in science and security. The committee recognizes the critical role that industry plays in achieving this task but limited the report to the government-university interface.

Policies for Openness and Information Control

Openness and communication are important foundations of modern science. They are particularly important for the United States because our extremely strong science and technology community has the capability to implement and exploit advances from around the world more rapidly and effectively than any other nation or group. It must be recognized, however, that sharing and publishing research results, while advancing the aggregate knowledge of researchers working in a given field of science, also can provide access to those who would use such information to harm others. However, policies aimed at limiting access by malicious parties also can constrain the efforts of those desiring to put such information to good use. Therefore, developing and implementing measures to control access to sensitive information must be considered within the context of overall costs to the research community and to the public that benefits from the results of such research, and with an eye toward the anticipated effectiveness of such measures to actually enhance security.

National Security Decision Directive-189 (NSDD-189)

NSDD-189 was issued by President Ronald Reagan to set forth official national security policy for the guidance of the defense, intelligence, and foreign policy establishments of the U.S. government. In summary, it states that it is the policy of the U.S. government to not restrict, to the maximum extent possible, the products of unclassified fundamental research. Universities view this policy statement as critical to their ability to conduct basic and applied research at their institutions without the need for securing licenses from the Departments of Commerce or State, since the policy provides an exclusion for the conduct of such research.

Although there have been instances of the inclusion of publication and access restrictions in assistance awards (grants and cooperative agreements), the far greater problem for universities has been in the procurement (contracts) area. Contracting officers and universities sometimes do not recognize that the fundamental principles as well as much of the wording of NSDD-189 are incorporated into the Federal Acquisition Regulations (FAR 27.404(g)(2)). The problem for universities is that federal agencies sometimes impose restrictions on publications or foreign nationals in their research contracts to universities when the research complies with the requirements of NSDD-189. More difficult for universities is the fact that federal agencies award research contracts to industrial firms without the fundamental research exclusion (which is appropriate) but do not consider that the subrecipient who will help perform the work may be a university for which the restrictions are not appropriate. The industrial prime may be reluctant (or unable) to secure sponsor approval to remove the requirement from their subcontracts to universities.

Furthermore, in addition to recognizing that NSDD-189 is incorporated into the FAR, it is important that federal regulations such as the Export Administration Regulations (EAR) and the International Traffic in Arms Regulations (ITAR) be made consistent with NSDD-189.

<u>Recommendation 1</u>: Federal research funding agencies should ensure that grants and contracts for fundamental research awarded to institutions of higher learning in the United States abide by the principles of NSDD-189. Instructions and guidance for how to express these

principles should be incorporated into each agency's contracting and granting procedures in a more uniform manner. In addition, the requirement for adherence to the principles of NSDD-189 as stated in FAR 27.404(g)(2) should be incorporated into all research contracts to universities for basic and applied research in science and engineering.

Recommendation 2: Federal funding agencies should make clear to industrial awardees that the restrictive publication and foreign national clauses placed in government awards that would not apply to universities should not be passed down to university subawardees conducting fundamental research. In cases where the content of the subaward is known in advance, government contracting officers should include the appropriate provision in the original award. When the content of the university subaward is not known in advance, agencies should state that industrial prime contractors do not need agency permission to remove the restrictive clauses from subawards to universities. In addition, federal contracting officers should incorporate the provisions of FAR 27.404(g)(2) in all research contracts to universities where applicable and instruct industrial awardees that this clause is the appropriate clause to include in subawards to universities.

Classification and Sensitive But Unclassified

During the committee's regional meetings, university officials reported that they had significant concerns about not only the increase in the types of research considered classified but also in the variability within and among agencies in classification policies and practices. In particular, however, concerns were expressed that increasing use of the "sensitive but unclassified," or SBU, category erodes the exclusions spelled out in NSDD-189, since it limits the scientific community's right to publish the results of basic research and restricts the participation of non-U.S. researchers. Other meeting participants expressed concern about the disparate use of the SBU

designation across agencies which potentially undermines the intent of NSDD-189.

A survey of 20 institutions in 2003-2004 conducted under the auspices of the Association of American Universities and the Council on Governmental Relations found 138 attempts by the government to restrict the publication of data or foreign-national participation in research. Anecdotal information presented at the regional meetings indicates that inappropriate restrictions are continuing to be included in research awards; however, it is not known whether the number and frequency of such restrictions are changing.

> **Recommendation 3: The data collected in the 2004 Association of American Universities and Council on Governmental Relations report, *Restrictions on Research Grants and Contracts*, should be updated annually. The report should be expanded to include review of other restrictive clauses and should specifically review the use of the "sensitive but unclassified" category. The results of this report should be provided to the U.S. Office of Science and Technology Policy and the proposed new Science and Security Commission (Recommendation 12) and released to the broader academic community.**

Export Controls and Deemed Exports

The federal government, in addition to using classification, also attempts to control the flow of information and materials through export control and arms trafficking regulations. Specifically, the Department of Commerce implements the EAR that bars the export of items, technology, and technological information found on the Commerce Control List to foreign countries without appropriate export licenses. The EAR covers the transfer of dual-use commercial goods. In addition, the Department of State implements the ITAR, which regulates the export of items, technology, and technological information maintained on the Munitions Control List. Both the EAR and the ITAR contain exclusions for fundamental research. Several meeting participants noted that many of the items on the Commerce Control List and the U.S. Munitions List are technologically outdated, broadly available, and not controlled in other countries. Commentators noted that if

the purpose of export controls is to protect a U.S. advantage, it makes no sense to restrict exports of technologies that are so broadly available in other countries.

> **Recommendation 4: In view of the growing globalization of technology and science, the Departments of Commerce and State should conduct regular government-wide reviews of export control policy with special emphasis on streamlining, removal of outdated items, and updating the Commerce Control List and the U.S. Munitions List to reflect the current status in technology and science and to identify truly unique and military critical technologies unavailable elsewhere. The proposed new Science and Security Commission (Recommendation 12) should work with the Departments of Commerce, Defense, and State in moving this review forward.**

In addition to these export controls, *deemed exports* is a term that is used to refer to the transfer of controlled information to a foreign national within the United States, such as a foreign scientist working in a university laboratory. Typically, universities rely on the fundamental research exclusion to exempt such research from export control, and universities have understood that fundamental research is excluded from deemed export regulations.

Recent efforts by the Departments of Commerce and Defense to revise these policies were met with concern by the research community, subsequently revised and, in the case of the Department of Commerce, were withdrawn. However, issues regarding their interpretation and implementation remain, and participants at the regional meetings expressed their belief that a serious effort is needed to evaluate and justify the items on the current Commerce Control List and U.S. Munitions List. Therefore, while the committee applauds the willingness of the Departments of Commerce and Defense to consider the concerns of the university community, additional work is needed to evaluate and justify the items on the lists. The committee noted that it is important that any such reviews of the export controlled technologies be conducted by the best available technical experts, and that these experts need not necessarily be government employees.

The Internationalization of U.S. Science and Engineering

The education and training of new scientists and engineers is critical to ensuring that the next generation of innovators is prepared, supported, and encouraged to seek breakthroughs in knowledge for the betterment of society. Science thrives when there is a free exchange of information and when scientists and engineers (embodying that information) are able to cross borders to train, collaborate, and share knowledge. The high level of participation of foreign-born scientists and engineers in U.S. laboratories and classrooms warrants increased efforts to ensure that policies regarding their movement, attendance at scientific meetings, and collaborative activities are adequate and not self-defeating. In the months after the September 11th attacks, the Department of State amended the Technology Alert List (TAL) used by consular officials during the interview process when determining the issuance of nonimmigrant visas. Participants at the regional meetings reported that initially there were some overly restrictive reviews of student visas and travel restrictions based on the TAL, but that the situation seems to be improving.

Recommendation 5: Universities and the U.S. government should continue to encourage and welcome talented students and scholars from around the world. While progress has been made with respect to granting visas for foreign students and scholars, responsible parties must work to ensure that whenever possible policies and practices are in place that encourage the free movement of foreign students and scholars to scholarly/scientific conferences and to meetings in the United States and elsewhere.

Recommendation 6: The research community and the federal government should continue to monitor the visa clearance process and address issues immediately should they arise. The Technology Alert List should be reviewed and streamlined to include areas of study that clearly have explicit implications for national security. Additionally, Congress should consider creating a new nonimmigrant visa subcategory for doctoral-level graduate students and postdoctoral scholars coming to the United States. Student visas should be of a duration commensurate with the term of study.

Recommendation 7: The Department of State, along with other federal agencies such as the Departments of Commerce and Labor, should determine whether students and scientists here on temporary visas should be allowed to extend their stay if they are working in a scientific or technical field deemed to be in demand in the United States.

Biosecurity and Dual-Use Research in the Life Sciences

The National Science Advisory Board on Biosecurity (NSABB) was chartered by the Executive Office of the President "to provide advice, guidance and leadership regarding biosecurity oversight of dual-use research, defined as biological research with legitimate scientific purpose that may be misused to pose a biologic threat to public health and/or national security." The NSABB is to be commended for its efforts to address life science and security issues. However, its role is advisory only, it does not have global authority, its requirements only apply to federally funded research, and it does not have a permanent mechanism to address these issues on an international scale. Moreover, unilateral regulations may disproportionately affect U.S. science, threatening our dominance in certain areas and hampering crucial collaborations with non-U.S. scientists.

Recommendation 8: Taking full advantage of the National Science Advisory Board for Biosecurity's international work, as well as that being undertaken by other Department of Health and Human Services agencies, the U.S. government should develop policies and procedures for the oversight of dual-use life sciences research that foster international collaboration and control strategies, with a goal of harmonizing the mechanisms of local oversight.

Biosafety oversight of life sciences and biotechnology research in the United States has historically been based on self-governance on the part of researchers and on local risk-based oversight. Such oversight generally is delegated to local committees, and those committees should receive training in issues relevant to national security.

Recommendation 9: To strengthen and harmonize the institutional review of life sciences research, the Department of

Health and Human Services, in conjunction with other agencies that conduct and fund life sciences research, should develop an education program on the basic principles of risk-based biosafety and biosecurity review.

Research Priorities

Perhaps one of the greatest challenges for the future will be in understanding threats and in redefining and understanding the meaning of *security*. The social sciences could help enhance our understanding of the conduct of science, the culture of laboratories, the technology transfer process, international collaborations in science, and the culture of openness and trust in science. With regard to security concerns, the social sciences could add to our understanding of the precise nature of "threats" to national and global security, the difference between Cold War approaches and strategies for asymmetric threats, and the nature of biological threats. Support for the social sciences also is needed because the lack of strategic analysis from the social sciences helped contribute to past intelligence failures, and human intelligence will continue to play an increasingly important role in our ability to understand our enemies and identify the next threat. Furthermore, methods and strategies for determining security risks and the benefits of preventive actions and establishing appropriate risk/benefit calculations need to be further developed, and mechanisms for accurately and appropriately communicating risks and threats to the scientific community and general public must be improved—all of which calls for the need to sufficiently support the fields of area studies, languages, risk analysis, and the social sciences more generally.

Recommendation 10: The National Science Foundation, the Departments of Defense and Homeland Security, and the intelligence agencies should increase funding for the social sciences, particularly for area studies and languages. These subjects are critical to developing the knowledge base needed to understand the social, cultural, and political bases of terrorism and to identify and characterize potential adversaries, threats, effective organizational and interorganizational response strategies, and opportunities to reduce or eliminate those threats.

If the federal government were to subsidize these areas of study, students could fulfill their obligation through committed time spent in the foreign service, the public health service, or the intelligence community.

Recommendation 11: The National Science Foundation, the Departments of Defense, Homeland Security, and Health and Human Services, and the intelligence agencies should work together to fund additional research in the fields of security risk assessment and cost-benefit analyses of security strategies affecting university research and the global movement of students and scholars. The current emphasis on "risk minimization" is one-sided and does not balance the costs and lost benefits against the magnitude and likelihood of the risk.

Partnerships for Science and Security

In the context of a constantly changing global economy—from which new threats to national and international security have emerged and will continue to do so—it is imperative to develop and maintain communication channels between the security and academic research communities in order to facilitate ongoing discussion and sharing of information. Discussions held at the regional meetings convened by the committee emphasized that a healthy alliance among research universities, industry, and government lies at the heart of the American innovation system and of the innovation economy. Moreover, such an alliance is essential to meeting national security goals.

The committee is reassured that recent communications between the security and academic communities have been productive and that government officials have been responsive and responsible. However, too often these communications and responses have occurred only in reaction to serious concerns that spread through the research community—concerns that could have been avoided were there more proactive communication in advance of policy decisions. In addition, although improvements have been made, many issues remain unresolved.

Recommendation 12: A deliberative, standing entity should be established to address ongoing shared concerns of the security and academic research communities, for example, implementation of NSDD-189, interpretation of deemed export

policies, and visa policies and practices. This entity must have access to relevant data, which might require security clearances. Through consultation with the national and international security and research communities it should review and recommend policies affecting security and the conduct of research. Its membership should include high-level representatives of the national security and federal research agencies so as to ensure access to information and to guide implementation at programmatic levels. It also should include representatives of the academic and industrial science and engineering communities.

While there are a number of ways to implement this recommendation, the Committee recommends the establishment of a high-level Science and Security Commission, co-chaired by the National Security Advisor and the Director of the Office of Science and Technology Policy.

As a first step, the commission should undertake a review of the mechanisms now being used to control exports, including deemed exports. It should utilize the recommendations that will be made by the recently established Commerce Department Deemed Exports Advisory Committee. The commission also should review the fundamental assumptions underlying U.S. visa policies with respect to foreign students and scholars. Through this convening mechanism federal research agencies and the academic research community should aim to work more closely with the national intelligence and security communities to increase mutual understanding. In addition, because the United States must focus on both national and international security, the U.S. government should enter into discussions with the global community about coordinated counter-threat measures that do not impede international collaboration. The proposed commission should pursue the best avenues for initiating such discussions.

Furthermore, other partnerships are needed between the science and security communities because the intelligence/security and university communities have limited understanding of each other's cultures. Many in the intelligence community do not understand the importance of foreign students and scholars, the extensive nature and benefits of international collaboration in science, and the need for open scientific communication. Many in the university community do not understand the concerns of the

intelligence community about academic research and communication or the responsibilities and limits that regulations such as export controls and select agents can place on researchers.

Recommendation 13: University leadership at the level of the senior vice president of research must educate administrators, faculty, and students about security, export controls, select agents, and other relevant policies and procedures, and must ensure compliance.

Recommendation 14: Universities should work closely with the relevant federal agencies to develop opportunities for scientists to participate in policy fellowships at intelligence and national security agencies and to develop opportunities for members of the intelligence and national security community to participate in fellowships at universities. The Intergovernmental Personnel Act Mobility Program should be explored as a mechanism for facilitating these exchanges.

In implementing new security measures the United States must be cognizant that, in a context of increasing globalization and competition, policies that consider only a desire for protection through additional restrictions and controls could have adverse effects on economic growth, international competitiveness, and even long-term aspects of national security if they are not properly balanced with the need for open communication and collaboration on the part of scientists and engineers. In addition, although beyond its charge, the committee recognized that the unknowable nature of when, where, and what the next threat will be requires that the United States continue to rely on a broad-based talent pool as well as fundamental, long-term research programs. Important advances from long-term research are critical to meeting the challenge of future technological threats and human health concerns, and thus such research must receive substantial federal support.

I. Introduction

"Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter century."

U.S. Commission on National Security/21st Century (February 2001)[2]

The tragedy of September 11, 2001, the subsequent anthrax attacks, and ongoing terror threats internationally have markedly changed national and international security. As concerns about threats and terrorist activities have become global, so have the rapid transfer of information and ubiquitous communication. The confluence of the globalization of U.S. businesses and the revolution in information storage and transmittal have changed the landscape on which to build national security. Advanced information and technology have become more valuable at the same time that they are more broadly shared. As a consequence, the United States faces major dilemmas with regard to the dissemination of scientific/technological information and dual-use technology.

During its deliberations, the committee heard presentations from a variety of government officials concerning the security threats that are confronting the United States. The officials were not always able to offer concrete examples of the reality of these threats, but they clearly perceived vulnerabilities to which all in the university community should be sensitive. They discussed a threat that has several dimensions. First, there is concern that the United States' porous borders could allow terrorists to enter the country and attack U.S. citizens. Some of these terrorists might pose as (or in fact be) students in order to gain entry and find cover in a university community. Hence, it is argued that there is a need for programs to police the entry of students and to verify their activities. This situation is different from that of the Cold War because of the variety of countries that are spawning grounds for such terrorists and because during the Cold War, those who

[2] U.S. Commission on National Security/21st Century (Hart-Rudman Commission, Phase III). 2001. *Road Map for National Security: Imperative for Change.* February 15.

sought to penetrate our borders under false pretenses were spies, not terrorists on missions of destruction.

Second, there is concern that terrorists might use U.S. advanced technology against us. Some universities are vulnerable because of the presence of dangerous pathogens or other research materials that could be used as weapons. Moreover, there is concern that terrorists aspiring to apply advanced technology in weapons might develop the technical capability to do so through a university education. This situation too is different from that of the Cold War because the Soviet Union was a sophisticated adversary, at least with respect to weapons technology, while current terrorists are not. Hence, it is argued that there is a need for special programs to screen foreign students from a range of countries who might study in "sensitive" fields.

Third, there is a more generalized concern about state actors and their access to advanced technologies of military significance. The U.S. military edge is built on the skillful application of advanced technology. There is concern that other countries might benefit militarily from access to scientific or technical information that is available at universities. This too is somewhat different from Cold War days because of the diffuse group of countries that might be judged to be potential adversaries; because research in some areas (e.g., biotechnology) is now far closer to application than in the past; and because, in some fields, the civilian applications of technology available at universities may be ahead of military applications of that same technology.

Finally, there are concerns that arise from the reality that America's economic well-being is founded on the maintenance of its scientific and technological edge. Government security officials expressed the general concern that foreign countries seek to penetrate U.S. universities (as well as U.S. businesses) for the purpose of obtaining early access to technology so that they can supplant U.S. capabilities and reap the economic gains for themselves.[3] This too is somewhat different from the situation during the Cold War, because the world is increasingly "flat," and individuals from most anywhere can connect, collaborate, innovate, and compete. Consequently, many countries now seek to exploit advanced technology as an engine of economic growth. Especially in the case of China, experts who spoke before the committee were sometimes vague regarding whether they

[3] Timothy D. Bereznay, 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007

were most concerned about traditional security-related espionage or more competitive economic espionage where high-technology research data are concerned.

In the view of this committee, none of these concerns should be dismissed or disregarded. And indeed, the committee heard, and from professional experience knew, that the university community has responded to concerns raised by the September 11th terrorist events by strengthening current policies and implementing new policies stemming from new federal regulations such as the USA PATRIOT Act. (See Box 1A.)

BOX 1A
Examples of the Academic Research Community's Response to Security Concerns

Since 9/11 universities have taken on considerably more activities to educate faculty and students about national security concerns, to comply with federal regulations, and to tighten their physical security. Some of these actions include the following:

1. Providing increased training to research staff on various compliance, safety, and security issues
2. Implementing additional processes related to the hiring of staff and to lists that have to be checked for exclusions
3. Meeting higher security requirements for certain human studies (e.g., research techniques for identifying potential terrorists or airport screening methods)
4. Responding to national security letters
5. Responding to the increased presence of and requests from the Federal Bureau of Investigation (FBI)
6. Balancing demand for security (from sponsors, contractors, regulatory agencies) with increasing requests for transparency from public groups.

Universities also have made changes for handling select agents and other microbiological agents of concern (e.g., SARS):

1. Creating peer review groups to address new security and safety requirements and integrate them into current operations
2. Identifying researchers who possess select agents rather than those who just transfer those agents—development of new processes to assure that only de minimis quantities of toxins on the select agent and Toxins list are used in identified laboratories
3. Increased correspondence with agencies and colleagues regarding the applicability of regulations and the nature of regulatory inspections/reviews
4. Education of investigators, laboratory staff, biosafety committee, human subjects protections committee, animal care and use committee, research administrators, business officers, etc., on the need for and means to address laboratory security and accountability
5. Incorporating the capacity for increased surveillance and security systems into laboratory renovations
6. Installing security systems to limit access to environmental health and safety offices where inventories of hazardous materials and security measures are stored
7. Holding more meetings with an increasing array of campus stakeholders—including meetings with lawyers, architects, engineers, research compliance directors, police, occupational health, etc.— rather than just investigators and their staff.

The committee concluded, however, that these concerns do not justify the use of extreme measures that serve to significantly disrupt the openness that has characterized the U.S. scientific and technology enterprise. The committee reached this conclusion because policies aimed to minimize the threats described above also can pose significant risks to our Nation's ability to remain economically and militarily secure.

The committee expressed the belief that the United States cannot achieve national security in the 21st century without economic security. As a result, it is critical that actions taken to protect us from our enemies do not compromise our competitive status in the global economy. Economic security cannot be achieved without a balanced approach to openness in scientific and technological exchange, education, and information sharing. Equally essential is the sustained provision of resources devoted to advanced research, so that the United States can maintain its lead in key technological areas. A robust scientific and technological enterprise is critical to both national security and the U.S. economy.

Participants in the regional meetings repeatedly spoke about three situations that illustrate the dilemma that the scientific and security communities face. First, the publication of research on pathogens could provide terrorists with recipes for their production, enabling an attack that could endanger our population. As a consequence, one reaction might be to restrict such publications. Yet a considerable amount of this research is performed outside the United States and is already available to those who might do us harm. Given such a situation, it is possible that we will face an attack enabled by advanced research in the coming years even if the United States were to impose restrictions on the publication of such information. Moreover, a failure to publish information might inhibit the development of the capability to treat those affected and prevent the spread of any resulting diseases. Open and rapid publication, rather than restrictions on publication, facilitates the rapid development of understanding on the part of researchers studying the pathogens.

Second, the exportation of advanced technology that can be used in both the civilian and military sectors (so-called dual-use technology) has the potential, if misused, to benefit adversaries. The United State's approach has been to keep in check such exportation through export control regulations. One consequence of such controls, however, is that we lose our economic standing and growth and stand to lose competitive advantage to companies outside the United States that do not face such controls.

Third, the training of foreign students in advanced dual-use technology may provide their countries of origin with increased understanding of some of those technologies when the students return. As a consequence, it has been proposed that access to such dual-use technology by foreign students at U.S. research universities be controlled through "deemed" export controls. Universities would have to obtain export licenses from one or more government agencies to permit foreign students to use such equipment to the extent that through modification or maintenance they gain knowledge of how it works. The Nation has, however, become highly dependent on foreign students who remain in this country because of its scientific, technological, and economic strengths. The proposed deemed export controls are likely to reduce the flow of highly talented foreign students into this country, endangering our scientific and technological leadership in the very areas we seek to protect. It is in the context of these dilemmas that the committee began its work.

In its 2005 prepublication report, *Rising Above the Gathering Storm Energizing and Employing America for a Brighter Economic Future*, a National Academies committee wrote, "Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and ideas exist throughout the world."[4] Not only does U.S. technology-based industry compete on an international level, but U.S. academic institutions also must compete for researchers and students, a relatively new and uneasy transition for some institutions. It is not just that U.S. institutions must compete against foreign institutions for students, but that a U.S. institution seeking the best students and researchers must be open to looking overseas. In other words, when much of the talent comes from abroad, an institution unwilling to acknowledge that it is in an international competition not only risks losing students, but also risks losing its technical edge. The United States must continue to make every effort to attract U.S.-born students to science and engineering careers while remaining open to attracting the best and brightest foreign students as well. Furthermore, upon being screened and granted a visa and permission to study at a U.S. research institution, a foreign-born student studying here should be accorded the same opportunities for study and research as his or her native born peers.

[4] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2005. *Rising Above the Gathering Storm Energizing and Employing America for a Brighter Economic Future*. Washington, D.C.: The National Academies Press.

The U.S.-China Economic and Security Review Commission found that "China has become central to the global supply chain for technology goods of increasing sophistication, and its technology research and development activities are steadily and substantially expanding….Advances in China's technology infrastructure and industries, along with similar advances in other developing countries, pose a significant competitive challenge that has begun to erode U.S. technology leadership."[5] These trends have led many high-level government officials to aggressively assert the relationship between scientific and technological leadership and national security. For example, Deputy Defense Secretary Gordon England has said, "The greatest long-term threat to U.S. national security is not terrorists wielding a nuclear or biological weapon, but the erosion of America's place as a world leader in science and technology."[6]

Thus, we as a Nation must redefine and expand our understanding of the nature of security and how it is linked to economic competitiveness and the health of the scientific and technological enterprise. During the 45 years of the Cold War, national security was defined in narrow military terms: the containment of the Soviet Union behind its Eastern European Iron Curtain and the prevention of the use of nuclear weapons through deterrence and negotiations. "As of September 11, 2001, a new third dimension, stateless nations, was forced onto the security chess board. Stateless nations, or 'nonstate actors' as they are called, do not play with the same figures or pieces,"[7] and as such they require us to reconsider how we think about scientific openness and national security. However, while the nature of the threat may have changed since the Cold War period, "the risks to scientific and technological progress and the potential negative effects of imposing restrictions remain similar."[8]

A broader view of security also must recognize that safety is increasingly international and shared, that nation-state borders are increasingly porous, that information—including scientific information—is increasingly ubiquitous, that intense communication is necessary to dispel

[5] Hearings before the U.S. Economic and Security Review Commission. April 2005. Washington, D.C.: U.S. Government Printing Office.
[6] Inside the Pentagon. 2006. *England: Decline of S&T capabilities Is the Greatest 'Long-Term Threat.'* InsideWashington Publishers: November 2.
[7] Gary Hart. 2006. *The Shield and the Cloak: The Security of the Commons*. New York: Oxford University Press.
[8] Mitchell B. Wallerstein. 2003. "After the Cold War: A New Calculus for Science and Security." *Academe*. 89(5):10-15.

misunderstanding, and that scientific collaboration across borders enhances cooperation and international security. Thus, in implementing new security measures, we must be cognizant that policies that consider only our desire for protection through additional restrictions and controls may be doomed to failure if they are not properly balanced against the need for communication and collaboration by scientists and engineers in an increasingly global and competitive world.

Charge to the Committee

With encouragement from the House Committee on Science and Technology and the White House Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF) and the National Institutes of Health (NIH) requested that the National Research Council's Committee on Science, Technology, and Law establish an ad hoc Committee on a New Government-University Partnership for Science and Security. The committee was composed of individuals with a wide array of experience in academic and government service, including individuals who served or are currently serving in senior government or committee positions within the following organizations:

- Central Intelligence Agency
- Defense Science Board
- Department of Defense
- Department of Energy
- Department of State
- National Nuclear Security Administration
- National Science Advisory Board on Biosecurity
- National Security Agency
- National Security Council
- Nuclear Regulatory Commission
- Senate Armed Services Committee and Intelligence Oversight Committee
- U.S. Air Force
- U.S. Commission on National Security for the 21st Century, and
- White House Office of Science and Technology Policy

The committee was charged with organizing three regional workshops to:

1) bring together faculty and research administrators, government officials from research and national security agencies, and congressional members;
2) focus on:
   a. restrictive clauses in federal contracts and grants,
   b. the dissemination of scientific information,
   c. sensitive but unclassified information, and
   d. the management of biological agents in academic research; and
3) issue a report identifying the committee's findings from the workshops and the committee's recommendations.

Each regional workshop addressed all four topics, although with different emphases depending on the research focus of a particular host institution/region.[9] This report reflects the key issues raised during the regional meetings. In its deliberations, the committee fully recognized the legitimate concerns of those tasked with securing our borders. Interestingly, even with such a divergent range of committee expertise and speaker/participant input, there was an overwhelming consensus that to keep the country secure and to maintain our freedoms, we must strive to keep U.S. universities open, welcome students and scholars from around the world, and participate in international research, while limiting access when warranted and placing appropriate restrictions on narrow and well-defined high-risk areas.

Response to the Charge

The committee assiduously sought the advice of senior representatives of the security and intelligence communities and heard from current and past senior government officials from the Office of the National Counterintelligence Executive, the Department of Homeland Security (DHS), the FBI, CIA, DOD, the Department of Commerce, and DOE. The

[9] Regional meetings were held at the Massachusetts Institute of Technology, May 15-16, 2006; Georgia Institute of Technology/Emory University, June 5-6, 2006; and Stanford University, September 27-28, 2006. Unedited transcripts from the meetings can be found at *www.nationalacademies.org/stl*. See Appendix E for the meeting agendas.

advice that was received was at every point balanced with an understanding of the intricately linked connections among scientific knowledge, economic progress, and national security. At no point did the committee consider sacrificing intelligence collection and border security in the name of education—scientific or otherwise. On the other hand, it concluded that U.S. leadership in science and technology, gained in part by the interchange of ideas within the international community, is central to achieving national security in the 21st century.

The leaders of the United States must understand, and in turn must help all Americans understand, that as a Nation we have no exclusive ownership of ideas or knowledge and that scientific discoveries and technological advances made in the United States often rely on knowledge created outside its borders. Prudence requires close stewardship of the most harmful and dangerous products of human ingenuity. But closing U.S. science off from the rest of the international scientific community in an effort to protect ourselves against unspecified dangers could isolate us from an increasingly integrated and competitive global community.

The task of achieving the appropriate balance between the need for rapid, open communication among scholars and the safeguarding of information that could be used to do U.S. citizens harm is challenging, requiring the continual and sustained attention of the scientific and security communities. The committee concluded that the United States can and must strike this balance so that our extraordinary creativity and productivity can continue to flourish and propel the Nation into a prosperous future.

This report reflects the key issues raised during the regional meetings. In particular, it discusses the principles that should be used in balancing the need for openness with the need for restrictions. It also discusses the principles that should be used in creating new paradigms for government-academic cooperation in order to institutionalize ongoing dialogue and the search for solutions to the tensions that are inherent when attempting to balance openness and watchfulness. In general, the committee focused its discussions on five issues central to promoting a robust scientific and technological enterprise essential to our economic and national security. These topics arose repeatedly during the three regional meetings:

- The need for rational and coherent policies governing openness and control of scientific and technical information and the tools and products of research

- The centrality of human capital in science and engineering—that is, the education and free movement of students and scholars among institutions and across borders
- The need for discussion and education in, and between, the scientific and security communities
- The requirement for rational, transparent, and international approaches to controlling dual-use life science research, and
- The need for ongoing dialogue between the scientific and security communities and improved strategies for assessing and addressing threats.

In this report the committee discusses the background for the concerns that persist in these areas. It also makes recommendations for addressing these concerns while calling on the university community and government to seek a new and enduring partnership dedicated to dialogue and ongoing solutions. The committee's efforts are by no means the first to try to shape a reasonable policy for moving forward in the complex worlds of science and security. In general, the committee's findings and recommendations build on and emphasize the importance of these prior efforts. (See Appendix B.)

Understanding the realities of the 21st century, the committee recognizes that we must continue to protect our Nation's most vital national security secrets. It is important for university leadership and the national security community to define those few key secrets that require safeguarding and to review them regularly. The committee recommended an institutionalized dialogue that will allow the government and university communities to regularly reassess security needs. The committee further recommended that the United States take the steps necessary to expand its presence in the global scientific community. It supported the recommendations of several NRC/NAS committees and others who over the past few years have addressed the need to recapitalize the U.S. educational base in the sciences and technologies, invest in and rebuild the Nation's research laboratories in both the public and private sectors, and host the most advanced collaborative research in the world.

II. Policies for Openness and Information Control

Openness and communication are foundations of modern science. The generation of new ideas arises from having access to the work of others; thus, the newest discoveries must be published or presented. However, the sharing and publication of research results, while advancing the aggregate knowledge of researchers working in a given field of science, also can provide access to those who would use such information to harm others. Policies aimed at limiting access by malicious parties, if not well conceived, can constrain the efforts of those desiring to put such information to good use. Thus, developing and implementing measures to control access to sensitive information must balance the overall costs of such controls to the research community and the public against the anticipated effectiveness of such measures to enhance security.

There are several principal mechanisms currently aimed at restricting the conduct and dissemination of research: 1) classification; 2) export control (including so-called deemed exports—i.e., access by non-U.S. citizens to information and equipment while in the United States); 3) provisions in federal contracts that curtail openness in fundamental research (such as sensitive but unclassified [SBU]);4) statutes controlling the conduct of certain types of research (e.g., biological research with select agents); and 5) self-governance by the scientific community.[10] During the regional meetings convened by the committee, various aspects of these control mechanisms were raised by participants who expressed concerns widely held in the scientific community that some controls were being inappropriately applied. These sentiments reflect those of others who have noted that "Rational and well-conceived restrictions do remain necessary, but they can and must be applied to substantially fewer areas of scientific inquiry and technology development than in Cold War days. No rationale remains for a large, overreaching list of controlled items and subject areas."[11]

[10] Center for Strategic and International Studies (CSIS). 2005. *Security Controls on Scientific Information and the Conduct of Scientific Research*. Washington, D.C.
[11] Mitchel B. Wallerstein. 2003. "After the Cold War: A New Calculus for Science and Security." *Academe*. 89(5):10-15.

National Security Decision Directive 189 (NSDD-189)

During the 1980s, the acquisition of advanced technology from U.S. universities and federal laboratories by Eastern Bloc nations for enhancing their military capabilities was perceived as a significant threat to national security. In 1982, the Department of Defense and the National Science Foundation asked the National Academy of Sciences to assess the need for controls on scientific information. The resulting report, *Scientific Communication and National Security*, also known as the "Corson Report" after its chair, Dale Corson, President Emeritus of Cornell University, concluded that, while there "has been a significant transfer of U.S. technology to the Soviet Union, the transfer has occurred through many routes with universities and open scientific communication of fundamental research being a minor contributor."[12]

In response to the Corson Report and other concerns about the effect of government restrictions on the free flow of scientific information, NSDD-189 was issued by President Ronald Reagan to set forth official national security policy for the guidance of the defense, intelligence, and foreign policy establishments of the U.S. government. (See Box 2A.) In developing this directive, administration officials were cognizant that the U.S. leadership position in science and technology was essential to economic and physical security, requiring "a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component."[13] Today, many believe that if it were determined that the greater threat is more economic than physical, it would not change the need for or the currency of the directive.

[12] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 1982. Panel on Scientific Communication and National Security. *Scientific Communication and National Security*. Washington, D.C.: National Academy Press.
[13] Ibid.

BOX 2A: NSDD-189

September 21, 1985

NATIONAL POLICY ON THE TRANSFER OF SCIENTIFIC, TECHNICAL AND ENGINEERING INFORMATION

I. PURPOSE

This directive establishes national policy for controlling the flow of science, technology, and engineering information produced in federally-funded fundamental research at colleges, universities, and laboratories. Fundamental research is defined as follows:

"'Fundamental research' means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons."

II. BACKGROUND

The acquisition of advanced technology from the United States by Eastern Bloc nations for the purpose of enhancing their military capabilities poses a significant threat to our national security. Intelligence studies indicate a small but significant target of the Eastern Bloc intelligence gathering effort is science and engineering research performed at universities and federal laboratories. At the same time, our leadership position in science and technology is an essential element in our economic and physical security. The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component.

In 1982, the Department of Defense and National Science Foundation sponsored a National Academy of Sciences study of the need for controls on scientific information. This study was chaired by Dr. Dale Corson, President Emeritus of Cornell University. It concluded that, while there has been a significant transfer of U.S. technology to the Soviet Union, the transfer has occurred through many routes with universities and open scientific communication of fundamental research being a minor contributor. Yet as the emerging government-university-industry partnership in research activities continues to grow, a more significant problem may well develop.

III. POLICY

It is the policy of this Administration that, to the maximum extent possible, the products of fundamental research remain unrestricted. It is also the policy of this Administration that, where the national security requires control, the mechanism for control of information generated during federally-funded fundamental research in science, technology and engineering at colleges, universities and laboratories is classification. Each federal government agency is responsible for: a) determining whether classification is appropriate prior to the award of a research grant, contract, or cooperative agreement and, if so, controlling the research results through standard classification procedures; b) periodically reviewing all research grants, contracts, or cooperative agreements for potential classification. No restrictions may be placed upon the conduct or reporting of federally-funded fundamental research that has not received national security classification, except as provided in applicable U.S. Statutes.

[stamped:] UNCLASSIFIED

According to the directive, fundamental research is defined as "basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development,

design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons."[14]

NSDD-189 is still in effect more than 20 years later. However, since September 11, 2001, there has been increased concern in the academic community that its spirit and intent could, and perhaps have begun to erode as security concerns increase. At the committee's first regional meeting in May 2006, Professor Richard K. Lester, Professor and Director of Industrial Performance Center, the Massachusetts Institute of Technology (MIT), summarized the tensions between openness and security:

> The fact that universities and businesses need the free flow of ideas and knowledge while government needs to keep its citizens safe and to prevent weapons or knowledge of how to make weapons from falling into the hands of the wrong people, these differences and the tensions that are implicit in these differences are likely to grow more rather than less pronounced as time goes on. We must assume that the security imperatives of the government will become more challenging rather than less over the coming years and decades, and at the same time it seems likely that the importance of the university's role as a public space in an increasingly globalized innovation process will also grow.[15]

In the months following the September 11 attacks, the Bush administration reaffirmed the intent of NSDD-189. The then Assistant to the President for National Security Affairs, Condoleezza Rice, confirmed that "the policy on the transfer of scientific, technical, and engineering information set forth in NSDD-189 shall remain in effect, and we will ensure that this policy is followed."[16]

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[14] National Policy on the Transfer of Scientific, Technical and Engineering Information, September 21, 1985. Available at *www.fas.org/irp/offdocs/nsdd/nsdd-189.htm*. Accessed December 28, 2006.

[15] Richard K. Lester. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at Massachusetts Institute of Technology. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.

[16] Letter from Condoleezza Rice to Harold Brown, Center for Strategic and International Studies, November 1, 2001. Available at *www.fas.org/sgp/bush/cr110101.html*. Accessed February 14, 2007.

NSDD-189's application to fundamental research conducted in U.S. universities cannot be overemphasized. Both the Export Administration Regulations (EAR) of the Department of Commerce and the Department of State's International Traffic in Arms Regulations (ITAR) acknowledge that NSDD-189 language provides an exclusion for certain research activities at colleges and universities in the United States from the application of the export regulations, provided that the institution does not accept restrictions (publication or access dissemination) that nullify the exclusion itself.

Nonetheless, concerned about an erosion of the protections to fundamental research offered by NSDD-189, in 2002 the presidents of the National Academies issued a statement calling upon the government to affirm and maintain the general principle of NSDD-189:

> A successful balance between these two needs—security and openness—demands clarity in the distinctions between classified and unclassified research. We believe it to be essential that these distinctions not include poorly defined categories of 'sensitive but unclassified' information that do not provide precise guidance on what information should be restricted from public access. Experience shows that vague criteria of this kind generate deep uncertainties among both scientists and officials responsible for enforcing regulations. The inevitable effect is to stifle scientific creativity and to weaken national security.[17]

The directive does not assert that the open dissemination of unclassified research is without risk. Rather, it asserts that openness in research is so important to security and other key national objectives that it warrants the risk that our adversaries may benefit from scientific openness as well.

In June 2005, the Center for Strategic and International Studies (CSIS) issued a report stating that NSDD-189 remains "the central principle

[17] The National Academies. 2002. Statement on science and security in an age of terrorism from Bruce Alberts, William A. Wulf, and Harvey Fineberg, Presidents of the National Academies. October 18. Available at *www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=s10182002b*. Accessed February 14, 2007.

governing security controls over fundamental research."[18] It also cited growing concerns about the effects of classification trends on fundamental research and the growing requirements for "deemed exports" (see discussion below). CSIS warned that the creeping nature of these controls creates ambiguity, results in discrimination, and creates delays and inflexibility that can hinder discoveries and scare away talent. The CSIS report noted that the security benefits of such policies are modest when weighed against the risks of such policies to U.S. technological leadership.

Many university officials who spoke to the committee during its regional meetings shared the same sentiments. They reported that their previous reliance on NSDD-189 to exempt unclassified research from controls is being eroded due to a growing tendency to label research as "sensitive but unclassified (SBU)" and thereby to require restrictions on publication and sharing. In addition, they cited concerns about moves to increase the scope of "deemed export controls," in the context of research conducted by foreign nationals in the United States (see further discussion below). It is not only that labeling research as "sensitive" can imply restrictions on publication and sharing, but there also is the converse problem that restrictions on sharing, for example, the requirement that a publication be reviewed by a sponsor prior to sharing with others, can cause the research to lose its status as "fundamental research." It may then be ineligible for the fundamental research exclusion in export control regulations and thus de facto require an export license.

In the regional meeting, some participants pointed out that universities are among a few limited institutions where one can openly conduct fundamental research that has potential implications for national security and that also has great potential for societal benefits. (See Box 2B.) In addition, the increasingly blurred distinction between fundamental and more applied research (particularly in the field of biology) makes for uncertainty in trying to draw a bright line between research that is subject to controls and that which is not. Stanford University President John L. Hennessy warned the committee that "Restricting access to projects or access to information is fundamentally antithetical to how we work. Although there are cases where limited access to sensitive information is needed and that information can be encapsulated without further damaging the nature of the

[18] Center for Strategic and International Studies (CSIS). 2005. *Security Controls on Scientific Information and the Conduct of Scientific Research*. Washington, D.C.

research, such situations are not the norm and cannot become commonplace."[19]

BOX 2B
Wireless Sensor Networks for Military and Homeland Security Applications

Advances in integrated circuit technology make it possible to combine sensors, signal processing and wireless communications in compact devices, and network them together to perform a wide variety of tasks. Traditionally, raw sensor data would be communicated to one central site. This approach is not scalable from either the point of view of energy consumption or bandwidth; by allowing two-way communication to re-task nodes and on-node signal processing, the volume of data traffic and thus the energy to send it can be greatly reduced. This new approach was funded by DARPA [Defense Advanced Research Projects Agency] in the mid-1990's and spawned a robust academic research community. Field tests were conducted during military exercises.

In recent years DARPA has moved to classify or otherwise restrict the technology, while also proceeding with contracting styles inconsistent with how universities operate. The result is a deadening of academic research in security applications (borders, situational awareness, detection of underground facilities, etc.) when it is apparent that there are both current and future needs. Recently, NSF stepped in and funded many new and exciting projects with scientific applications. These demonstrated some limitations with the original concept of sensor networks for military applications. The basic information management concerns are essentially the same in commercial, scientific or military systems, and so classifying or restricting the research may be counter-productive.

Several who participated in the committee's regional meetings called for a reaffirmation of the intent of NSDD-189, so that all fundamental research at U.S. universities can be free from any publication restrictions. Such a reaffirmation would provide a clear recognition that academic freedom strengthens the nation's security and also advances its competitiveness and economic well-being. The committee heard that in recent years some universities have been able to work with contracting personnel at federal agencies to recognize the difference in a research contract between basic and applied (in export terms "fundamental") research conducted at a university versus the proprietary work done by an industrial partner (which is not able to rely on NSDD-189). Occasionally, sponsors have structured awards to recognize that difference. Often these contracts are delayed or complicated by restrictions that are inappropriate for university research. Through terms and conditions of unclassified research awards,

[19] John L. Hennessy, 2006. Remarks made to the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007.

particularly subawards from for-profit entities, universities are being asked by some federal funding agencies to accept restrictions on fundamental research.

Although there have been instances of the inclusion of publication and access restrictions in assistance awards (grants and cooperative agreements), the committee heard that the far greater problem for universities is in the procurement (contracts) area. Contracting officers and universities sometimes do not recognize that the fundamental principles, as well as much of the wording of NSDD-189, are incorporated into the Federal Acquisition Regulations (FAR). The problem for universities is that federal agencies sometimes impose restrictions on publications or foreign nationals in their research contracts with universities when the research complies with the requirements of NSDD-189. More difficult for universities is the fact that federal agencies award research contracts to industrial firms without the fundamental research exclusion (which is appropriate) but do not consider that the subrecipient who will help perform the work may be a university for which the restrictions are not appropriate. The industrial prime may be reluctant (or unable) to secure sponsor approval to remove the requirement from their subcontracts to universities. One speaker informed the committee of a basic research contract in the aerospace domain that was refused when a small company attempted to challenge the flow-down of restrictive contract language appropriate for its portion of the work but not for the open research to be conducted at the university. The government agency responsible refused to make the changes despite persistent efforts by the prime contractor.[20]

Furthermore, in addition to recognizing that NSDD-189 is incorporated into the FAR, it is important that federal regulations such as the EAR and the ITAR be made consistent with NSDD-189. The recent recommendation of the Department of Commerce's Inspector General's (IG's) office concerning a distinction between the conduct and results of research illustrates the inconsistency.

Given these concerns, the committee offered the following recommendations:

Recommendation 1: Federal research funding agencies should ensure that grants and contracts for fundamental research awarded to institutions of higher learning in the United States

[20] Memorandum from Gregory J. Pottie, 10/2/2006, on file with study staff.

abide by the principles of NSDD-189. Instructions and guidance for how to express these principles should be incorporated into each agency's contracting and granting procedures in a more uniform manner. In addition, the requirement for adherence to the principles of NSDD-189 as stated in FAR 27.404(g)(2) should be incorporated into all research contracts to universities for basic and applied research in science and engineering.

Recommendation 2: Federal funding agencies should make clear to industrial awardees that the restrictive publication and foreign national clauses placed in government awards that would not apply to universities should not be passed down to university subawardees conducting fundamental research. In cases where the content of the subaward is known in advance, government contracting officers should include the appropriate provision in the original award. When the content of the university subaward is not known in advance, agencies should state that industrial prime contractors do not need agency permission to remove the restrictive clauses from subawards to universities. In addition, federal contracting officers should incorporate the provisions of FAR 27.404(g)(2) in all research contracts to universities where applicable and instruct industrial awardees that this clause is the appropriate clause to include in subawards to universities.

Classification and Sensitive But Unclassified

Classification of information is one means by which the government controls access to information. "With rare exceptions, only information that is owned by, produced by or for, or is under the control of the U.S. government is eligible to be classified."[21] In 1997, the "Moynihan Commission" found that roughly 3 million people in the United States had the ability to classify information.[22] During this committee's meetings, university officials reported that they had significant concerns about not only the increase in the types of research considered classified but also in the

[21] Center for Strategic and International Studies (CSIS). 2005. *Security Controls on Scientific Information and the Conduct of Scientific Research*. Washington, D.C, p. 5.
[22] Named after its Chair, Senator Daniel Patrick Moynihan, "Report of the Commission on Protecting and Reducing Government Secrecy." 1997. Senate Document 105-2 Pursuant To Public Law 236, 103rd Congress. Washington, D.C.: U.S. Government Printing Office.

variability within and among agencies in classification policies and practices. A participant at the May 2006 regional meeting noted the tendency for over reaching on classifications:

> I used to do declassifications as a GS-9 in the Pentagon, and no one ever got promoted for giving away information. The only safe thing to do as a junior person in the bureaucracy is to make sure you never let anything out of the bag you shouldn't. So you are always going to say no and err on the side of caution. There needs to be a higher level place where … supervision can kick in and free up the information.[23]

Most universities do not pursue classified research on campus because of concerns that restrictions placed upon facilities, access, and participation are counter to the free flow of individuals and information that is typical of the university setting.[24] As more research is considered classified, the disadvantages of excluded or exclusive research becomes greater. Stanford President John L. Hennessy noted:

> . . . our ability within the university to monitor access and information flow is limited. We could find ourselves either rejecting outright potential research grants or research directions that required such restrictions or placing them in separate wholly contained units that essentially segregate them from the rest of the university. This would, of course, end up in a situation where we segregate the participants and create what is essentially a different unit.[25]

Nonetheless, a small number of universities have been willing to accept classified research on campus. The committee heard that "at Georgia Tech we have no policies that prohibit faculty members or students from

[23] Lincoln P. Bloomfield, Jr. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at Massachusetts Institute of Technology. May 15. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.
[24] Comments of Rachel Claus and Michael Nacht, September 27, 2006, regional meeting.
[25] John L. Hennessy. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University, September 27.

engaging in any kind of research they want to pursue,"[26] and Georgia Tech has established a program whereby classified research can be carried out on campus.

In particular, however, concerns were expressed that inconsistent and arbitrary use of the "sensitive but unclassified," designation may be eroding some of the freedoms spelled out in NSDD-189. Research administrators attending the committee's regional meetings described the difficulty of anticipating and implementing the requirements for SBU information and recommended that SBU should be largely (if not fully) eliminated. Many commented that if something affects national security it should be classified. Stanford University President John L. Hennessy asserted, "From the university's perspective, restrictions on access to information are best delineated by clear boundaries such as the one created by classification or by outright restrictions on entry to the United States for individuals that pose a threat to our country." Many speakers presented the view that the U.S. should do an effective review of an individual at the point of determining whether to issue a visa. Once a visa has been granted, individuals should be accorded the same opportunities for study and research as U.S.-born students. Universities and their faculty and staff must be vigilant about reporting unusual behavior of any student, foreign or U.S.-born.

Other meeting participants expressed concern about the disparate and at times seemingly liberal use of the SBU designation across agencies noting that DHS is considering developing a policy definition of SBU research conducted at DHS-funded university-based centers of excellence that is contrary to the principles of NSDD-189. At the June 2006 regional meeting, Wayne Clough, President of the Georgia Institute of Technology, summarized the dilemma:

> What it boils down to is that we have no consistent policy. This is one of the problems that we have; we don't know which answer is the one we should use. What the Department of Energy finds acceptable today, the Department of Homeland Security may reject tomorrow.

[26] Stephen E. Cross. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 14, 2007.

> What NSF considers legitimate may be unacceptable to the Department of Defense.[27]

The use of SBU is particularly troubling because it has no single definition. Indeed, a 2006 GAO report found that federal agencies use 56 different designations for information that has been determined to be SBU.[28] Further, the report found that there are no government-wide policies or procedures detailing how an agency should designate and handle SBU research. Consequently, inconsistent and contradictory policies can be found throughout the government. The arbitrariness of this designation means that research universities must contend with unclear definitions and variability in policy from agency to agency.

In an attempt to improve the government's sharing of information, in December 2005, the President issued "Guidelines and Requirements in Support of the Information Sharing Environment," which included a Guideline entitled "Standard Procedures for SBU." The President's memo called on agencies to develop standard procedures for handling SBU information. "To promote and enhance the effective and efficient acquisition, access, retention, production, use, management, and sharing of Sensitive But Unclassified (SBU) information, including homeland security information, law enforcement information, and terrorism information, procedures and standards for designating, marking, and handling SBU information must be standardized across the Federal Government."[29] At the committee's Georgia Tech meeting, a DHS official informed the committee of the difficulty in trying to work through the various definitions, categories, and policies for designating, marking, and handling SBU. An ongoing government review of the use of SBU will be reported to the Director of National Intelligence, who is expected to present recommendations on standardized SBU procedures for the President's approval in 2007.

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[27] G. Wayne Clough. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

[28] U.S. Government Accountability Office. 2006. "Information Sharing: The Federal Government Needs to Establish Policies and Processes for Sharing Terrorism-Related and Sensitive but Unclassified Information," Washington, D.C.: GAO.

[29] Memorandum from the President for the Heads of Executive Departments and Agencies, Subject: Guidelines and Requirements in Support of the Information Sharing Environment, December 16, 2005.

At the MIT regional meeting, Judith Reppy, Cornell University, said: "In many cases, these new regulations have been implemented with very little regard for the core values [or benefits] of the university, namely, the free and open exchange of information." [30] Others noted that classification policies have become more complex, farther reaching, and in the view of some, inconsistent and illogical. Judith Reppy went on to note:

> …in practice, the regulations in this area are so complex that they can only be understood by specialists, which is why we have these new bureaucracies. The rules as they are written … are really arcane for any normal person. I think the real problem here though is one of consistency.[31]

A survey of 20 institutions in 2003-2004 conducted under the auspices of the Association of American Universities and the Council on Governmental Relations found 138 instances of attempts by the government to restrict publication of data or foreign national participation in research. Most of these restrictions showed up with the inclusion of the Defense Federal Acquisition Regulation Supplement (DFARS) 7000 clause, which relates to access or the generation of unclassified information that may be sensitive.[32] Anecdotal information presented at the regional meetings indicates that restrictions are continuing to be placed in research awards; however, it is not known whether the number and frequency of restrictions is increasing.

Recommendation 3: The data collected in the 2004 Association of American Universities and Council on Governmental

[30] Judith Reppy. 2006. Remarks made to the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at Massachusetts Institute of Technology. May 16. Available at www7.nationalacademies.org/stl/032896.pdf. Accessed February 14, 2007.

[31] Ibid.

[32] Association of American Universities/Council on Governmental Relations 2004. *Restrictions on Research Awards: Troublesome Clauses, A Report of the AAU/COGR Task Force*. DFAR 252.204-7000, Disclosure of Information, reads: "When the Contractor will have access to or generate unclassified information that may be sensitive and inappropriate, include the clause DFARS 252.204-7000." The clause addresses release of information without prior approval.

Relations report, *Restrictions on Research Grants and Contracts*, should be updated annually. The report should be expanded to include review of other restrictive clauses and should specifically review the use of the "sensitive but unclassified" category. The results of this report should be provided to the U.S. Office of Science and Technology Policy and the proposed new Science and Security Commission (Recommendation 12) and released to the broader academic community.

Export Controls and Deemed Exports

The federal government also attempts to control the flow of information and materials through export control and arms trafficking regulations. Specifically, the Department of Commerce implements the EAR that bars the export of items, technology, and technological information found on the Commerce Control List[33] to foreign countries without appropriate export licenses. The EAR covers the transfer of dual-use commercial goods. In addition, the Department of State implements the ITAR, which regulates the export of items, technology, and technological information maintained on the U.S. Munitions List.[34] The ITAR focuses on armaments and military technologies. Both the EAR and the ITAR contain exclusions for fundamental research. However, some research can be subject to both sets of regulations. Participants at the committee's regional meetings noted that these lists are out of date, in part because other countries' technologies have surpassed those of the United States in some areas. Several meeting participants noted that many of the items on the Commerce Control List and the U.S. Munitions List are outdated technologically and broadly available and not controlled in other countries. Yet companies and universities are required to comply with the lists.

In addition to these export controls, "deemed exports" refer to the transfer of controlled information to a foreign national within the United States, such as a foreign scientist working in a university laboratory.[35]

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[33] The Commerce Control List can be found at *www.access.gpo.gov/bis/index.html*.
[34] The Munitions Control List can be found at *www.access.gpo.gov/nara/cfr/waisidx_01/22cfr121_o1.html*.
[35] The USA PATRIOT Act (P.L. 107-56) also has provision to control access to information by foreign nationals. In particular, access to select agents (biological and toxin agents on a

"Universities generally rely on the fundamental research exclusion to exempt the research performed there from export control."[36] Otherwise, for foreign nationals working in U.S. laboratories to have access to this controlled information, the institution must apply for a license. According to Sue Eckert, Senior Fellow at the Watson Institute for International Affairs at Brown University and former Assistant Secretary of Commerce for Export Administration, approximately one thousand deemed export licenses are requested every year and only one percent are denied.[37]

Under the National Defense Authorization Act (NDAA) for Fiscal Year 2000, the IGs of the Departments of Commerce, Defense, Energy, and State, in consultation with the Directors of the CIA and FBI, are required to conduct an eight-year assessment of the adequacy of current export controls and counterintelligence measures to prevent the acquisition of sensitive U.S. technology and technical information by countries and entities. In April 2004, these offices issued seven reports focused on deemed exports regulations, including an interagency review that summarizes the findings and recommendations of the six individual agency reports. The reports of the Department of State, DHS, and CIA remain either classified or publicly unavailable. The publicly available agency reports were particularly troubling for research universities because they called for a re-examination of several federal export license rules from which universities have historically believed they were exempt. Given that the primary mission of the university system is the dissemination of knowledge, the potential for conflict was considered substantial.

The Department of Commerce IG report was the first to attract the attention of the university community for two reasons: 1) it contained a surprising change in the interpretation of existing regulations, and 2) a large number of items would be affected by the changes suggested in the report, including common laboratory tools such as furnaces, portable electric generators, gas leak detectors, centrifuges, and fermenters.

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select list) or information about those agents is barred to students and researchers originating from countries that support terrorism.

[36] G. J. Knezo. 2006. "Sensitive but Unclassified" information and other controls: policy options for scientific and technical information. *CRS Report for Congress*, February 15.

[37] Sue E. Eckert. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at Massachusetts Institute of Technology. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.

With regard to the first issue, universities long assumed that fundamental research was excluded from deemed export regulations. The Commerce IG report, however, concluded that only the outputs of research (e.g., publications) were excluded; the inputs (e.g., access to controlled equipment used in the conduct of research) were not. The rationale for this interpretation was that the fundamental research exclusion, NSDD-189, exempts that which "arises from or during" fundamental research.

As the CSIS White Paper on *Security Controls on Scientific Information and the Conduct of Scientific Research* points out, that rationale is clearly wrong:

> *Inconsistency with NSDD-189.* The Inspector General's report contains only a passing reference to NSDD-189, and that discussion deals only with the *results* of fundamental research; it makes no mention of the Directive's parallel discussion of the *conduct* of such research. Perhaps for this reason, the IG report does not address the apparent inconsistency between its recommendation to expand deemed export controls and NSDD-189's direction that "no restrictions may be placed upon the conduct … of [unclassified] federally-funded fundamental research". . . Admittedly, the same inconsistency can be found in the position of the Commerce Department's Bureau of Industry and Security, which according to the IG report asserts that "technology relating to controlled equipment … is subject to the deemed export provisions *even if the research being conducted with that equipment is fundamental*". . . Nevertheless, the Bush Administration's reaffirmation of NSDD-189 can be interpreted to mean that deemed export controls should not be applied at all to fundamental research, much less expanded.

Nonetheless, the Department of Commerce continues to distinguish research results and conduct. Some have argued that the first error is "the assertion that not only is the deemed export rule consistent with NSDD-189, but that NSDD-189 clarifies that the product that results from fundamental research is distinct from the conduct involved in the research."[38] Although NSDD-189 may clarify that the two are distinct, the directive categorically

[38] See *www.fas.org/blog/secrecy/2006/05/deemed_exports_commerce_depart.html*#comment-2914, p. 9.

asserts that they are to be treated the same. Thus, regardless of whether or not the *conduct* of research is differentiated from the *product* of research, neither one should be subject to these controls.

In addition to these new interpretations of existing regulations, the Commerce IG report was troubling to the research community because of the number and scope of research activities that would be affected if a blanket "fundamental research exclusion" no longer applied. The research community initially interpreted the IG's proposal to mean that licenses would be required for foreigners to have access to all items on the extensive Commerce Control List, making the impact on research unimaginably large. Additionally, far-ranging discussions ensued over the surprisingly major implications of the Commerce IG's proposal to change the word "and" to "or" in the list of disallowable knowledge transfer activities (e.g., operation, installation, maintenance, repair, overhaul, and refurbishing).

The report also suggested that, while U.S. Green Card holders could be assumed to have a U.S. affiliation, the IG recommended that deemed export policies be determined by the country of origin of non-U.S. residents, in addition to or notwithstanding their country of most recent citizenship. For example, permanent residency in Canada should not automatically lead to the assignation of "Canada" as the country of affiliation for an individual born in China. This proposed change generated a tremendous controversy in industry and academia.

In response to widespread concern in the academic community about the changes proposed in the IG report, the Department of Commerce Bureau of Industry and Security (BIS) officials engaged in public meetings and onsite campus visits.[39] After many long discussions with the university community, site visits to a number of willing host institutions, and the National Science and Technology Council's formation of a task force on deemed exports (co-chaired by DOD and DOE), the Department of Commerce published a request for comments in the *Federal Register* on the IG's proposed changes.

Because of the overwhelmingly critical responses to the proposed changes, in July 2006, BIS announced its withdrawal of the Advanced Notice of Proposed Rulemaking and the establishment of a Deemed Export Advisory Committee (DEAC) charged with evaluating policies and

[39] A transcript from the National Academies workshop on deemed exports held on May 6, 2005, to discuss the Department of Commerce proposal can be found at *www7.nationalacademies.org/stl/*.

recommending actions. While the announcement was generally welcomed by the university research community, one aspect remains a concern. In the announcement BIS distinguishes the information or product (i.e., a scientific paper) that results from fundamental research from the conduct that occurs within the context of the research.[40] The product is not subject to the EAR, but a license still may be required if "during the conduct of the research controlled technology is released to a foreign national." The announcement goes on to assert that this distinction between the research results and the conduct of fundamental research is consistent with NSDD-189. Under the BIS interpretation, licenses still may be required for access to controlled-use technology unless it meets the "publicly available" or other exclusion. So the research community remains concerned about the status of NSDD-189 and the fundamental research exclusion as evidenced in discussions at the Georgia regional meeting with then Commerce Undersecretary David McCormick. At that meeting the Undersecretary indicated that DEAC would take up the matter of the status of NSDD-189 if it identified it as an issue worthy of high-level attention.

In 2005, DOD issued a proposed rule responding to the DOD IG's March 25, 2004, report. The proposed rule would add an additional clause to DOD contracts that *may* involve export-controlled information or technologies and would mandate compliance plans that would include "unique badging requirements for foreign nationals and foreign persons and segregated work areas for export-controlled information and technology."[41] The university community objected to the proposal, with many noting that the proposed rule went beyond the current requirements in export control regulations and failed to acknowledge the fundamental research exclusion.

Following much discussion with academic and industry groups, in 2006 DOD issued a new proposed rule. The 2006 proposed modifications would alter the intent and language of the agency's 2005 proposed rule on export controls. The revised language acknowledges the "fundamental research exclusion" for academic research from export licensing requirements. It also no longer requires that universities and medical schools

[40] NSDD-189 itself states that "[n]o restriction may be placed *upon the conduct or reporting* of federally funded research…." [emphasis added].

[41] Department of Defense. 48 CFR Parts 204, 235, and 252 (DFARS Case 2004-D010). Defense Federal Acquisition Regulation Supplement; Export-Controlled Information and Technology. *Federal Register*. 70(132):39976-39978. Available at *www.fas.org/sgp/news/2005/07/fr071205.html*. February 14, 2007.

with certain types of DOD contracts maintain unique identification badges and segregated work areas for foreign nationals where certain technology is involved. This second proposed rule includes:

> …less prescriptive contractor requirements, in recognition of existing related Department of Commerce and Department of State regulations; addresses the responsibilities of the requiring activity in identifying acquisitions involving export-controlled information and technology; and contains three separate contract clauses tailored for use in contracts for research and development, fundamental research only, and supplies or services.[42]

Even with the withdrawal of the proposed changes in the Commerce language and the revisions to the DOD language, academic institutions are still likely to encounter difficulties interpreting and implementing the deemed export requirements. A Congressional Research Service report summarized the problems:

> …members of the academic community cite problems administering use controls, including ambiguity about identifying which equipment or material in university laboratories is subject to export controls; discrimination on the basis of nationality; difficulty in controlling access of students and researchers in university laboratories; time required to obtain licenses and inflexibility in obtaining licenses; modest security benefits; slowing or preventing important discoveries due to licensing delays; loss of research talent if students and researchers study in other countries; and reduction in research at the leading edge of science.[43]

On the other hand, those in the intelligence and security communities are committed to identifying and controlling threats within our borders—thus, the tension. At the inaugural meeting of the committee, Michelle Van Cleave, Office of the National

[42] See proposed modifications at *www.acq.osd.mil/dpap/dars/dfars/changenotice/*.
[43] G. J. Knezo. 2006, p.6.

Counterintelligence Executive, reminded the committee of the intelligence community's mission:

> It will sound familiar to many of us who have looked at the whole question of the prosecution of the global war on terrorism and what it means to be able to understand the presence of terrorist activities in the United States and how vital and important it is that we find ways to know where terrorists may be recruiting and training and planning operations within the United States, preparing for attacks, that kind of a compelling mission to deal with terrorist threats, to protect the American public, has been one that has animated the President's national security strategy in the global war on terrorism, where he has said that we are not going to sit back and wait for these threats to manifest themselves and harm us here.[44]

In December 2006, the U.S. Government Accountability Office reported that "The federal government is not doing enough to ensure that colleges are keeping sensitive technologies out of the hands of foreign spies and terrorists."[45]

Participants at the Georgia Tech regional meeting expressed their belief that the current Control Lists trivialize the real issues for concern and that a serious effort must be made to reduce the number of items on the lists. Statements by law enforcement and federal officials that export controls are not an effective way to address national security threats reinforced this perception.[46] As stated by DHS Assistant Secretary for Policy Stewart

[44] Michelle Van Cleave. 2006. Remarks made at a meeting of the Committee on New Government-University Partnership for Science and Security. The National Academies. January 12-13.

[45] *Export Controls: Agencies Should Assess Vulnerabilities and Improve Guidance for Protecting Export-Controlled Information at Universities*. Available at *www.gao.gov/new.items/d0770.pdf*. Accessed February 14, 2007.

[46] Timothy Bereznay and Stewart Baker. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.

Baker, "I will posit that immigration policy, visa policy, export control policy is not the answer. I'm not convinced that we have the answer."[47]

In October 2006, the Council on Governmental Relations sent a letter to DOD expressing its concerns about the evolving policy, including, "the conceptual framework for use of the three DFARS contract clauses set forth in the proposed rule, the characterization of the fundamental research exclusion from export controls, and the need to address what happens when there is disagreement between DOD and university contractors. …[We] remain concerned about assuring the necessary level of understanding of the export regulations on the part of DOD program and contracting staff."[48] COGR emphasized its concern "that it is inappropriate for DOD contracting officers to make determinations on the applicability of export controls," adding that "contractors have the legal responsibility to comply with these requirements, and they are in a better position to determine whether the fundamental research or other exclusion or license exclusion applies to the performance of particular projects."[49]

Although the committee applauded the willingness of the Departments of Commerce and Defense to consider the concerns of the university community, it expressed the belief that additional work needs to be done on export controls. Consequently, the committee makes the following recommendation:

> **Recommendation 4: In view of the growing globalization of technology and science, the Departments of Commerce and State should conduct regular government-wide reviews of export control policy with special emphasis on streamlining, removal of outdated items, and updating the Commerce Control List and the U.S. Munitions List to reflect current status in technology and science and to identify truly unique and military critical technologies unavailable elsewhere. The proposed new Science and Security Commission (Recommendation 12) should work with the Departments of Commerce, Defense, and State in moving this review forward.**

[47] Stewart A. Baker. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.
[48] Letter from Anthony DeCrappeo, President, COGR, to Ms. Debra Overstreet, OUSD (AT&L), DPAP (DARS), IMB 3C132, The Pentagon, October 13, 2006.
[49] Ibid.

Summary

Representatives of the research community told the committee that, in the interest of national security, the United States must be cautious about actions that unduly prevent the dissemination and exchange of information with other governments and research and academic institutions. Overly restrictive measures pose the danger that the United States could stultify its own efforts to achieve progress in scientific research by severing long-established ties with the global scientific community. This could undermine, rather than enhance, U.S. security. As Michelle Van Cleave, National Counterintelligence Executive, Office of National Counterintelligence, warned the committee, "…you can't so lock down this country, our institutions, and our people to protect against all threats at all times. If we tried to do that, we would become a society that we wouldn't want to be."[50]

[50] Michelle Van Cleave. 2006. Remarks made at a Committee on New Government-University Partnership for Science and Security meeting. The National Academies. January 12-13.

III. The Internationalization of U.S. Science and Engineering

The education and training of new scientists is an international endeavor, ensuring that the next generation of innovators is prepared, supported, and encouraged to seek breakthroughs in knowledge for the betterment of society. Science thrives when there is a free exchange of information and when scientists (embodying that information) are able to cross borders to train, collaborate, and share knowledge. As the United States continues to strengthen its efforts to encourage its sons and daughters to pursue careers in science, it also must remain open to the knowledge, creativity, and talent of foreign-born individuals. "To remain competitive in the coming decades, we must continue to embrace the most capable students and scholars of other countries. Our security and quality of life depend on it."[51]

For more than 50 years, U.S. research universities have welcomed and fostered the talents of both foreign-born and U.S. students in the service of national and economic security. Since World War II, the United States has experienced a steadily growing inflow of students and postdoctoral scholars from throughout the world, most rapidly during the 1990s.[52] Foreign-born scientists and engineers come to the United States, stay in large numbers, and make significant contributions to America's ability to achieve and maintain technological and economic leadership. Between 1990 and 2004, more than one-third of Nobel Prizes in the United States were awarded to foreign-born scientists. One-third of all U.S. Ph.D.s in science and engineering are now awarded to foreign-born graduate students. Today, the total number of foreign citizens studying in the United States (including undergraduates) has passed the half-million mark. Nearly one-third of all graduate students enrolled at U.S. universities come from abroad.[53]

Clearly, both domestic and international scientists and engineers have an opportunity to make a lasting impact on the U.S. economy. Their impact

[51] C. D. Mote, President, University of Maryland. 2005. Testimony before the House Committee on Education and Workforce, Subcommittee on 21st Century Competitiveness and Select Education Committee on Education and the Workforce. March 17.
[52] National Science Board. 2004. *Science and Engineering Indicators 2004* (NSB 04-1). Arlington, VA: National Science Foundation, pp. 1-12.
[53] J. Oliver. 2006. *First-Time Science and Engineering Graduate Enrollment of Foreign Students Drops for the Third Straight Year* (NSF 06-321). Arlington, VA: National Science Foundation.

can be inferred from, if not proven by, their participation in U.S. universities, industries, and national laboratories after they receive their doctorates. Foreign-born doctorate-level scientists and engineers constituted 37.3 percent of the U.S. science and engineering labor force in 2000, an increase from 23.9 percent in 1990.

Skilled immigrants may contribute at many levels—as technicians, teachers, and researchers—and in other occupations for which technical training is desirable. Also, research suggests that they generate economic gains by adding to the processes of industrial and business innovation. Such innovations tend to contribute to the future productivity gains of both citizen and immigrant workers, which results in a net increase in real wages. The high level of participation of foreign-born scientists and engineers in U.S. laboratories and classrooms warrants increased efforts to ensure that policies regarding their movement and activities are adequate and not unduly punitive.[54]

In the wake of the September 11, 2001, terrorist attacks, and the subsequent anthrax incidents, some public officials became concerned that research universities in particular could be at heightened risk of terrorism, vandalism, and cyber attacks. As a result, there has been increased pressure on academic institutions to monitor the activities of foreign national students and scholars, and the government has imposed greater restrictions on obtaining visas for foreign-born scientists wishing to train or work in the United States.

Policies, such as the USA PATRIOT Act and proposed increased restrictions through deemed exports, have placed new strains on universities that rely on foreign national students for much of their talent; that rely on a diverse student body as a key part of the education experience of students, faculty and scholars; and that rely on foreign national faculty and research scholars for their critical contributions. In the view of some, the current and proposed policies could unjustifiably stigmatize foreign national students by requiring them to wear special identification and to have special controls on access to laboratories. These policies run directly counter to the principle of

[54]The National Academies. 2005. *Policy Implications of International Graduate Students and Postdoctoral Students in the United States*. Washington, D.C.: The National Academies Press.

nondiscrimination in universities, and there is no way to enforce them without creating a second-class status for these particular individuals.[55]

Moreover, "foreign students have taken on a different importance now," said Suzanne Berger, MIT, at the committee's May 2006 regional meeting. "The best companies today are those that have mastered operating in [a] fragmented world" where production, research, development, design, and distribution systems operate or are located in separate places or realms. "[Students/researchers] are going to have to access knowledge and capabilities outside their own organization's boundaries, and they are going to have to coordinate and bring together knowledge and capabilities that are outside their own organization's borders and outside their own country's borders."[56] The impact of international scientists and engineers on U.S. industries, as measured by their presence, is considerable. Skilled immigrants are highly mobile, and one study concludes that most technology industries in which they are concentrated are fast-growing exporters and leading contributors to the nation's economic growth.[57] International scientists and engineers contribute actively to our economic growth, and additionally, while here as students, they contribute to the overall educational experience of U.S.-born students by providing them with a better appreciation and knowledge of the world. A 2005 Committee on Science, Engineering, and Public Policy report stated the following:

> The participation of international graduate students and postdoctoral scholars is an important part of the research enterprise of the United States. In some fields they make up more than half the population of graduate students and postdoctoral scholars. If their presence were substantially diminished, important research and teaching activities in academe, industry, and federal laboratories would be curtailed,

[55] Judith Reppy. 2006. Remarks made to the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032896.pdf*. Accessed February 14, 2007.
[56] Suzanne Berger. 2006. Remarks made to the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032896.pdf*. Accessed February 14, 2007.
[57] A. L. Saxenian. 2001. *Silicon Valley's New Immigrant Entrepreneurs* (Working Paper No. 15). San Diego, CA: Center for Comparative Immigration Studies, University of California. Available at *www.ccis-ucsd.org/PUBLICATIONS/wrkg15.PDF*. Accessed February 14, 2007.

particularly if universities did not give more attention to recruiting and retaining domestic students.[58]

Recent Trends in International Graduate-Student Enrollments

Following the dramatic increases in international student enrollments in the 1980s and 1990s, enrollments showed a marked decrease following the terrorist attacks of September 11, 2001. Most institutions attributed these declines to visa denials and delays. For the year 2002, NSF noted a decrease in first-time, full-time science and engineering graduate enrollments among temporary residents, by about 8 percent for men and 1 percent for women.[59]

The Council of Graduate Schools has been tracking international graduate student application, admission, and enrollment data since 2003.[60] Compared to 2003, it found a substantial decrease in international student applications for graduate study in U.S. institutions in 2004. These decreases were seen in all fields and for almost all countries. Concerns about these trends were expressed by many participants in the committee's regional meetings, including Georgia Tech President Wayne Clough who remarked:

> Thirty years ago, the United States was conferring 54 percent of the world's Ph.D. degrees, but by 2001 our share dropped worldwide to 41 percent. China, which was virtually offering no Ph.D.s as recently as 20 years ago, now produces 12 percent, and that is rising. Doctoral degree recipients in nations like India and China also have a growing range of opportunities for employment at home. As nations like these develop world-class universities and skilled work forces, high tech corporations pay attention, and they locate there because of the talent.[61]

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[58] Committee on Science, Engineering and Public Policy. 2005. *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States*, p. 65.
[59] National Science Foundation. 2004. *Graduate Enrollment in Science and Engineering Fields Reaches New Peak; First-Time Enrollment of Foreign Students Declines* (NSF 04-326). Arlington, VA: National Science Foundation.
[60] Council of Graduate Schools. International Graduate Admissions Survey. Available at *www.cgsnet.org/Default.aspx?tabid=172*. Accessed February 14, 2007.
[61] Wayne Clough. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 4. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

However, by 2006, the decreases had reversed course in all fields. After three consecutive years of decline, the Council of Graduate Schools reported an increase in total foreign enrollment of one percent in 2006, and the number of new foreign students increased by 12 percent, led by newly entering students from India and China.[62] While the data do not indicate a full recovery, they do suggest that international students are still interested in studying in the United States, and that the recent policies enacted by the Departments of State and Homeland Security to streamline and shorten visa processing, as well as procedural changes in admissions and recruitment processes by educational institutions, have been effective, although some concerns remain about re-entry. In addition, in November 2006, the Department of State amended its regulations and extended the permitted program duration from three to five years for professor and researcher participants.[63] These measures have gone a long way to reduce some of the early concerns about an apparently unwelcoming environment for international students and scholars after September 11, 2001. However, it may be too soon to tell if increasing competition for science and engineering students will continue to draw international students away from U.S. graduate education, or if increasing educational capacity abroad will affect the numbers of students applying for graduate study in the United States.

Several participants at the regional meetings expressed continuing concerns about the ability of U.S. and international scholars to freely exchange information through meetings and conferences and to work with items on the Technology Alert List (TAL) (i.e., technologies with potential dual-use applications), which some believe to be too broad, inhibiting legitimate areas of scientific inquiry. They cautioned that the TAL has been stretched far beyond its original purpose of denying access to those who the government has reason to believe seek to violate export control laws. In addition, the discriminatory treatment of visiting faculty and scholars traveling to the United States for visits and conferences continues to be a concern among members of the scientific community.

Finally, the research community expressed interest in the establishment of a nonimmigrant-visa subcategory for doctoral-level graduate students and postdoctoral scholars. (See Box 3A for current visa

[62] Council of Graduate Schools. International Graduate Admissions Survey. Available at *www.cgsnet.org/Default.aspx?tabid=172*. Accessed February 14, 2007.
[63] Department of State. 2006. Notice of effective date for implementation of five-year professor and research scholar exchange program. *Federal Register.* 71(211):64330.

types.) As indicated in a National Academies report, U.S. visa and immigration policies ought to provide consistent, clear procedures that do not unduly obstruct the flow of international graduate students and postdoctoral students. A new subcategory would "provide a better mechanism for …officials to track student and scholar visa applicants," and would provide a "means for collecting clear data on numbers and trends of graduate-student and postdoctoral-scholar visa applicants."[64]

BOX 3A

Visas for Graduate Students and Postdoctoral Scholars

Graduate students typically obtain an F or J visa to study in the United States. To apply, they must supply proof of acceptance at a United States institution and also provide evidence that their current intent is for further study and research, not to immigrate. Postdoctoral scholars use a variety of visas to train in the United States, with the majority using a J visa. A substantial proportion enter on H-1b visas; several other visa classes include O, TN, EA, F, B, G, WB, A, L, and PR.

-- *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States.*

Summary and Recommendations

The participation of international graduate students, postdoctoral scholars, faculty, and research scholars is an integral element of the research enterprise of the United States. For example, in some fields these students, faculty, and scholars make up more than half of the populations of graduate students and postdoctoral scholars. Foreign students and scholars—both those who are here temporarily and those who remain here—provide the United States with an additional and important pool of talented individuals. Many foreign students and scholars who return to their home countries serve as ambassadors of goodwill, establishing close ties between the United States and their home countries, and they become important national leaders in their home countries. If their presence were substantially diminished, important research and teaching activities in academe, industry, and federal laboratories would be curtailed. Advancements made by other countries now offer foreign students the opportunity to receive a first-rate education and training in countries other than the United States—and the same is true for foreign faculty and researchers. Thus, if we drive them away, there is a double

[64] The National Academies. 2005. *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States* Washington, D.C.: The National Academies Press.

penalty, since we lose and our economic competitors and our potential future competitors gain.

Although it is clear that earlier concerns about undue restrictions on the entry and activities of international students in U.S. research institutions have been allayed, the committee determined that ongoing oversight and policy changes are critical to ensure continued progress in this area. Regional meeting attendees told the committee that universities and the U.S. government should continue to encourage and welcome talented students and scholars from around the world. They noted that although progress has been made with respect to foreign students and scholars, much work is still needed on our policies and practices, which include encouraging the free movement of foreign students and scholars to scholarly/scientific conferences and meetings in the United States and elsewhere.

At the end of the committee's deliberations, Congress began focusing on immigration reform. The Committee is encouraged by congressional efforts that give serious consideration to policies that govern the flow of foreign scientists and engineers into the United States, such as proposals that would ease restrictions on foreign students pursuing scientific and technical degrees. Efforts such as this—coupled with congressional action to implement the recommendations of *Rising Above the Gathering Storm* that would increase the number of U.S. students who earn science and engineering degrees—could help the United States maintain its leadership position in science and engineering.

Recommendation 5: Universities and the U.S. government should continue to encourage and welcome talented students and scholars from around the world. While progress has been made with respect to granting visas for foreign students and scholars, responsible parties must work to ensure that whenever possible policies and practices are in place that encourage the free movement of foreign students and scholars to scholarly/scientific conferences and to meetings in the United States and elsewhere.

Recommendation 6: The research community and the federal government should continue to monitor the visa clearance process and address issues immediately should they arise. The Technology Alert List should be reviewed and streamlined to include areas of study that clearly have explicit implications for

national security. Additionally, Congress should consider creating a new nonimmigrant visa subcategory for doctoral-level graduate students and postdoctoral scholars coming to the United States. Student visas should be of a duration commensurate with the term of study.

Recommendation 7: The Department of State, along with other federal agencies such as the Departments of Commerce and Labor, should determine whether students and scientists here on temporary visas should be allowed to extend their stay if they are working in a scientific or technical field deemed to be in demand in the United States.

IV. Biosecurity and Dual-Use Research in the Life Sciences

In the life sciences, dual-use research "encompasses biological research with legitimate scientific purpose, the results of which may be misused to pose a biologic threat to public health and/or national security."[65] Generally, the term tends to refer to technologies that have both a civilian and a military use. The dual-use research dilemma in the life sciences refers to the conundrum of producing and publishing research within the life sciences that is directed toward or intended to improve public health, animal health, or agricultural productivity, but that in the hands of a rogue state, terrorist group, or individual, could be used to impair public health. As early as the 18th century, greater understanding of the smallpox virus led to the first viral vaccine, as well as use of the virus as a bioweapon.[66] In the wake of the anthrax attacks of 2001 and heightened concerns regarding terrorism, the more tangible possibility of bioterrorism has increased fears and concerns regarding the performance and publication of dual-use research.

Within the last 50 years alone, the scientific community has solved the structure of DNA and sequenced the entire genomes of 10 mammals (including the human, chimpanzee, mouse, rat, dog, and cat), 2 other vertebrates, 6 invertebrates, 3 protozoa, 9 plants, and 14 fungi,[67] not to mention numerous viruses and bacteria. Only 30 years ago, one could spend years on a doctoral thesis to sequence one gene. In contrast, with current technology, the sequencing of one gene can occur in a matter of hours. In 2002, a group of researchers published its work describing the synthetic reconstruction of poliovirus, a project that took three years.[68] The next year, the reconstruction of an equivalently sized virus took only two weeks.[69] The exponential increase in sequencing and synthetic biology technologies reflects the increased productivity and advancement throughout the life

[65] The NSABB dual-use research definition is available at *www.biosecurityboard.gov/faq.asp#14*.
[66] National Research Council. 2004. *Biotechnology in an Age of Terrorism*. Washington, D.C.: The National Academies Press. p. 34.
[67] See *www.ncbi.nlm.nih.gov/mapview/*.
[68] J. Cello, et al. 2002. Chemical synthesis of Poliovirus cDNA: Generation of infectious virus in the absence of natural template. *Science.* 297(5583):1016-1018.
[69] H. O. Smith, et al. 2003. Generating a synthetic genome by whole genome assembly: ϕX174 bacteriophage from synthetic oligonucleotides. *Proceedings of the National Academies.* 100(26):15440-15445.

sciences in general. The rise of biotechnology, informatics, and automation has decreased the labor required and the time to knowledge acquisition, while increasing productivity and the number and types of questions that biologists can address. Such a convergence of biology and technology increases the pace of biological findings and the creation of new fields within biology in unpredictable ways. The discoveries and innovations that are happening today will precipitate advances over the next 30 years, and most likely even over the next 5 to 10 years—discoveries and innovations that have not even been envisioned at this time.

In addition, life sciences research occurs in an increasingly interdisciplinary and international environment. As George Church, Director of the Center for Computational Genetics at the Harvard Medical Center, pointed out at the May 2006 regional meeting, "Biology has a thousand journals and the Internet allows rapid information dispersion."[70] Just as computing and other technological innovations have created new industries and sectors toward the end of the 20th century and during the early part of the 21st, technology also has pushed the boundaries of the life sciences. Now, when research in the life sciences is considered, computational biology, systems biology, nanotechnology, and synthetic biology are at the forefront of such discussions. These fields blend biology—from whole organismal biology to microbiology—with computer science, the physical sciences, engineering, and mathematics.

Although the risk that pathogens will be used for harm has been around for centuries, the emerging global, fast-paced, and collaborative nature of the life sciences now makes protecting information, personnel, and materials from abuse that much more difficult. To effectively identify dual-use research of concern, and perhaps restrict it, techniques must be available to determine what types of biological agents could stand as threats, as well as what types of mathematics, software programs, physical materials, and computational tools could enhance biological threats. The ability to understand the ways that these emerging biology applications could be used for offensive purposes poses a formidable challenge because of the unpredictable nature of science and the ways in which new technologies that come along completely alter what can be accomplished.

[70] George Church. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf.* Accessed February 14, 2007.

Despite these important advances, in contrast with other weapons, the materials and equipment required to create and propagate a biological attack using naturally occurring or genetically manipulated pathogens remain decidedly "low-tech," inexpensive, and widely available. In the case of the physical sciences and nuclear proliferation, the development of nuclear weapons R&D required equipment that was specialized and expensive. As a result, the ability to engage in research promoting nuclear proliferation was restricted to the global superpowers and other well-funded nonstate entities. In addition, nuclear weapons R&D could be detected by monitoring the acquisitions of the specialized equipment needed for such programs and by other technical means. By contrast, much of the same equipment that can be used to create a dangerous biological agent is also a key part of benign biological research programs. Moreover, in the case of life sciences research, it is not just that much of the same materials and equipment can be used for illegal and benign research, but also that biological research can produce agents and knowledge that in the hands of some would promote human health and welfare, but that in the hands of others would be used for harm. This is the crux of what is called "dual-use research of concern."

Oversight of Dual-Use Life Sciences Research

In the late 1970s, scientists conducting research in the emerging field of recombinant DNA developed a model of oversight that involved 1) personal responsibility and accountability of the researcher to conduct his or her research safely; 2) deliberations by a nationally convened advisory group to provide recommendations regarding biosafety with recombinant DNA research; and 3) local oversight by the institution through a committee of peer researchers and biosafety professionals to assure that appropriate facilities, practices, personnel, and training were in place. Although all of these components of self-governance and local assurance were recommended for all U.S. researchers regardless of affiliation, the practical outcome of this system is that only institutions accepting federal funding for recombinant DNA research are obligated to use this model of oversight.

Discussions of oversight for dual-use life sciences research have centered on the same components as those considered 30 years ago for recombinant DNA. In 2003 the National Academies published *Biotechnology Research in an Age of Terrorism*, also referred to as the "Fink Report," after the committee chair, Gerald Fink. The Fink Report was

compiled by experts mostly from the academic community and therefore largely represented the response of the scientific community to increased concerns about bioterrorism. The report concluded that many of the current structures and regulations used to monitor and mitigate risk resulting from dual-use research were sufficient for that task; however, they needed to be enforced at a greater and more comprehensive level. The report also outlined seven categories of experiments of concern that should be scrutinized by "informed members of the scientific and medical community" as a part of any research program and in any publication. These experiments of concern generally were those that would greatly alter the transmissibility, detectability, and/or pathogenicity of a biological agent for greater use in bioterror. Such dual-use research, the report suggested, should not be prohibited, but should be scrutinized carefully, and if undertaken, should be performed under the pronounced awareness of the threat of bioterrorism.[71]

The Fink Report endorsed, among other things, expanded self-governance by researchers toward issues of biosecurity, as well as the formation of a national advisory board to help guide both the government and research community in addressing issues involving dual-use research. The report also advocated expanding the responsibilities of Institutional Biosafety Committees (IBCs), the local committees formed to oversee recombinant DNA research, to include biosecurity and dual-use concerns.

The National Science Advisory Board on Biosecurity

In response to the recommendation that a national advisory board be formed to address issues regarding dual-use research of concern, the National Science Advisory Board on Biosecurity (NSABB) was chartered by the Executive Office of the President "to provide advice, guidance and leadership regarding biosecurity oversight of dual-use research, defined as biological research with legitimate scientific purpose that may be misused to pose a biologic threat to public health and/or national security."[72] The board was formed to serve in an advisory capacity to the "secretary of HHS, the director of NIH, and the heads of all federal agencies and departments that conduct or support life sciences research."[73] In addition to the voting members, the board includes ex officio representatives from each of the

[71] National Research Council. 2004. *Biotechnology Research in an Age of Terrorism*.
[72] See *www.biosecurityboard.gov*.
[73] Ibid.

interested federal agencies. When the NSABB became fully operational in June 2005, five working groups were created to 1) outline the criteria for dual-use research; 2) assemble a code of conduct for scientists; 3) develop strategies and guidelines for the communication of dual-use research; 4) advise on the usage and regulation of synthetic genomes; and 5) foster international cooperation regarding the oversight of dual-use research. To date, the NSABB has been involved in defining dual-use research that may be of concern, creating guidelines for communication of the results of such research, developing the principles of a code of conduct, and making preliminary recommendations regarding the nascent field of synthetic genomics. It also was asked by the Secretary of HHS to review one manuscript prior to publication.[74] In 2006, the NSABB formed a working group that was to focus on the "oversight of dual-use research."[75] Specifically, this working group has made recommendations regarding 1) the review of research with dual-use potential by local entities, the government, and/or NSABB; 2) risk assessment of research; 3) risk management of dual-use research; and 4) education of institutions and individuals regarding dual-use research.

Nearly all presenters addressing the dual-use dilemma at the regional meetings stressed that life sciences research is now nearly borderless and is a global collaborative activity. In this era of globalization, the boundaries of national security do not end at our borders—they extend across the world. It has been stated that if controls and regulations regarding dual-use research are instituted or followed only in the United States, they will be meaningless because the scientific enterprise is global. Unilateral regulations will disproportionately affect U.S. science, threatening our dominance in certain areas and hampering crucial collaborations with non-U.S. scientists. These factors make it necessary to include in a conversation about dual-use research and national security the ways in which the United States can work with other nations to fortify our biosecurity measures for their ultimate effectiveness. In this regard, several national and international scientific bodies have released statements regarding biosecurity and their stances toward the movement, procurement, and use of bioterrorist and dual-use agents for malevolent purposes.[76] Although developing individual statements

[74] Donald Kennedy. 2005. Better never than late. *Science.* 310(5746):195.
[75] NSABB meeting July 13, 2006. Available at *www.biosecurityboard.gov*.
[76] Biotechnology and Biological Sciences Research Council, Medical Research Council, Wellcome Trust. 2005. "Managing risks of misuse associated with grant funding activities: a

regarding dual-use research is a necessary first step, it is still critical to harmonize international efforts to inhibit the misuse of dual-use research.

Self-Governance Versus Regulation

To date, the response of the scientific community largely has been to assert the value of open scientific dialogue and exchange of information, self-governance, and increased communication among all affected sectors. However, others support mandatory government regulations in addition to, or in lieu of, voluntary measures.[77] For example, Elisa Harris told the committee at the June 2006 regional meeting that "The choice is not between regulation or self-governance. Neither one on its own is sufficient to be effective. To develop an effective response, we need to do both. We need self-governance and we need regulation."[78] Others at the regional meetings suggested the need for more strenuous measures in certain areas of the life sciences. For example, at the May 2006 regional meeting, George Church proposed surveillance measures, in synthetic biology, "of the whole stream of chemicals from precursors, which are unique to oligonucleotides, to synthetic genes to instruments that employ these, to even experts in the field."[79] At their 2006 meeting, Synthetic Biology 2.0, synthetic biologists were offered a draft "community declaration" regarding the ethical use of synthetic biology and the governance of synthetic biology research as it relates to the threat of bioterrorism. This proposal for self-governance would have been consistent with the "culture of responsibility" that NSABB is urging the life sciences community to develop, and it also might have had the effect of staving off "attempts to set controls or limits on the field."[80] Draft

Joint BBSRC, MRC and Wellcome Trust policy statement," September 2005; InterAcademy Panel. 2005, "IAP Statement on Biosecurity," November 2005. InterAcademy Panel.

[77] D. Malkoff and M. Enserink. 2003. Researchers await government response to self-regulation plea. *Science.* 302(5644):368; GeneWatchUK, May 19 2006 press release, *Global Coalition Sounds the Alarm on Synthetic Biology, Demands and Societal Debate.*

[78] Elisa D. Harris. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

[79] George Church. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.

[80] E. Check. 2006. Synthetic biologists try to calm fears. *Nature.* 441(7092):388.

recommendations dealt with the stated need to promote, establish, and/or standardize monitoring systems within companies, domestically and internationally, that can detect potentially harmful sequences or combinations of sequences and also to improve such monitoring technologies.[81]

At the June 2006 regional meeting, Gigi Gronval, University of Pittsburgh, cautioned against an overly restrictive approach:

> . . .I would recommend that we have to accept some level of risk from dual-use research. Scientists need to recognize that their work could be misused, and there need to be mechanisms to make sure that they do the work safely and smartly. But on the other hand, and this is more addressing a code of conduct discussion, but I don't think that scientists can promise to do no harm. They can promise to intend to do no harm, but what they uncover is very often by serendipity and there should be some mechanism to deal with the consequences of an experiment, as well as just the intent. So what is at stake if we don't accept some of this risk and push forward? We will harm research that needs to be done in a time of crisis. In conclusion, I would recommend three things, [first] that we promote self governance and we promote self awareness as scientists as best we can to make sure that work is done safety and is done as fast as possible in the public interest. Second, that the information that is uncovered that is dual use be used to inform strategy. Third, we need to get better at response in general, because eventually prevention efforts are going to fail for a deliberate attack, and it is certain, certain, certain that we are going to have another natural epidemic of a new disease that we don't know how to deal with.[82]

Related to these issues of openness and self-governance is the issue of whether the presentation of dual-use research (e.g., publication, papers at conferences, seminars) should be restricted. The practice of science being an

[81] R.F. Service. 2006. *ScienceNow Daily News.* Available at *sciencenow.sciencemag.org/cgi/content/full/2006/523/1.* Accessed February 15, 2007.
[82] Gigi Gronval. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

open, public forum that stimulates discussion and furthers the advancement of the scientific enterprise is a long-standing tenet of scientific research and one that is embraced within the life sciences community. However, there is concern that the ability of terrorists to glean information from scientific publications poses a severe risk to the public. It is possible that bioterrorists could directly or indirectly use published scientific information related to pathogens or the delivery of pathogens to plan a terrorist attack. Within the last two years, two publications precipitated a public debate regarding whether dual-use research should be openly published and disseminated. In June 2005, an article appeared in the *Proceedings of the National Academy of Sciences* that modeled a bioterrorist attack on the milk supply of the United States.[83] In October 2005, *Science* published the reconstructed genome of the 1918 pandemic human influenza virus.[84] While some argued that publishing these data was irresponsible, the prevailing view among many scientists appearing before the committee was that, generally, the risk of bioterrorism is far outweighed by the benefit of further scientific work based upon openly disseminated information and also that open dissemination, in virtually all cases, is best for national security as well.[85] The reasoning is that the ability to further the scientific frontier is based upon knowledge of where the frontier lies. Obscuring the scientific frontier could limit the progress of the scientific enterprise as a whole and perhaps would limit the abilities of terrorists very little, if at all.[86]

It has been acknowledged, however, that there may be cases in which open publication of research would not be in the best interest of national security and, therefore, some form of restriction would be needed. How that determination would be made and by whom is not clear. To determine when restriction, or other lesser measures, should be incurred, scientists and government and intelligence officials have repeatedly stated the need for

[83] L.M. Wein and Y. Liu. 2005. Analyzing a bioterror attack on the food supply: The case of botulinum toxin in milk. *Proceedings of the National Academy of Sciences.* 102(28):9984-9989.
[84] T. Tumpey, et al. 2005. Characterization of the reconstructed 1918 Spanish influenza pandemic virus. *Science.* 310(5745):77-80.
[85] P. Sharp. 2005. 1918 flu and responsible science. *Science.* 310(5745):17.
[86] Gigi Gronval. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 6. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

standardized, commonly practiced guidelines and regulations for dual-use research.[87]

Editors of scientific journals have emphasized that openness in research and publication procedures and continued self-governance are the best tools to advance science and to mitigate the threat of a successful bioterrorist attack. [88] At the September 2006 regional meeting, Donald Kennedy, Stanford University, and editor of *Science* magazine, emphasized the sense of responsibility that most editors feel:

> I think that almost everybody I know who is in the business of evaluating, peer reviewing and publishing scientific work realizes that they have some kind of a responsibility to reassure the public that they are conscious of this problem and watchful for it.[89]

Local Oversight and Assurance

IBCs normally handle biosafety issues within the life sciences, in particular with regard to recombinant DNA research. The Fink Report suggested that the IBCs also should monitor institutional biosecurity issues. Critics have argued that IBCs are not properly trained to oversee biosecurity issues and are already overburdened with tasks. In 2004, an organization known as "The Sunshine Project" requested and surveyed the minutes of IBCs and reported that, based on its undisclosed criteria, few IBCs were equipped to operate in a fully compliant and transparent manner. [90] The real problem, however, is that IBCs currently are not properly constituted to assess biosecurity risks. At the September 2006 regional meeting, David Relman, Stanford University, noted that "Today's IBC's can't do biosecurity

[87] Elisa D. Harris. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.
[88] D. Kennedy, op. cit.
[89] Donald Kennedy. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 28. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007.
[90]The Sunshine Project. 2004. *Mandate for Failure: The State of Institutional Biosafety Committees in an Age of Biological Weapons Research*. Available at *www.sunshineproject.org/biodefense/ibcreport.html*. Accessed January 12, 2007.

because the members have not been adequately informed about how you think [about] biosecurity, how you think about the potential misuse of science."[91] Nonetheless, local oversight remains a key component in providing scientific and risk-based evaluation of biosafety and biosecurity, including dual-use concerns. The history of U.S. biosafety oversight of life sciences and biotechnology research hinges on self-governance by researchers and on local risk-based oversight. Such oversight generally is delegated to IBCs. However, the requirement for convening an IBC or a similar committee is limited to those institutions receiving federal funding for research involving recombinant DNA technology. In addition, few punitive mechanisms are ever used for institutions that fail to provide adequate local oversight. These local committees often lack the necessary resources, staff, and training. Additional proposed requirements toward oversight of biosecurity issues will further stress these institutions and committees, which are already struggling to stay in compliance.

Meeting participants noted that if controls and regulations regarding dual-use research are instituted or followed only in the United States, they will be meaningless because the scientific enterprise is global. No longer are research programs relegated to one institution or even one country; many funded research programs include research professors both from within and outside of the United States. Therefore, having disparate international dual-use regulations can have negative effects for some institutions. In addition, the individuals that compose the review board for the journal *Science* and most scientific journals are located around the world,[92] making open dissemination immediate and global.

The NSABB has a working group specifically focused on bringing international harmonization to dual-use research guidelines. It is currently carrying out this task through the enlistment of several international scientific bodies. The scientific journal *Nature,* which is based in the United Kingdom, has set up advisory committees that include U.S. scientists for sensitive publications and biosecurity issues. Although having individual

[91] David R. Relman. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007.

[92] Joanne P. Carney. 2006. Remarks made at a meeting of the Committee on New Government-University Partnership for Science and Security. The National Academies. January 12-13.

national and international statements regarding dual-use research is a necessary first step, there still may be a need for a harmonized international effort to inhibit the misuse of dual-use research. An opinion often stated throughout the regional meetings is that an international agreement is needed regarding the dual-use publication review process, along the lines of previous international agreements that addressed the possession, import, and use of dual-use biological agents.

Summary and Recommendations

The international nature of science, scientific talent, and possible security threats requires a common international approach to overseeing policies pertaining to dual-use life sciences research. As recommended in the 2004 NAS report, *Biotechnology Research in an Age of Terrorism,* a mechanism is needed to "develop and promote harmonized national, regional, and international measures."[93]

Recommendation 8: Taking full advantage of the National Science Advisory Board for Biosecurity's international work, as well as that being undertaken by other Department of Health and Human Services agencies, the U.S. government should develop policies and procedures for the oversight of dual-use life sciences research that foster international collaboration and control strategies, with a goal of harmonizing the mechanisms of local oversight.

The history of U.S. biosafety oversight of the life sciences and biotechnology research hinges on self-governance by researchers and on local risk-based oversight. Such oversight is generally delegated to local committees. In order to increase the culture of responsibility within these committees, their members will need to receive training on issues relevant to national security. Programs providing this training should be developed at the national level in collaboration with the university community.

Recommendation 9: To strengthen and harmonize the institutional review of life sciences research, the Department of

[93] National Research Council. 2004. *Biotechnology Research in an Age of Terrorism.*Wasington, D.C.: The National Academies Press.

Health and Human Services, in conjunction with other agencies that conduct and fund life sciences research, should develop an education program on the basic principles of risk-based biosafety and biosecurity review.

To promote the importance of local oversight and to encourage institutions to fully support their committees, federal funding agencies should assure that 1) the institution has taken part in and disseminated information from the education program; 2) an oversight committee is appropriately constituted and convened; and 3) the research to be funded has been reviewed by the committee prior to commencement of the experiments. This is not dissimilar to the process for ensuring local review of research involving animals or human subjects.

V. Research Priorities

The unknowable nature of when, where, and what the next threat will be requires that the United States continues to rely on a broad-based talent pool as well as fundamental, longer-term research programs. The important advances from longer-term research are critical to meeting the challenge of future technological threats and human health concerns. Yet, at each of its regional meetings, the committee heard concerns about declining overall investment in research (while other countries are increasing their support).[94]

According to an analysis conducted by the American Association for the Advancement of Science (AAAS), the U.S. federal R&D portfolio totaled $134.8 billion in 2006, a $2.2 billion, or 1.7 percent, increase over the previous year. [95] However, 97 percent of the increase is focused in two areas: defense weapons development and human space exploration technologies. Funding for all other federal R&D programs collectively fell nearly 2 percent after adjusting for inflation, and within R&D there has been a significant shift away from long-term research to short-term development. Overall:

> Federal research investments are shrinking as a share of the U.S. economy, just as other nations are increasing their investments. . .the federal R&D investment has plateaued at about 1.1 percent of U.S. Gross Domestic Product (GDP) in recent years, buoyed by big increases in weapons development, but is projected to decline sharply in 2006. But the federal research/GDP ratio is already falling and falls further in 2006 down to the historical average of 0.4 percent after briefly increasing during the NIH doubling campaign. Despite an increasingly technology-based economy and a growing recognition among policymakers that federal research investments are the seed corn for future technology-based innovations, the U.S. government research investment has failed to match the new realities

[94] R. Cook-Deegan. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 6. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf.* Accessed February 14, 2007.

[95] Koizumi, K. 2006. AAAS. *Congressional Action on Research and Development in the FY 2006 Budget*. Available at *www.aaas.org/spp/rd/ca06main.htm*.

> and has also failed to match the competition. While the European Union goal of boosting its government research investments by 2010 may not be met, Asian nations are dramatically increasing their government research investments: both China and South Korea, for example, are boosting government research by 10 percent or more annually.[96]

Other participants in the regional meetings expressed concern about the shifting balance between fundamental and applied or strategic research, with a growing focus on the latter. In addition, several commentators called for an increased emphasis on the role of social science to inform assessments of the precise nature of "threats" and how to address them.

Fundamental (Long-Term) Versus Applied (Short-Term) Research

In recent years several agencies, including DOD and DHS, NASA and NIH have focused resources on short-term, applied research to address immediate needs or current perceived threats. According to AAAS, the federal investment in basic research fell 0.5 percent to $26.7 billion in 2006.

Many flagship federal science agencies have had disappointing budgets in 2006: the NIH budget fell for the first time in 36 years; NSF won a small increase, but has less in real terms for its research portfolio than in any of the last three years; the DOE Office of Science budget declined, and despite big increases in development funding, DOD's basic research funding declined.

At the September 2006 regional meeting, Stanford President John L. Hennessy noted that "After the events of September 11, 2001, the federal government did increase its [research] support by 31 percent in 2004 but I worry that much of those research dollars are focused on short-term research not likely to ensure our continued leadership."[97] He went on to express his concern about the expectation that short-term research goals can be deployed to academic researchers:

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[96] Ibid.

[97] John L. Hennessy. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007; see also written submission to the committee.

> We [universities] are not good at finding short-term solutions to either commercial or military problems. If you think about how long it takes us to start up a new research effort you realize we should never focus on problems that need a solution in less than about a decade because by the time we can mobilize a research group, bring it up to speed, develop in-depth knowledge about a particular field and then make progress that just takes a while for us. So, we are better off with that long-term focus on research even in the more strategic work we do. If the country sees a need for institutions that will do that work then I think the national labs or other groups that can more quickly mobilize to respond to things and . . .also deal with issues of classification and security are a more appropriate venue for doing that.[98]

Gregory J. Pottie, UCLA School of Engineering and Applied Science, commented at the September 2006 regional meeting that he has already witnessed examples of research domains where short-term thinking on security has "directly damaged long-term research of direct benefit to our national security."[99] In particular, he cited cybersecurity:

> As computer systems have grown increasingly intertwined and ever more essential to the commerce and security of the nation, these vulnerabilities are no longer matters of mere inconvenience. Yet DARPA has vastly cut funding for academic research in computer science and other information technology areas, including both internet-related research and topics related to information-centric warfare….electronic security threats by their nature constantly evolve, requiring a long-term commitment of resources.

Several university officials expressed concern about the direction research funding in the life sciences has taken. Over the last five years, there has been a remarkable increase of funding for bioterrorism-related research, while long-standing research budgets in the life sciences have been cut or have

[98] Ibid.
[99] Gregory J. Pottie. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007; see also written submission to the committee.

remained stagnant.[100] For example, NIH has increasingly devoted a great deal of funding to translational research, away from more basic long-term research. In addition, Elisa Harris noted the huge expansion in dollars for bioterrorism and biodefense-related research funded by NIH—from $53 million in fiscal year 2001 to more than $1.9 billion requested for fiscal year 2007. Although the actual dollar amount and percent increase of bioterror-related funding is a subject of debate,[101] the amount of research funds and resources specifically for select agents and dual-use research has increased substantially. In fact, one-third of the extramural budget of the National Institute of Allergy and Infectious Diseases is targeted for biodefense. In addition, NIH is funding more laboratories that can handle the most dangerous pathogens and eight new regional centers of excellence for biodefense and emerging infectious disease research. As noted during the Georgia Tech regional meeting, some 16,000 researchers have now been approved to work with select agents.[102] Together these factors have, arguably, placed less emphasis on basic biological research and a greater emphasis on applied biological research that can have more near-term, tangible benefits.[103] While the committee appreciates the need to address some targeted areas, it fundamentally believes, as stated in the 2006 National Academies report *Rising Above the Gathering Storm: The Role of Science and Technology in Countering Terrorism* that "A balanced research portfolio in all fields of science and engineering is critical to U.S. prosperity."[104]

Social Science and Security Concerns

Perhaps one of the greatest challenges for the future will be understanding the threat and redefining and understanding the meaning of

[100] AAAS R&D Funding Update on R&D in NIH FY 2007 House Appropriations.
[101] A S. Fauci and E. Zerhouni. 2005. NIH response to open letter. *Science.* 308(5718):49.
[102] Elisa D. Harris. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.
[103] N. Stafford. 2006. EU stem cell funding in jeopardy? *The Scientist.* March 28. Available at *www.the-scientist.com/news/display/23252/*. Accessed February 14, 2007.
[104] National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2007. *Rising Above the Gathering Storm.* Implementation Action B-1.

security. As Michelle Van Cleave indicated at the inaugural meeting of the committee, "There are 135 nations in the world that collect intelligence against the United States. …Why? Because we are the premier nation in the world. Most of the cutting-edge research in so many things is done here….Everybody is interested in us and some of their interests are fine but many of their interests are going to be inimical to ours and we together as a country, government, industry, academia, we all are part of this."[105] Figuring out which interests are harmful and what security really means is paramount. Current discussions tend to migrate from one definition to another, for example, protecting information from dissemination to unauthorized users, or protecting biological, chemical, and nuclear research facilities from infiltration by foreign agents. Security in the first case can be enhanced through visa policies, international collaboration, conference exchanges, and policies for publication. Security in the second case concerns the more classic issue of the security and integrity of physical facilities and hazardous materials.

The social sciences have a major role to play in understanding threats, risks, and potential organizational response strategies. Several commentators at the committee's regional meetings highlighted the need for increased focus on the social sciences:

> There is a glaring gap between the importance of U.S. intelligence agencies in the public policy world and the attention that they are receiving by social scientists here in the Academy and the consequence of this gap is that we have an underdeveloped understanding of the political, sociological and organizational factors that critically influence what our agencies do and how effectively they do it. If you fund it, they will come. …one way to do that is to increase NSF funding … which shouldn't be too difficult given that since 9/11 not a single NSF grant for political science went to focusing on U.S. intelligence issues, 141 grants, $29 million, not one devoted to the study of U.S. intelligence agencies. Risk-benefit analysis is really what we are talking about in terms of communication flow in science, something that hasn't always been

[105] M. Van Cleave. 2006. National Counterintelligence Executive, Office of the National Counterintelligence Executive, Remarks made at the January 12, 2005 meeting of the Committee on a New Government-University Partnership for Science and Security, National Academy of Sciences.

> first and foremost in the minds of the scientists in the community or the individual investigator....[106]

As the 2002 National Academies report, *Terrorism: Perspectives from the Behavioral and Social Sciences*, emphasized that "systematic theoretical and empirical research—some ongoing, some new—can create, confirm, refine, and reject understandings about terrorism as a social and political phenomenon, thereby improving the knowledge base for efforts to contend with it."[107] Furthermore, the social sciences can enhance our understanding of the conduct of science, the culture of laboratories, the technology transfer process, international collaborations in science, and the culture of openness and trust in science. With regard to security concerns, the social sciences could focus on the precise nature of current "threats" to national and global security, including investigations of the culture of terrorist groups and the structure of terrorist networks. In addition, the social sciences could inform us about the difference between Cold War approaches and strategies for coping with biological threats, terrorist attacks, and stateless violence. Human intelligence will continue to play an increasingly important role in our ability to understand our enemies and identify the next threat. As MIT President Emeritus Charles Vest noted, "The lack of perspective and strategic analysis from the social sciences and so forth were absolutely at the core of some of our worst intelligence failures, especially that in Iraq."[108]

Methods and strategies for determining security risks and the relative benefits of preventive actions and for establishing appropriate risk/benefit calculations need to be further developed. In addition, mechanisms for accurately and appropriately communicating risks and threats to the scientific community and general public must be improved. This calls for sufficient

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[106] Amy Zegart. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at www7.nationalacademies.org/stl/202006.pdf. Accessed February 14, 2007.

[107] National Research Council. 2002. *Terrorism: Perspectives from the Behavioral and Social Sciences.* Washington, D.C.: The National Academies Press, p. 50.

[108] Charles Vest. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at the Massachusetts Institute of Technology. May 16. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.

support for research in the fields of area studies, languages, risk assessment, and the social sciences more generally.

> **Recommendation 10: The National Science Foundation, the Departments of Defense and Homeland Security, and the intelligence agencies should increase funding for the social sciences, particularly for area studies and languages. These subjects are critical to developing the knowledge base needed to understand the social, cultural, and political bases of terrorism and to identify and characterize potential adversaries, threats, effective organizational and interorganizational response strategies, and opportunities to reduce or eliminate those threats.**

If the federal government were to subsidize these areas of study, students could repay their obligation through committed time spent in the foreign service, the public health service, or the intelligence community.

> **Recommendation 11: The National Science Foundation, the Departments of Defense, Homeland Security, and Health and Human Services, and the intelligence agencies should work together to fund additional research in the fields of security risk assessment and cost-benefit analyses of security strategies affecting university research and the global movement of students and scholars. The current emphasis on "risk minimization" is one-sided and does not balance the costs and lost benefits against the magnitude and likelihood of the risk.**

Summary

Congress and the Executive Branch should examine ways to further support and expand research opportunities, ensuring that long-term goals are not being compromised by short-sighted concerns. Additionally, federal research agencies should ensure that their research portfolios contain the critical aspects of the social sciences that are needed to support their research missions and national security efforts. At the first meeting of the committee, White House OSTP Director John Marburger noted that "The science community has much to offer regarding the definition and analysis [of] threats and possible responses to them. It is not clear that we have captured

all that social science particularly can give in informing our processes and our principles of responding."[109]

[109] Jack Marburger, 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Meeting, The National Academies. January 12-13.

VI. Partnerships for Science and Security

In the changing global economy, where new threats have emerged against both national and international security, it is imperative that channels be created and left open between the security and academic research communities for ongoing discussion and sharing of information. Historically, the national security and research university communities have "talked past" each other. When discussions do occur, conversations are replete with assumptions and stereotypes. And there often is a perception by some that neither community is willing to compromise. At the inaugural meeting of the committee, OSTP Director Jack Marburger noted that although there is no easy way to resolve the natural tensions among government, academia, homeland security, and the national security sectors, conversations among these communities are critical, and the solutions to problems are not likely to be what any single sector would have determined on its own.[110]

In the regional meetings convened by the committee, it became clear to all that a healthy alliance between research universities, industry, and government lies at the heart of the American system of innovation and of the innovation economy. Moreover, this alliance is essential to meeting the goals of national security. In her opening address at the first regional meeting of the committee, MIT President Susan Hockfield said:

> This alliance forms the critical foundational infrastructure of our national defense. The questions that this committee addresses could not be more important for our nation's future. .In an increasingly global and interdependent world, what is the appropriate conceptual framework for national security? How do we organize science and engineering research in a way that takes globalization and global competition into account, while protecting America from people who would use that research for pernicious purposes? In the great tripartite innovation alliance between government, university and industry, two of these three partners are increasingly embedded in a global

[110] Ibid.

> economy. Business and the Academy are essentially on an around-the-world tour together.[111]

Similar sentiments with regard to the need for university-government dialogue were expressed by Stanford University President John L. Hennessy, who told the committee that "In the post-9/11 era it is vital that we renew our commitment to the spirit of scientific inquiry and the search for new knowledge that galvanized us as a country in the fifties and sixties and this will involve, must involve an ongoing dialogue between the university community and the government."

Although the government and university communities are working together to address science and security concerns, these interactions often are ad hoc, hastily convened, and in reaction to government policies that have been proposed without any initial input from the research community. Several commentators at the regional meetings observed that often the government responds to crises by over reaching. For example, Judith Reppy noted that:

> The governmental response to change has been an increase in oversight and regulation of research. In many cases, these new regulations have been implemented with very little regard for the core values of the university, namely, the free and open exchange of information and non-discrimination in treatment of students, faculty and staff. These problems have been exacerbated in times of crisis."[112]

The committee is reassured that communication between the security and academic communities is productive and is paying off and that government officials largely have been responsive and responsible. Significantly, the Department of Commerce retracted a proposed rule regarding deemed exports after listening carefully to the comments of the

[111] Susan Hockfield. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 15. Available at *www7.nationalacademies.org/stl/032895.pdf*. Accessed February 14, 2007.
[112] Judith Reppy. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Northeast Regional Meeting at MIT. May 16. Available at *www7.nationalacademies.org/stl/032896.pdf.* Accessed February 14, 2007. See transcript at pp. 4-13.

research community (see Chapter 2). In addition, the visa situation is improving for foreign scientists, with clearance times decreasing, better training at consulates, and foreign enrollments increasing after several years of decline (see Chapter 3). Furthermore, government agencies have sought the advice of the National Academies in the area of dual-use life sciences research and have created the NSABB (see Chapter 4). In addition, the Commerce Department's establishment of an advisory committee to review deemed export policy is welcome. However, it must be noted that too often these responses occur only in reaction to serious concerns that spread through the research community—concerns that could have been avoided were there more proactive communication in advance of policy decisions. In addition, although improvements have been made, a number of unresolved issues remain.

The source and nature of the security threats now facing our country have changed. Similarly, the ability to secure information has changed with the advent of the internet and global exchange. Yet the policies that govern our ability to protect and the mechanisms that implement them have not been systematically reviewed and revised to reflect the current environment. The 2002 National Academies report *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (2002) recommended that OSTP "…. Initiate immediately a dialogue between federal and state government and the research universities on the balance between protecting information vital to national security and the free and open way in which university research is…accomplished. This dialogue should take place *before* enactment of major policy changes affecting universities…." [113] The committee believes that these dialogues must be institutionalized to achieve an appropriate balance between science and security concerns so that policies affecting visas, deemed exports, and other restrictions on academic research can be discussed prior to formal government action.

<u>Recommendation 12</u>: A deliberative, standing entity should be established to address ongoing shared concerns of the security and academic research communities, for example, implementation of NSDD-189, interpretation of deemed export policies, and visa policies and practices. This entity must have access to relevant data, which might require security

[113] National Research Council. 2002. *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism.* Washington, D.C., National Academies Press, p. 371.

clearances. Through consultation with the national and international security and research communities it should review and recommend policies affecting security and the conduct of research. Its membership should include high-level representatives of the national security and federal research agencies so as to ensure access to information and to guide implementation at programmatic levels. It also should include representatives of the academic and industrial science and engineering communities.

While there are a number of ways to implement this recommendation, the Committee recommends the establishment of a high-level Science and Security Commission, co-chaired by the National Security Advisor and the Director of the Office of Science and Technology Policy.

As a starting point, the commission should address the recommendations that come from the recently established Commerce Department Deemed Exports Advisory Committee. In addition, the commission should review the fundamental assumptions underlying U.S. visa policies with respect to foreign students and scholars. Through this convening mechanism, federal research agencies and the academic research community should aim to work more closely with the national intelligence and security communities to increase mutual understanding. The establishment of this commission is an important step in building links between the research and intelligence/security communities.

Ongoing discussions must include data on the efficacy of restrictive policies on security as well as on the consequences of restrictive policies on research. Needed are better and more systematic methods for assessing risks. If we are to adopt, for example, control policies (e.g., for visas, exports, publications), such policies should be based on risk/benefit analyses (while managing risks), rather than on the current risk minimization policy. For example, the cost of one potential leak (e.g., through a deemed export) must be balanced against the national competitiveness and economic benefits gained from encouraging foreign students and scholars to come to American universities and perform fundamental research with minimal restrictions. Developing such methods for assessing and managing risks will require that all relevant communities be involved in the discussion.

Finally, because it is increasingly important to address not only national security but also international security, the U.S. government should enter into discussions with the global community about counter-threat measures. International collaboration, among nations of good will, could define conditions for sharing scientific information, cross-border contacts, collaborative research, peaceful application of nonhazardous inventions, cooperative research on medical technologies, and international cooperation on threat reduction and attack response. The proposed commission should pursue the best avenues for initiating such discussions.

The committee wrestled with where to house the proposed commission, considering OSTP or one of the research agencies such as NIH or NSF as the appropriate lead. However, in considering the need for the university community to better understand and appreciate the analysis, ethos, and concerns of the national security community, the committee opted for housing the commission at the National Security Council (NSC) and having it jointly co-chaired by the NSC Advisor and the OSTP Director. University presidents and other senior university administrators, many of whom have security clearances, should be appointed to the commission. Security clearances are critical to the commission so that the government can openly share information regarding credible threats with the university community. Furthermore, the committee believes that the research agencies and national security agencies, including the FBI, should have seats at the table. The committee considered whether the FBI's National Security Higher Education Advisory Board (see below) could be expanded to fulfill the role of the proposed commission, but decided that the range of issues that should be considered and the level of interagency coordination that will be required would be more appropriately handled by an entity co-chaired by NSC and OSTP. Funding to support the staff for this activity should be provided by the research agencies, with Congress appropriating new funding for the commission.

Creating New Partnerships Between the Science and Security Communities

The intelligence/security and university research communities have limited understanding of each other's cultures. Many in the intelligence community do not understand the importance of foreign students and the need for open scientific communication. Many in the university community

do not understand the concerns of the intelligence community and the broader national security and defense establishment about the potential exploitation of academic research and adverse communication among adversaries and also do not understand the responsibilities export controls and select agents place on researchers.

Ongoing communication must involve honest exchanges about basic assumptions. For example, security professionals might assume that they will "take the fall" if research is misused, and scientists might assume that the increasing restrictions on research are evidence that research and researchers will (and have) become the prime suspects. There has been historical distrust between academe and law enforcement, but recent efforts to overcome this are encouraging.

In September 2005, the FBI announced the creation of a panel of university presidents—the National Security Higher Education Advisory Board—to advise the agency on how to improve relations with higher education. The panel provides the FBI with ideas about how to better understand academic culture and values and explore research areas that could promote national security. Robert S. Mueller III, Director of the FBI, said in a statement that the bureau wanted "to be sensitive to university concerns about international students, visas, technology export policy and the special culture of colleges and universities."[114] The committee was formed, in part, because many universities have been critical of the policies of the FBI and other security agencies since September 11, 2001, as needlessly intrusive or restrictive in the academic environment.[115]

Currently, the FBI's law enforcement authority allows the agency to investigate university researchers and/or laboratories without university permission. The traditional tenets of openness and freedom to work on any scientific question often can clash with the culture of law enforcement. Because of negative responses to this use of power, the FBI has taken other measures. At the June 2006 regional meeting, Gretchen Lorenzi, an Intelligence Analyst with the FBI, described a new science and technology

[114] "FBI Appoints National Security Higher Education Advisory Board." 2005. Federal Bureau of Investigation, Washington, D.C. September 15.
[115] Carol Zuiches. 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007.

outreach program aimed at recognizing that the science community "has an ability to deal with and take responsibility for its own vulnerabilities, but that the FBI can be an asset in that fight."[116] Both communities should work together to identify critical infrastructure areas of vulnerability in the university setting. In a new environment of collaboration, the FBI should continue to work closely with the university community to establish protocols for carrying out investigations. However, universities also must take responsibility for improving understanding and cooperation with the security and intelligence communities.

> **Recommendation 13: University leadership at the level of the senior vice president of research must educate administrators, faculty, and students about security, export controls, select agents, and other relevant policies and procedures, and must ensure compliance.**

Raymond J. Clark, University of California, San Diego, recommended that there be more cross-training between the two communities, because it is the most effective way to promote understanding and communication. Clark noted the need for:

> . . . increased recruitment by the security community itself. The security community, intelligence, State Department's Diplomatic Corps, Executive Branch agencies and Congress need to actively recruit from the S&T community at all levels of experience.[117]

> **Recommendation 14: Universities should work closely with the relevant federal agencies to develop opportunities for scientists to participate in policy fellowships at intelligence and national security agencies and to develop opportunities for members of the intelligence and national security community to participate**

[116] Gretchen Lorenzi, 2006. Remarks made the Committee on a New Government-University Partnership for Science and Security Southeast Regional Meeting at the Georgia Institute of Technology. June 5. Available at *www7.nationalacademies.org/stl/Partnership-6-6-06.pdf*. Accessed February 15, 2007.

[117] Raymond J. Clark, 2006. Remarks made at the Committee on a New Government-University Partnership for Science and Security Western Regional Meeting at Stanford University. September 27. Available at *www7.nationalacademies.org/stl/202006.pdf*. Accessed February 14, 2007.

in fellowships at universities. The Intergovernmental Personnel Act Mobility Program should be explored as a mechanism for facilitating these exchanges.

Summary

Building partnerships between the science and security communities could help us as a Nation to better balance relative risks and benefits as viewed from the different perspectives of the university and security communities. Such collaboration will help educate the two communities in order to achieve a better understanding of the security issues and the consequences for science, higher education, and the future of the U.S. economy. The committee believes that enduring mechanisms should be created to maintain on an ongoing basis the important dialogue needed between these two communities. Improved relationships between these communities will improve awareness of issues before they become a source of controversy or confrontation, and they will help inform regulatory decisions with the appropriate technical and policy expertise.

APPENDIX A

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE

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September 30, 2002

The Honorable John H. Marburger, III
Director, Office of Science and Technology Policy
Executive Office of the President
Washington, DC 20502

Dear Dr. Marburger:

At a joint House-Senate hearing on *Science and Technology to Combat Terrorism,* we heard from several witnesses representing the National Academy of Sciences who testified to the possible adverse impact of our response to terrorism on America's science and technology enterprise. The witnesses spoke of the need to regulate some aspects of the university research environment, while maintaining, insofar as possible, the openness and freedom of inquiry that have contributed to our nation's scientific leadership.

As Chairman and Ranking Member of the House Committee on Science, we have been grappling with how to strike a proper balance between the need to secure potentially sensitive research information, products, and facilities and the intellectual and interdisciplinary openness—including the free exchange of students, scholars, and scientific information—that characterize our research enterprise.

We understand that the National Academy of Sciences is planning to convene a series of science and security roundtable discussions around the country to solicit input from the scientific community on how best to balance the competing requirements of national security and unfettered scientific inquiry. Based on a preliminary proposal that we have seen (copy attached), we believe that the outcome of their process would significantly aid us in our deliberations on this issue.

We hope that the Office of Science and Technology Policy could commission this endeavor and identify an agency to fund this project quickly to allow all of us to have the benefit of the science community's input as we move forward on addressing security and research.

We look forward to your support and expedited response to our request. If you have additional questions please contact our Science Committee staff: Peter Rooney at 202-225-8844, or Mark Harkins at 202-226-8324.

Sincerely,

SHERWOOD L. BOELHERT
Chairman

RALPH M. HALL
Ranking Democratic Member

Enclosure

APPENDIX B
Previous Reports Regarding Science and Security

Reporting Agency	Report	Related Findings/Recommendations	Release Date
National Academies: Committee on Science, Engineering, and Public Policy	*Scientific Communication and National Security*; also known as the "Corson Report"	Contributed to the federal policy stated in National Security Decision Directive 189 (NSDD-189), National Policy on the Transfer of Scientific, Technical and Engineering Information. NSDD-189 was reaffirmed in 2001 by Dr. Condoleeza Rice.	1982
U.S. Commission on National Security/21st Century	*Road Map for National Security: Imperative for Change*; also known as the "Hart-Rudman Report"	Recommended the creation of Department of Homeland Security, doubling of federal investment in research and development and in increased focus on science education.	2001
Massachusetts Institute of Technology	*In the Public Interest: Report of the Ad Hoc Faculty Committee on Access to and Disclosure of Scientific Information*	Recommended that no classified research be performed on MIT's main campus.	2002
Congressional Research Service	*Dual-Use Biological Equipment: Difficulties in Domestic Regulation*	Outlined options for regulating dual-use biological equipment, Underscores the difficulties and likely limited impact of such regulations.	2003
Stanford University: Center for International Security and	*Biotechnology and Bioterrorism: An Unprecedented World*	Recommends the United States limit classified biodefense work and perform such work with transparency to dissuade an increase in global biodefense	2004

Cooperation		research.	
National Academies: Development, Security and Cooperation	*Biotechnology Research in an Age of Terrorism*; also known as the "Fink Report"	This report led to the creation in 2004 of the National Science Advisory Board for Biosecurity (NSABB), which was established under DHHS to advise all federal departments and agencies that conduct or support life sciences research that could potentially be dual use.	2004
Government Accountability Office	*Streamlined Visas Mantis Program Has Lowered Burden on Foreign Science Students and Scholars, But Further Refinements Needed*	This report was commissioned because of the delay found in processing visa applications of foreign students and scholars; when released the report found that the delay had been significantly reduced.	2005
Center for Strategic and International Studies	*Global Evolution of Dual-Use Biotechnology*	Outlined differences between previous warfare equipment regulation with dual-use biological equipment and the difficulty in regulating equipment for dual-use research.	2005
Center for Strategic and International Studies	*Security Controls on Scientific Information and the Conduct of Scientific Research*	Asserted that an open scientific environment is needed for the greatest security of the United States.	2005
National Academies: Committee on Science, Engineering, and Public Policy	*Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States*	Recommended reshaping federal policies that govern the movement and activities of international scientists and engineers, particularly with respect to visa and immigration policy.	2005
National Academies:	*Rising Above the Gathering Storm*;	America's economic leadership is being challenged by globalization;	2005

Committee on Science, Engineering, and Public Policy	also known as the "Gathering Storm"	recommended increasing and strengthening math and science education, as well as science and technology research and development.	
National Research Council	*Making the Nation Safer: The Role of Science and Technology in Countering Terrorism*	Recommended that OSTP initiate dialogue between federal and state governments and research universities on the balance between protecting information vital to national security and the free and open way in which university research is accomplished.	2002
Center for Strategic and International Studies	*Security Controls on the Access of Foreign Scientists and Engineers to the United States*	Asserted that the competitiveness of American science and technology enterprises depends on foreign nationals and international collaborations.	2005
National Academies: Board on Global Health	*Globalization, Biosecurity, and the Future of the Life Sciences*	Report asserts that the best way to handle future malevolent uses of biotechnology is to have open access to scientific information, broad definitions about potential threats, and increased scientific expertise in the security community.	2006

APPENDIX C

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APPENDIX D
Committee on a New Government-University Partnership for Science and Security

COMMITTEE BIOGRAPHIES

HON. JACQUES S. GANSLER (Co-Chair)-NAE
The Honorable Jacques S. Gansler is Vice President for Research at the University of Maryland and is also the first holder of the Roger C. Lipitz Chair in Public Policy and Private Enterprise. He was the former Under Secretary of Defense for Acquisition, Technology, and Logistics. As the third-ranking civilian at the Pentagon from 1997 to 2001, Dr. Gansler was responsible for all research and development, acquisition reform, logistics, advanced technology, environmental security, defense industry, and numerous other security programs. Before joining the administration, Dr. Gansler held a variety of positions in government and the private sector, including Deputy Assistant Secretary of Defense (Material Acquisition), Assistant Director of Defense Research and Engineering (Electronics), Senior Vice President, TASC, Vice President of ITT, and engineering and management positions with Singer and Raytheon Corporations. Throughout his career, Dr. Gansler has written, published, and taught on subjects related to his work. He is the author of *Defense Conversion: Transforming the Arsenal of Democracy* (1995), *Affording Defense* (1989), and *The Defense Industry* (1980), all published by MIT Press. He has published numerous articles in *Foreign Affairs*, *Harvard Business Review*, *International Security, Public Affairs*, and other journals, as well as newspapers, and has given frequent congressional testimonies. He is a member of the National Academy of Engineering and a Fellow of the National Academy of Public Administration.

ALICE P. GAST (Co-Chair)-NAE
On August 1, 2006, Alice P. Gast became Lehigh University's 13th president. Previously she was the Robert T. Haslam Professor of Chemical Engineering and the Vice President for Research and Associate Provost at the Massachusetts Institute of Technology (MIT). Before moving to MIT in 2001, she spent 16 years as a professor of chemical engineering at Stanford

University and at the Stanford Synchrotron Radiation Laboratory. In her research, she studies surface and interfacial phenomena, in particular the behavior of complex fluids. Some of her areas of research include colloidal aggregation and ordering, protein lipid interactions, and enzymes reactions at surfaces. In 1997, Gast co-authored the sixth edition of *Physical Chemistry of Surfaces* with Arthur Adamson. Professor Gast received her B.S. in chemical engineering from the University of Southern California. After earning her Ph.D. in chemical engineering from Princeton University, Gast spent a postdoctoral year on a NATO fellowship at the École Supérieure de Physique et de Chimie Industrielles in Paris. She returned there for a sabbatical as a Guggenheim Fellow. She was a 1999 Alexander von Humboldt Fellow at the Technical University in Garching, Germany. She received the National Academy of Sciences Award for Initiative in Research and the Colburn Award of the American Institute of Chemical Engineers. She was elected to the National Academy of Engineering in 2001 and to the American Academy of Arts and Sciences in 2002. She has served on numerous advisory committees including the National Research Council Board on Chemical Science and Technology and the Homeland Security Science and Technology Advisory Committee. She was elected to the Board of the American Association for the Advancement of Science in 2006.

HON. ARTHUR I. BIENENSTOCK

The Honorable Arthur I. Bienenstock, B.S. (physics), Polytechnic Institute of Brooklyn; M.S. (physics), Polytechnic Institute of Brooklyn; Ph.D. (applied physics), Harvard University, is Special Assistant to the President for Federal Research Policy. He was Vice Provost and Dean of Research and Graduate Policy, Stanford University. He is immediate past Director of Geballe Laboratory for Advanced Materials, Stanford University. Previously he was Associate Director for Science, Office of Science and Technology Policy, Executive Office of the President (1997-2000); Director of the Stanford Synchrotron Radiation Laboratory, Stanford University (1978-1997); Vice Provost for Faculty Affairs (1972-1977), Stanford University; and Member of the Stanford University faculty since 1967. He is the recipient of the Sidhu Award of the Pittsburgh Diffraction Society; the Distinguished Alumnus citation of Polytechnic Institute of New York Alumni Association; and the Rector's Lecture and Medal, University of Helsinki, 1994. In 1998 he received an honorary Ph.D. from Polytechnic University. He received an honorary Ph.D. from Lund University in 2006. His National Academies service includes current membership on the Committee on Smaller Facilities,

the Board on Chemical Sciences and Technology, and the Committee on Science, Technology, and Law. He served previously on the Forum on Diversity in the Engineering Workforce; Committee on Physics of the Universe; and the Committee on Condensed-Matter and Materials Physics, among other activities. He is a Fellow, American Physical Society; Fellow, American Association for the Advancement of Science; Member, American Crystallographic Association, the Materials Research Society, New York Academy of Science, and Sigma Xi.

LOUANN CRAWFORD BURNETT

LouAnn Burnett is an Assistant Director of Environmental Health and Safety at Vanderbilt University in Nashville, Tennessee. She serves as Biological Safety Officer and manages the Biosafety and Occupational Hygiene Program at Vanderbilt where she serves as manager and a member of Vanderbilt's Institutional Biosafety Committee, as well as serving as a member on the Vanderbilt Animal Care and Use Committee and the Institutional Review (Humans Subject Protection) Boards. Before moving to Vanderbilt in 1999, she spent six years as head of Biological Safety at the University of Illinois at Urbana-Champaign. Ms. Burnett holds a B.S. in biology from New Mexico Tech and an M.S. in biology from the University of Illinois at Urbana-Champaign and is certified by the National Registry of Microbiologists and the American Biological Safety Association (ABSA) as a specialist in biological safety microbiology. She has also worked as an environmental scientist for the Illinois Pollution Control Board and as a research biologist for the Illinois Natural History Survey. Ms. Burnett was the 2003 recipient of the ABSA's Everett Hanel, Jr., Presidential award, which is awarded for outstanding contributions to ABSA by promoting the field of biological safety and fostering, by example, the high professional standards of the association's membership. Ms. Burnett is an active ABSA member and serves as Team Leader for the Professional Development team, developing courses and curriculum to address emerging biosafety issues. Ms. Burnett has served as an ad hoc reviewer for the National Institutes of Health Recombinant DNA Advisory Committee and has authored and edited chapters on biosafety, biosecurity, and biosafety program management. She was recently appointed to the Policy, Ethics, and Law panel of the Southeast Regional Centers of Excellence for Biodefense and Emerging Diseases.

KAREN S. COOK-NAS

Karen S. Cook is the Ray Lyman Wilbur Professor of Sociology at Stanford University, Chair of the Department of Sociology and Director of the Institute for Research in the Social Sciences (IRISS), and in 2007 she was elected to the National Academy of Sciences. She joined the faculty of the Department of Sociology in academic year 1998-1999. She served as Cognizant Dean of the Social Sciences from 2001 to 2005. Before coming to Stanford she was at the University of Washington, where she was Chair of the Department of Sociology from 1993 to 1995 and Director of the Laboratory for Sociological Research. In 1995 she became the James B. Duke Professor of Sociology at Duke University, where she also served as the director of the Laboratory for Social Research in the Department of Sociology. Professor Cook was elected President of the Pacific Sociological Association in 1990-1991, and in 1994-1995 she was elected Vice President of the American Sociological Association. She also has served as Vice-President of the International Institute of Sociology and as Chair of Research Committee 42 (social psychology) in the International Sociological Association. In 1996 she was elected to the American Academy of Arts and Sciences, and in 1998-1999, she was a fellow at the Center for Advanced Study in the Behavioral Sciences. In 2004, she received the Cooley-Mead Award for career contributions to social psychology from the American Sociological Association. Professor Cook has a long-standing interest in social exchange, bargaining, and social justice and is currently involved in a large interdisciplinary project focusing on trust in social relations. She recently published *Cooperation Without Trust?* (2005), co-authored with Russell Hardin and Margaret Levi. She has also edited a number of important books, including *The Limits of Rationality* (with Margaret Levi, 1990), *Sociological Perspectives on Social Psychology* (with Gary Alan Fine and James S. House, 1995), *Trust in Society* (2001), and *Trust and Distrust in Organizations* (with Roderick Kramer in 2004). Currently she also serves as co-editor (with Doug Massey) of the *Annual Review of Sociology* (1998-2008). In the past, she has served on many editorial boards and as editor of *Social Psychology Quarterly* (1988-1992). Her research has been supported by the National Science Foundation and the Russell Sage Foundation, and articles based on this work have appeared in the *American Journal of Sociology*, the *American Sociological Review*, *Social Psychology Quarterly*,

and other journals in sociology. Professor Cook received her B.A. (1968), M.A. (1970), and Ph.D. (1973) from Stanford University.

GEN. JOHN A. GORDON

General John A. Gordon (U.S. Air Force, Retired) served in the White House as the President's Homeland Security Advisor from June 2003 until June 2004 and as the Deputy National Security Advisor for Counter Terrorism and the National Director for Counter Terrorism from June 2002 to June 2003. Prior to joining the White House team, General Gordon was the first Administrator of the National Nuclear Security Administration and Undersecretary of Energy, responsible for the entirety of the nation's nuclear weapons program, serving from June 2000 until June 2002. As an Air Force four-star general, he was the Deputy Director of Central Intelligence from October 1997 until June 2000. General Gordon's 32 year Air Force career included significant concentration on research and development, strategic planning, missile and space operations, intergovernmental operations, and international negotiations. General Gordon holds an M.S. degree in physics and an M.A. degree in business administration. General Gordon is a private consultant and serves on the boards of several corporations and nonprofit organizations.

SEN. GARY HART

Since retiring from the United States Senate, Gary Hart has been extensively involved in international law and business as a strategic advisor to major U.S. corporations, an author and lecturer, and the Wirth Professor of Public Policy at the University of Colorado. Before teaching at the University of Colorado, Senator Hart was Senior Counsel to Coudert Brothers, a multinational law firm with offices in 32 cities located in 19 countries around the world. He was Co-chair of the U.S. Commission on National Security for the 21st Century. The commission performed the most comprehensive review of national security since 1947, predicted the terrorist attacks on America, and proposed a sweeping overhaul of U.S. national security structures and policies for the post-Cold War new century and the age of terrorism. He was president of Global Green, the U.S. affiliate of Mikhail Gorbachev's environmental foundation, Green Cross International. He is a founding member of the Board of Directors of the U.S.-Russia Investment Fund; a former member of the Defense Policy Board; and a member of the Council on Foreign Relations. He was co-chair of the council task force that

produced the report "America Unprepared—America Still at Risk," in October 2002. Gary Hart has been Visiting Fellow at All Souls College, Chatham Lecturer, and McCallum Memorial Lecturer at Oxford University, Global Fund Lecturer at Yale University, and Regents Lecturer at the University of California. He earned a doctor of philosophy degree from Oxford University and graduate law and divinity degrees from Yale University. He was visiting lecturer at the Yale Law School and is the author of 16 books. Gary Hart represented the State of Colorado in the United States Senate from 1975 to 1987. In 1984 and 1988, he was a candidate for his party's nomination for President. Senator Hart was first elected to the Senate in 1974, having never before sought public office, and was re-elected in 1980. During his 12 years in the Senate, he served on the Armed Services Committee, where he specialized in nuclear arms control and was an original founder of the military reform caucus. He also served on the Senate Environment Committee, Budget Committee, and Intelligence Oversight Committee. During his Senate years, he played a leadership role in major environmental and conservation legislation, military reform initiatives, new initiatives to advance the information revolution, and new directions in foreign policy. He is widely recognized as among the first to forecast the end of the Cold War.

MICHAEL J. IMPERIALE

Dr. Michael Imperiale is a native of New York City. He received his undergraduate and graduate training at Columbia University, receiving a B.A. in 1976, M.A. in 1978, and Ph.D. in 1981, all in biological sciences. His graduate dissertation was an examination of the specificity of individual helper T lymphocytes during the humoral immune response. He then moved to The Rockefeller University, where he first became interested in viruses, studying gene regulation in the human pathogen, adenovirus. During that time he was supported by postdoctoral fellowships from the Damon Runyon-Walter Winchell Cancer Fund and the National Institutes of Health (NIH). In 1984, Dr. Imperiale joined the Department of Microbiology and Immunology at the University of Michigan Medical School as the Arthur F. Thurnau Assistant Professor of Microbiology and Immunology. He was promoted to Associate Professor in 1990 and to Professor in 1996. Most recently, he served as Interim Chair of the Department of Microbiology and Immunology (January 2003 to June 2004). Dr. Imperiale is also the Chair of the Institutional Biosafety Committee at the University of Michigan, a position he has held since 2000. In 2005, Dr. Imperiale was appointed to the National

Science Advisory Board for Biosecurity. Dr. Imperiale's research interests focus on the study of DNA tumor viruses. He has made important contributions to our understanding of how these viruses regulate expression of their genes, how they contribute to oncogenesis, and how they interact with the infected cell in order to cause acute disease. Most recently his laboratory has been examining how these viruses assemble as well as exploring the use of adenovirus as a vector for gene therapy and vaccination against infectious diseases. Dr. Imperiale's work has been funded by NIH and other federal and private agencies and has been published in leading journals in the field. He has presented his findings at numerous national and international conferences. He has also served on various NIH grant review panels and the National Gene Vector Laboratories Steering Committee.

HON. RICHARD MESERVE-NAE

Richard A. Meserve, J.D., Harvard Law School; Ph.D. (applied physics) Stanford University, is President, Carnegie Institution of Washington. Before assuming the Carnegie presidency in April 2003, he was Chairman of the U.S. Nuclear Regulatory Commission (NRC), having served since October 1999 under both Presidents Clinton and Bush. Before joining the NRC, Dr. Meserve was a partner in the law firm of Covington & Burling and he now also serves as Senior Of Counsel to the firm. His legal practice focused on nuclear-related issues, technical issues arising in environmental and toxic tort litigation, and counseling scientific societies and high-technology companies. Early in his career, he served as legal counsel to the President's science advisor and was a law clerk to Justice Harry A. Blackmun of the United States Supreme Court and to Judge Benjamin Kaplan of the Massachusetts Supreme Judicial Court. He is a member of the National Academy of Engineering and the American Philosophical Society and a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Sciences, and the American Physical Society. He currently serves on the Board of Directors of the Universities Research Association, Inc. He has previously served on numerous committees and boards of the National Academies. Dr. Meserve was a member of the National Academies planning committee that initiated the 1997 Academy Symposium on Science, Technology, and Law. He wrote the amicus briefs on behalf of the National Academy of Engineering in the Kumho case and on behalf of the National

Academy of Sciences in the Daubert case. These landmark cases established the basis for admitting expert testimony into court.

JULIE T. NORRIS

Julie T. Norris is an independent consultant and also is affiliated with Huron Consulting Group. She previously served as the Director of the Office of Sponsored Programs at the Massachusetts Institute of Technology (MIT) from 1994 to 2004. Her responsibilities at MIT included management of the full spectrum of both pre- and postaward activities in the area of sponsored programs and compliance, including responsibility for the preparation and negotiation of the Institute's F&A cost proposal and other cost analysis activities. Before MIT she worked at the University of Houston for 21 years serving in various positions, including director. Ms. Norris was a member of the Council on Governmental Relations (COGR). She served on COGR's board from 1982 to 1988, 1989 to 1990, and 1992 to1998. During that time she served at various times as Chairman of the Board, as chair of the Grant and Contract Policy Committee, as chair of COGR's Costing Policies committee, and as chair of the Research Administration and Compliance Committee. She has served the National Council of University Research Administrators (NCURA) as treasurer, vice president, and president. She also served on the research team for the study entitled "Financing and Managing University Research Equipment" which was produced by the Association of American Universities, NASULGC, and COGR and consults with the National Science Foundation on its Research Facilities and Expenditures studies. She is the primary contributor to the COGR document *Managing Externally Funded Programs at Colleges and Universities* and one of the authors of the recently revised NCURA *Regulation and Compliance Handbook: 2005*. In addition she is one of the authors of AIS' *A Guide to Managing Federal Grants for Colleges and Universities*. Ms. Norris was the first recipient of NCURA's award for Outstanding Achievement in Research Administration.

HON. ELIZABETH RINDSKOPF PARKER

Honorable Elizabeth Rindskopf Parker joined Pacific/McGeorge as its eighth dean in 2003 from her position as General Counsel for the 26-campus University of Wisconsin System. Her fields of expertise, in addition to national security and terrorism law, include international relations, public policy and trade, technology development and transfer, commerce, and litigation in the areas of civil rights and liberties. Dean Rindskopf Parker's

expertise in national security and terrorism comes from 11 years of federal service, first as General Counsel of the National Security Agency (1984-1989), then as Principal Deputy Legal Adviser at the U.S. Department of State (1989-1990), and as General Counsel for the Central Intelligence Agency (1990-1995). From 1979 to 1981, Dean Rindskopf Parker served as Acting Assistant Director for Mergers and Acquisitions at the Federal Trade Commission. In addition to her experience managing government legal offices, Dean Rindskopf Parker also served as Director of the New Haven Legal Assistance Association, Inc. Early in her career, she gained significant expertise with a wide variety of complex federal litigation, raising discrimination and civil liberties issues at all levels of the federal court system, including two successful arguments before the U.S. Supreme Court while a cooperating attorney for the NAACP Legal Defense and Education Fund. She has also handled substantial commercial litigation, as well as international arbitration before the Iran-U.S. Claims Tribunal and the International Chamber of Commerce (Paris). While at the international law firm of Bryan Cave, LLP, Dean Rindskopf Parker counseled clients on public policy and international trade issues, particularly in the areas of encryption and advanced technology, U.S.-Sino relations, and nuclear nonproliferation. A member of the American Bar Foundation and the Council on Foreign Relations, and former Chair of the ABA Standing Committee on Law and National Security, Dean Parker is a frequent speaker and lecturer and has taught national security law at Case Western Reserve Law School, Cleveland State School of Law, and Pacific/McGeorge. Currently, she serves on several committees of the National Academy of Sciences, including the Roundtable on Scientific Communication and National Security and the Commission on Scientific Communication and National Security, examining responses to terrorism.

STAFF BIOGRAPHIES

ANNE-MARIE MAZZA

Anne-Marie Mazza joined the National Academies in 1995. She has served as Senior Program Officer with both the Committee on Science, Engineering and Public Policy and the Government-University-Industry Research Roundtable. In 1999 she was named the first director of the Science, Technology, and Law (STL) Program, a newly created program designed to foster communication and analysis among scientists, engineers, and members of the legal community. Dr. Mazza has been the study director on numerous Academy reports including *Reaping the Benefits of Genomic and Proteomic Research, 2005*; *Intentional Human Dosing Studies for EPA Regulatory Purposes: Scientific and Ethical Issues, 2004; Ensuring the Quality of Data Disseminated by the Federal Government, 2003; The Age of Expert Testimony: Science in the Courtroom, 2002; Issues for Science and Engineering Researchers in the Digital Age, 2001;* and *Observations on the President's Fiscal Year 2000 Federal Science and Technology Budget, 1999.* Between October 1999 and October 2000, she divided her time between the STL Program and the White House Office of Science and Technology Policy, where she served as a Senior Policy Analyst responsible for issues associated with the government-university research partnership. Before joining the Academy, Dr. Mazza was a Senior Consultant with Resource Planning Corporation. She received a B.A., M.A., and Ph.D. from The George Washington University.

ELIZABETH BRIGGS

Elizabeth Briggs is Senior Program Associate for the Committee on Science, Technology and Law. She has been with the National Academies since 2001, and has worked on numerous projects and reports for the Board on Higher Education and Workforce and the Committee on Women in Science and Engineering including *Monitoring International Labor Standards, 2005; Bridging the Bed-Bench Gap—Contributions of the Markey Trust, 2005; Achieving XXcellence in Science, the Role of Professional Societies in Advancing Women in Science, 2004;* and *Observations on the President's Fiscal Year 2003 Federal Science and Technology Budget, 2002.* In 2001, Ms. Briggs completed two years abroad teaching English in Nagasaki, Japan,

with the Japan Exchange Teaching Programme. She holds a B.A. in political science from Linfield College, McMinnville, Oregon. Ms. Briggs is currently pursuing a M.A.L.S. in International Affairs at Georgetown University.

KATHI E. HANNA

Kathi E. Hanna, M.S., Ph.D. is a science and health policy consultant, writer, and editor specializing in biomedical research policy and health policy. She served as Research Director and Senior Consultant to President Clinton's National Bioethics Advisory Commission and as Senior Advisor to President Clinton's Advisory Committee on Gulf War Veterans Illnesses. She served as the lead author and editor of President Bush's Task Force to Improve Health Care Delivery for Our Nation's Veterans and as lead writer for the Task Force on the Future of Military Health Care. In the 1980s and 1990s, Dr. Hanna was a Senior Analyst at the congressional Office of Technology Assessment, contributing to numerous science policy studies requested by congressional committees on science education, research funding, biotechnology, women's health, human genetics, bioethics, and reproductive technologies. In the past decade, she has served as an analyst and editorial consultant to the Howard Hughes Medical Institute, the National Institutes of Health, the Department of Energy, the National Academy of Sciences, FasterCures, The National Health Council, several charitable foundations, voluntary health organizations, and biotechnology companies. Before coming to Washington, D.C., she was the Genetics Coordinator at Children's Memorial Hospital in Chicago, where she directed clinical counseling and coordinated an international research program in prenatal diagnosis. Dr. Hanna received an A.B. in biology from Lafayette College, an M.S. in human genetics from Sarah Lawrence College, and a Ph.D. from the School of Business and Public Management, George Washington University.

SARA DAVIDSON MADDOX

Sara Davidson Maddox, M.A., is a science and health policy writer and editor, with extensive experience in the area of bioethics, biomedical research, and health services and quality. She was editor for the National Bioethics Advisory Commission and has participated in projects for the National Institutes of Health and the Institute of Medicine.

APPENDIX E

Meeting Agendas

MEETING 1
Washington, D.C.
JANUARY 12, 2006

8:00 Welcome and Introductions

Committee Co-Chairs
Jacques S. Gansler, Vice President for Research, University of Maryland
Alice P. Gast, Vice President for Research and Associate Provost, MIT

8:30 Committee Charge and Expectations

Amy P. Patterson, Director, Office of Biotechnology Activities, National Institutes of Health

Peter A. Freeman, Assistant Director, Computer and Information Science and Engineering Directorate, National Science Foundation

John H. Marburger, III, Director, Office of Science and Technology Policy, The White House

David J. Goldston, Chief of Staff, House Science Committee

9:30 Discussion with Committee

9:45 Overview of the NSABB and its Consideration of Dual-Use Life Science Research

Amy P. Patterson, Director, Office of Biotechnology Activities, National Institutes of Health

10:15 Discussion with Committee

10:30 Break

10:45 Counterintelligence Strategy for the United States

Michelle Van Cleave, National Counterintelligence Executive, Office of the National Counterintelligence Executive

11:30	Discussion with Committee
12:00	Lunch
1:00	Overview of Sensitive But Unclassified (SBU) Scientific and Technical Information
	Genevieve J. Knezo, Senior Specialist, Science & Technology Policy, Congressional Research Service
	Dana Shea, Analyst, Science & Technology Policy, Congressional Research Service
2:00	Discussion with Committee
2:15	Overview of IG Export Control Reports and Recommendations
	Richard A. Johnson, Partner, Arnold & Porter
2:40	Discussion with Committee
3:00	Break
3:15	Overview of the U.S. PATRIOT ACT As It Applies To Research Universities
	Wendy J. Keefer, Bancroft Associates PLLC
3:40	Discussion with Committee
4:00	Adjourn

JANUARY 13, 2006

8:00 Welcome

Committee Co-Chairs

Jacques S. Gansler, Vice President for Research, University of Maryland

Alice P. Gast, Vice President for Research and Associate Provost, Massachusetts Institute of Technology

8:15 Concerns of the National Security Community

Peter Lichtenbaum, Assistant Secretary for Export Administration, Department of Commerce

John Hamre, President and CEO, Center for Strategic and International Studies

Patrick A. Mulloy, Commissioner, U.S.-China Economic and Security Review Commission

Randall S. Murch, Associate Director, Research Program Development, Virginia Tech (FBI retired)

10:00 Concerns of the Research Community

Janet Shoemaker, Director, Office of Public Affairs, American Society for Microbiology (ASM)

Tobin Smith, Senior Federal Relations Officer, Association of American Universities (AAU)

Joanne P. Carney, Director, Center for Science, Technology, and Congress, American Association for the Advancement of Science (AAAS)

Mark F. Smith, Director, Government Affairs, American Association of University Professors (AAUP)

Howard J. Silver, Executive Director, Consortium of Social Science Associations (COSSA)

12:15 Adjourn

MEETING 2
Massachusetts Institute of Technology
MAY 15, 2006

8:30 Introductions and Purpose of Meeting
Jacques S. Gansler and Alice P. Gast
Committee Co-Chairs

8:40 Welcome and Opening Remarks
Susan Hockfield, President, MIT

9:00 The Future of National Security and the Research Enterprise

Moderator: Arthur I. Bienenstock, Stanford University

John H. Marburger, III, Science Advisor to the President and
Director, Office of Science and Technology Policy,
The White House

9:25 Discussion

10:00 Government Policy for Homeland Security

Moderator: Michael J. Imperiale, University of Michigan/University of Michigan Medical School

Stewart A. Baker, Assistant Secretary for Policy, Department of Homeland Security

10:20 Discussion

10:50 Break

11:00 Energy, Security and the Long War of the 21st Century

Moderator: Richard A. Meserve, Carnegie Institution of Washington

R. James Woolsey, Vice President, Booz Allen Hamilton, Inc.

11:25 Discussion

12:00 Lunch

1:15 Export Control Policy in an Increasingly Competitive World

Moderator: Jacques S. Gansler, University of Maryland

Lincoln P. Bloomfield, Jr., President, Palmer Coates LLC/
Senior Advisor, Akin Gump Strauss Hauer & Feld LLP

1:35 Discussion

2:00 Panel: Key Indicators/Sectors (Role of Academic Research)

Moderator: Gary Hart,* University of Colorado

Innovation Indicators: Richard K. Lester, Director, Industrial Performance Center, Professor of Nuclear Science and Engineering, MIT

Energy: Ernest J. Moniz, Professor of Physics, MIT

Nanotechnology: James R. Baker, Jr., Director, Nanotechnology Institute for Medicine and the Biological Sciences, University of Michigan

Social Sciences: Gary LaFree, Director, National Center for the Study of Terrorism and Responses to Terrorism, University of Maryland

3:15 Panel Discussion

4:15 Adjourn

MAY 16, 2006

8:45 Welcome
Jacques S. Gansler and Alice P. Gast
Committee Co-Chairs

9:00 Panel: Concerns of the Academic Community

Moderator: Sheila S. Jasanoff, Pforzheimer Professor of Science and Technology Studies, John F. Kennedy School of Government, Harvard University

Dual-Use Research: George M. Church, Professor of Genetics, Director, Center for Biosecurity; Computational Genetics, Harvard Medical Center

Regulatory Structure: Judith V. Reppy, Professor, Science and Technology Studies, Cornell University

Export Controls: Sue E. Eckert, Senior Fellow, Brown University

International: Suzanne Berger, Raphael Dorman and Helen Starbuck Collaboration Professor of Political Science and Director, International Science and Technology Initiatives, MIT

Graduate Education: Debra W. Stewart, President, Council of Graduate Schools and Teaching

10:15 Panel Discussion

10:45 Break

11:00 Creating a New Partnership

Moderator: Alice P. Gast, MIT

Timothy Bereznay, Assistant Director for Counterintelligence, FBI

11:20 Discussion

11:45 The Role of the Research University in U.S. Security and the Need for Rational Government Policies

Moderator: Eugene B. Skolnikoff, Professor Emeritus, Department of Political Science, MIT

Charles M. Vest, President Emeritus, MIT

12:15 Discussion

12:30 Adjourn

MEETING 3
Georgia Institute of Technology
JUNE 5, 2006

9:00 Introductions and Purpose of Meeting

Jacques S. Gansler and Alice P. Gast, Committee Co-Chairs

9:20 Welcome and Opening Remarks

Jilda Diehl Garton, Associate Vice Provost for Research and General Manager, Georgia Tech Research Corporation (GTRC)

G. Wayne Clough, President, Georgia Tech

9:45 Keynote Address: Challenges and Opportunities for the Research University in National Security

Frank Gaffney, Founder and President, Center for Security Policy

10:15 Discussion

10:30 Break

10:45 "Sensitive But Unclassified" Information: Challenges for the Government

Grace L. Mastalli, Director, Information Sharing and Collaboration, Department of Homeland Security

11:10 Discussion

11:30 Classified Research on University Campus

Stephen E. Cross, Vice President, Georgia Tech, and Director, Georgia Tech Research Institute

12:00 Discussion

12:15 Lunch

1:30 Dual-Use Life Sciences Research: Government Perspective

Moderator: Ruth L. Berkelman, Rollins Chair and Director of the Center for Public Health Preparedness and Research, Emory University

Dennis M. Dixon, Chief, Bacteriology and Mycology Branch, National Institute of Allergy and Infectious Diseases

Lisa M. Lee, Assistant Science Officer, Office of the Chief Science Officer, Centers for Disease Control

Gretchen L. Lorenzi, Intelligence Analyst, FBI

Carol D. Linden, Senior Scientist, Office of Research and Development, Science and Technology Directorate, Department of Homeland Security

2:45 Discussion

3:15 Dual-Use Life Sciences Research: Regulation or Self-Governance?

Moderator: Richard Compans, Professor and Chairman, Department of Microbiology Immunology, Emory University School of Medicine

Elisa D. Harris, Senior Research Scholar, Center for International and Security Studies at Maryland, University of Maryland

Gigi Kwik Gronvall, Associate, Center For Biosecurity; Assistant Professor of Medicine, University of Pittsburgh

4:00 Discussion

4:30 Adjourn

JUNE 6, 2006

9:00 Welcome: Jacques S. Gansler and Alice P. Gast, Committee Co-Chairs

9:10 Concerns of the Academic Community

Moderator: Paul Gilman, Director, Oak Ridge Center for Advanced Studies

Biodefense-Policy, Ethics, and Law: Robert Cook-Deegan, Director, Institute for Genome Sciences and Policy, and Center for Genome Ethics, Law and Policy, Duke University

Challenges for Institutional Biosafety Committee: Gary Miller, Associate Professor, Department of Environmental and Occupational Health, Rollins School of Public Health, Emory University

Implications for Distance Learning and Professional Education: William J. Wepfer, Vice Provost, Georgia Tech

Export Controls: Gary K. Bertsch, University Professor of Public and International Affairs, and Director, Center for International Trade and Security, University of Georgia

10:15 Discussion

10:45 Break

11:00 Deemed Exports and Academic Research

David McCormick, Undersecretary, Bureau of Industry and Security, Department of Commerce

11:15 Discussion

12:00 Adjourn

MEETING 4
Stanford University
SEPTEMBER 27, 2006

8:00 Introductions and Purpose of Meeting

Jacques S. Gansler and Alice P. Gast, Committee Co-Chairs

8:15 Welcome and Opening Remarks

Arthur I. Bienenstock, Office of the Dean of Research and Graduate Policy, Stanford University

John L. Hennessy, President, Stanford University

8:45 The Unintended Consequences of American Security Policy

William J. Perry, Senior Fellow, Hoover Institution, and the Michael and Barbara Berberian Professor, Stanford University

9:20 Discussion

9:45 Break

10:00 Academic Research and National Security: University Concerns

Moderator: Michael Nacht, Aaron Wildavsky Dean and Professor of Public Policy at the Goldman School of Public Policy, UCB

Raymond J. Clark, Project Manager for Security Studies and Training, Institute on Global Conflict and Cooperation, UCSD Central Office and Founding Member of the National Postdoctoral Association

Amy Zegart, Associate Professor of Public Policy, UCLA School of Public Affairs

Carol Zuiches, Assistant Vice Provost for Research and Executive Director, Office of Sponsored Programs, University of Washington

Barbara Yoder, Contract and Grants Officer, University of California, Office of the President

11:30 Discussion

12:15 Lunch

1:30 Restrictions on Research ("Sensitive But Unclassified," DFARS Clause, Lost Awards, Export Controls)

Moderator: Julie Norris, Director (emeritus), Office of Sponsored Research, MIT

C.W. Francis Everitt, Professor (Research) at the W.W. Hansen Experimental Physics Laboratory, Principal Investigator of the NASA Gravity Probe B and Satellite Test of the Equivalence Principle Programs, Stanford University

Shankar Sastry, Director, Center for Information Technology Research in the Interest of Society, NEC Distinguished Professor of Engineering, Departments of Electrical Engineering and Computer Sciences and Bioengineering, University of California, Berkeley

Gregory J. Pottie, Associate Dean, Research and Physical Resources, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles

Rachel Claus, Senior University Counsel, Office of the General Counsel, Stanford University

3:00 Discussion

3:15 Select Agents Research/IBCs: Challenges for Academic Research

David A. Relman, Associate Professor of Medicine (Infectious Diseases and Geographic Medicine) and of Microbiology and Immunology, Stanford University; Member, National Science Advisory Board for Biosecurity; Chair, Administrative Panel on Biosafety, Stanford University

3:40 Discussion

4:00 Adjourn

SEPTEMBER 28, 2006

8:30 Introductions and Purpose of Meeting

Jacques S. Gansler and Alice P. Gast, Committee Co-Chairs

8:45 Security Concerns at National and University Laboratories

Siegfried S. Hecker, Visiting Professor at the Center for International Security and Cooperation in the Freeman Spogli Institute for International Studies, Stanford University; former director of the Los Alamos National Laboratory

9:10 Discussion

9:30 International Collaborations

Jonathan Dorfan, Director, Stanford Linear Accelerator Center, Professor of Physics, Stanford University

9:50 Discussion

10:15 National Security and Academic Publishing

Donald Kennedy, Editor in Chief, Science, and President Emeritus, Stanford University

10:35 Discussion

11:00 Open Discussion: Moving Forward

11:30 Adjourn