1 Risky Business: Research Universities in the Post-September 11 Era

M.R.C. Greenwood

On September 11, 2001, the nation was attacked. We knew deep in our hearts that the world was changing before our eyes; that the freedoms and openness we had taken for granted were now being used against us; and that our lives—both personal and professional—would never be the same.[1]

As members of the research science and technology (S&T) community, we knew that we would have a key role to play in ensuring the future safety of our country. But sometimes in our community we forget that the research university is first and foremost a "university" and not just a scientific or technological institute where new knowledge about the natural world is generated and processed into new products. The word "university" is derived from the Latin root *universitas*, meaning "whole" or "body," yet we often forget the whole and work in departmentalized, segmented units. We must keep in mind the whole university, as we will need the full complement of intellectual tools within those institutions to ensure our national security and well being.

The Opportunity and Danger before Us

The following poem was brought to my attention by Wlad Godzich, the dean of humanities at the University of California, Santa

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Cruz, and himself a scholar of the role of the humanities in an era of globalization and technology.

> The time will come, America,
> When the hordes of Afghanistan
> Will crash your gleaming airplanes
> Into the shiny towers of Manhattan.
>
> —*Surrealist Revolution* (1925)[2]

These words are shocking and prophetic. They were not, however, based on any military, technological, or scientific analysis of our national security. They represented the views of some creative impressionists of that era who harbored no love for an America they saw as materialist, imperialist, and sterile.

It is not surprising that in this early period of our nation's response to terrorism, we are focusing on bolstering national security to guard us from future attacks. Our government's efforts to protect the nation are starting to unfold in many aspects of our lives, most markedly in airports. But policy changes are occurring in other arenas too, and this chapter discusses some of those policy changes that are potentially risky business for research universities in the post-September 11 era.

All of us are uncomfortable with changes being forced on us by outside actors who are not under our control. But now is not the time for the science and technology community to engage in days of "whine and poses." With crisis and change come tremendous opportunities. I am reminded of the Chinese symbol for crisis, which is a combination of the symbols for danger and opportunity. Facing up to our new dangers and opportunities will require the best of America, and the best of those of us at research universities. We, like most Americans, want to be part of advancing national security in all of its forms.

What do I mean by national security in all of its forms? I mean security from

- biological and chemical warfare;
- nuclear and radiological threats;
- systemic damage to information technology, computers, and telecommunications;
- assaults on our transportation system, energy facilities, buildings, and fixed infrastructure;
- slipping into economic turmoil; and, most importantly,
- the failure to understand the roots of terrorism.

The public and our policymakers may need to be reminded that research universities play a unique role in all of these areas. Our universities educate and train students who will become the next generation of informed and engaged citizens, as well as the scholars in all disciplines, the professionals and leaders in all fields, and of course, the scientists and engineers who will help us face these tremendous challenges.

We must, therefore, reach out to our colleagues in academe and our fellow citizens in government, indeed to our entire society, to forge a new compact to work together. Research universities now have a once-in-a-generation opportunity to renew and redefine a partnership (a compact, if you will) with the federal government to develop new programs, new areas of research, and new strategies to advance our national security and improve our society.

It is understandable that since September 11, there has been a close hold on information, and that strategic decisions have been made under the auspices of the military, as well as intelligence and law enforcement agencies. But, as we move from reaction to action to pro-action, new ways to work together must be developed.

Research Universities in the Post-September 11 Era

Leading a public research university since September 11 has been an illuminating and transforming experience on many levels. My conviction is even stronger now than it was then that the universities can and must play a critical role in understanding and preventing terrorism in the next generation. As much as I have been inspired by the contributions of our scientists and engineers and the bravery of our firefighters, police, and medical personnel, I also have been struck by how much we can learn from our research colleagues in the social sciences and the humanities in bringing about a deeper understanding of the interconnectedness of our world. We saw this demonstrated at the University of California, Santa Cruz, when our faculty organized and engaged in a variety of forums with students, the community, and local religious leaders. These gatherings offered perspective on the rise of terrorism and the clash between modernity and fundamentalism.

As one would expect, the research S&T community immediately began to make significant contributions to our safety and well being. In short, many of us found ourselves involved, in small and large ways, as "civic scientists engaged in civic duty."[3] For example:

- Experimental robots developed at the University of South Florida helped in the search-and-rescue efforts at the World Trade Center towers. The robots showed how leading edge technology could be applied immediately to search in areas that were too dangerous for humans.

- During the Olympics, biosensors developed at the Lawrence Livermore and Los Alamos National Laboratories were used to help detect the presence of hazardous biological agents.

- Technologies to detect explosives are being used extensively in airports around the nation, as well as in the subways of Washington, DC. Some of these technologies were developed by those same national laboratories.

The Risks in the Proposed Changes in S&T Policy

I will elaborate on the importance of the whole university below, but first, I want to go back to the risky business of proposed changes in S&T policy and their potential impacts on research universities. The proposed changes relate directly to our changed threat level and perceived risk as a nation. History shows us that perceived risks change our national security policy, and always have. But these changes are, I believe, risky business for research universities.

Let me focus on three specific risks:

- proposed limitations on researchers' access to data and methodologies;
- proposed allocation of tax dollars in the Administration's FY 2003 budget, in particular the changing allocation of research and development (R&D) with an increased emphasis on "missiles and medicine"; and
- the move to increase the tracking of foreign students in universities.

Risk 1: Proposed limitations on researchers' access to data and methodologies

The basic issue with the first proposal is the shift from the "right to know" to the "need to know," which threatens to erode some basic democratic principles, as well as the basic framework of scientific interactions.

Balancing the perceived risks of open access with the risks to the health and vitality of the research community is exactly the kind of issue that calls for a new partnership between the research community and the government.

The news media have reported that in its initial attempts to assess the threat of terrorists developing harmful chemical, biological, or other agents of mass destruction, the Office of Homeland Security has expressed an interest in requesting, or requiring, limitations in scientific publishing, especially in publishing data sets and methodologies that might lead to replicating certain results.[4, 5] The risks and benefits of such actions must be clearly understood. The tradition and structure of research in the United States today depend on replication and refutation. This means that sufficient data and methods that allow for sufficient data must be published in peer-reviewed journals.

Openness has enabled the vast majority of advances in civilian applications and innovations in the last 50 or more years, and makes our research system the envy of the world. It has led to new knowledge, and thus innovations that drive our economy, ensure national security, and fight terrorism. It also militates against fraudulent results, sloppy science, and political biases guiding important policy decisions. In addition, open communication of results influences our national policies in environmental and health issues. We cannot imagine environmental or health policies that are not based on the open access and review of research data.

A recent example from *Science* illustrates this point. Scientists reported to have seen evidence of nuclear fusion in a beaker of organic solvent. Much controversy accompanied the publication of this paper, referred to as "bubble fusion," but *Science's* editor-in-chief Donald Kennedy argued (correctly, in my view) that publication is always the right option, even when there is controversy. He said:

> …that's what we do; our mission is to put interesting, potentially important science into public view after ensuring its quality as best as we possibly can. After that, efforts at repetition and reinterpretation can take place out in the open. That's where it belongs, not in an alternative universe in which anonymity prevails, rumor leaks out, and facts stay inside.[6]

Of course, some circumstances may warrant restrictions, but the onus for blocking publication should be on the government through a process that is clearly defined, free of arbitrary edicts, and understood by the research community. This is exactly the kind of issue that calls for a new kind of partnership between the government and research universities.

History can inform us about how to engage with our government in meaningful ways in helping to set national science policy that maintains and strengthens the science and technology research enterprise. Through much of our national security history, but especially since World War II, national security priorities have had a strong influence on national science policy. They always have and they always will. The events of September 11 represent the beginning of yet another era of great change in our national security priorities.

To put my comments in context, it is necessary to reflect on the links between national security and national science policy during five eras of great change.

World War II

During World War II, scientists, engineers, mathematicians, and language specialists used their expertise to help fight the war. They made key contributions to the aviation industry; dramatically improved manufacturing, communications, and transportation systems; improved the health and nutrition of soldiers; developed new weapons; and used their mathematical and language skills to break codes, providing intelligence and enabling communication with resistance fighters in occupied countries. In addition, the government mobilized the physics and technology community to develop the first atomic bomb, which ended a world war.

But during this period of threats to the nation, our nation always expected that the war itself was an episode that would have an end and would someday be over. This expectation stands in contrast to our current war on terrorism, which President Bush has reminded us time and again will be fought using many different strategies on many different fronts for an unpredictable period of time. Furthermore, the current war is partly in our homeland. A major challenge is to be sure we understand the differences between homeland security and national security, especially when the objectives may be the same.

The Cold War

The very weapons that ended World War II opened a new era of national security, one focused on the proliferation of such weapons. When the Cold War started, the government mobilized scientists and engineers to work on defense R&D to ensure national security, which was defined primarily in the military terms of preparedness and deterrence. The goal was to keep the Soviet Union in check.

In the post-World War II era, Vannevar Bush's *Science—The Endless Frontier* defined nondefense R&D. As Bush stated in that report, "Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress."[7] This persuasive viewpoint laid the foundation for the rise of the American research university and the primacy of unfettered basic, or fundamental, research from the 1950s through the 1990s. This research was a driving force for innovation and growth in both civilian and defense R&D.

We began to see more clearly the links between research and development, or between doing research and then doing something with it. We also saw the links between fundamental research and advances in technology, and then how those advances in technology enabled more fundamental research. Thus, we witnessed the emergence of research and development as a network of enabling interactions instead of a linear progression.

Sputnik

In October 1957, a new threat, the launch of Sputnik, was a symbolic event that caused a shift in perceived risk. Changes in national science and technology policy followed. Beating the Soviets in space added to the patriotic fervor, and shocked us out of a sense of complacency derived from our economic successes of the 1950s.

End of the Cold War/*Science in the National Interest*

The fall of the Berlin Wall in November 1989 was another symbolic act that signaled the rapid end of the Cold War. Our national priorities changed once again.

In the face of a perceived reduced risk, our government leaders started to talk about a "peace dividend." Resources that had been devoted to national security, which had been defined primarily in military terms, would now be released for other uses. We began to think about broader ways to use our science and technology talents to advance our own national interests and those of our global partners.

Science in the National Interest, published by the White House Office of Science and Technology Policy in 1994, crystallized that way of thinking. It began to change the nature of the discussion. We went from characterizing R&D as defense R&D and nondefense R&D to speaking about R&D for broader national interests. National security was expanded to include economic security, environmental security, health security, and personal security with the following core elements:

- health security through understanding, preventing, and treating disease and ensuring an adequate, safe, and nutritious food supply;

- economic security and prosperity through technical innovation driven by basic scientific and engineering research, which in turn brings about technology improvements and revolutionary advances that create new industries;

- national security based on technological superiority bred of scientific and engineering innovation and a strategic commitment to both breadth and excellence in basic research;

- environmental security and responsibility that requires better understanding of the complex interrelationship among components of the biosphere, human activities, and the world around us;

- personal security, as demonstrated through improved quality of life through culture, inspiration, and full participation in the democratic process.[8]

Throughout the 1990s, industry, universities, and government made the case that fundamental research and innovations were creating entire new fields of economic activity. Whole new industries emerged, such as those that converted the Internet from a military network into a major public institution and force for economic growth and information exchange. Whole new classes of pharmaceuticals that resulted from biomedical research entered the market, such as the hepatitis B vaccine and protease inhibitors to treat HIV. And new commercial technologies, such as the global positioning system, are now in standard use in automobiles.

In the 1990s, the argument in support of science in the national interest seemed to capture people's imaginations. Perhaps most successful was "health security" and the advances in the life sciences. One measure of the nation's interest is the rapid increase in funding for the National Institutes of Health (NIH). Although personal health will always have the most general appeal, the science and technology and business communities were succeeding in the argument that strong health sciences also need the physical sciences and mathematics to continue to progress.

During the same time, the nation (including research universities) backed away from supporting the humanities, the arts, and the social sciences. Research universities, which were making a strong case for the support of science and technology and the role of industry, no longer were making the case for *universitas*. This is reflected in the fact that the entire budget request in fiscal year 2003 for the National Endowment for the Humanities is $127 million, and few U.S. students were studying foreign languages seriously. The severity of this issue was dramatically noted when Federal Bureau of Investigation (FBI) Director Robert S. Mueller III, at a press conference shortly after September 11, put the FBI's telephone number on the television screen in an attempt to recruit Americans who spoke Arabic, since we had a shortage of Arabic speakers.

Post-September 11

Our nation's scientists have traditionally stepped up to the plate when needed to work toward national goals, and clearly this has already begun. Over 125 of our nation's distinguished science and technology experts have volunteered and are working together, through a committee of The National Academies, to develop a research agenda for countering terrorism. No one who has been asked to serve, including me, has declined the invitation. Our committee's report will be out in June, and I am confident that it will provide valuable advice for the nation.

Science in our nation, as the late Congressman George Brown, Jr. often reminded us, is funded through the political process. If we are to receive taxpayers' dollars, we must be seen to be responsive to perceived and real threats. It has been this way since the beginning of our nation.

Risk 2: Proposed allocation of tax dollars in the Administration's FY 2003 budget, in particular the changing allocation of R&D with an increased emphasis on "missiles and medicine"

I want to focus on a few significant aspects of the overall federal R&D budget, especially the emphasis on "missiles and medicine," and their impact on research universities.

- Today, defense and health R&D make up more than three-quarters of the federal R&D portfolio (which totals $112 billion in FY 2003), with both areas increasing.

- Research universities perform about 11 percent of the nation's total R&D, and with that share, do more than half of federally funded fundamental research.

- The federal government funds nearly 60 percent of the R&D performed by universities, but this percentage is going down.

- NIH funds nearly two-thirds of federal R&D at colleges and universities, a reality that strongly influences the mix of science and engineering disciplines in their R&D portfolios.

- Other disciplines such as engineering and the physical sciences now account for far smaller shares of the total academic R&D than in past years. Engineering gets 15 percent and the physical sciences get 9 percent of the total university R&D portfolio.[9]

These kinds of imbalances may mean that we might not be training the right mix of scientists, engineers, and other scholars that we will need to work for national security in the next generation. This is not to say that we need less funding for health R&D; rather, we need more nondefense R&D in many other disciplines. Perhaps it is even time for the science and technology community to help out its other colleagues and call for increases in federal funding for specific areas in the humanities.

While a "missiles and medicine" approach is predictable and a basically simple start on a counterterrorism agenda, it is only a beginning. A comprehensive agenda will require investments in many other research areas and a better balance to encourage new ideas. Already those of us on various counterterrorism committees are struggling with this dilemma.

I cannot predict how the rapid shifts in funding priority may directly affect our economy or our national security in the short term. But I can predict that any dramatic decreases in funding for some areas and resulting imbalances of research across disciplines are likely to have negative effects on the kind of research done in universities, as well as the training of scientists and engineers. Such redistribution needs to be carefully considered.

There is no question that the S&T community must provide leadership in research areas that lead to threat reduction. A new partnership between the government and research universities could identify important and significant foci for research and innovation. We need to develop forums and engage in serious discussions with our government leaders to make the case for carefully considered research priorities. By working together, we can avoid pouring money and people into some areas simply because things *can* be done, while we miss defining what *needs* to be done.

Risk 3: The move to increase the tracking of foreign students in universities

Our government is concerned that potential terrorists may abuse our student-visa process as a way to enter our country. As a consequence, the Homeland Security Presidential Directive-2 says:

> The Government shall implement measures to end the abuse of student visas and prohibit certain international students from receiving education and training in sensitive areas, including areas of study with direct application to the development and use of weapons of mass destruction.[10]

According to the U.S. Department of State, the "sensitive areas" could include:

- nuclear technology,
- missile technology,
- navigation and guidance control,
- chemical and biotechnology engineering,
- remote imaging and reconnaissance,
- advance computer/microelectronic technology,
- materials technology,
- information security,
- lasers and directed energy systems,
- sensors,
- marine technology,
- robotics,
- advanced ceramics, and
- high-performance metals and alloys.[11]

I cannot vouch for other universities, but a large portion of this list describes the University of California's research and graduate education portfolio in science and technology.

If implemented without careful consideration, this policy will be risky to our national security for many reasons. Three are given below.

- At least since World War II, the United States has prided itself on being a magnet for the brightest students from around the world who see our educational system as a beacon of hope. After studying in our universities, many stay and make significant contributions to our economy. Indeed, our newly nominated NIH director, Dr. Elias Zerhouni, is a perfect example of the kind of talent that comes to our country for training and opportunity, and then stays to serve our country. Andrew S. Grove, a founder of Intel, is another example. Others return and make positive contributions to their home countries.

- The United States benefits from the infusion of non-U.S. scientists and engineers by gaining access to valuable skills and by exploiting the development of new knowledge overseas.

- Moreover, restricting international students would contribute to an international perception that we are isolationist and imperialistic. That would not be a good thing for national security.

The National Science Board recently released the newest data regarding foreign-born scientists and engineers in the United States. The Board found the following:

- Significant numbers of scientists and engineers in the United States were foreign born. These include
  ? 9.9 percent of bachelor's degrees,
  ? 19.9 percent of master's degrees, and
  ? 27 percent of doctorates.[12]

- Foreign-born Ph.D.s make up
  ? 45 percent of the total U.S. pool n engineering,
  ? 46 percent of computer sciences, and
  ? 31 percent of mathematics.[13]

This foreign-born pool of science and technology talent is distributed across academe, industry, and all levels of government. In academe, for example, foreign-born Ph.D. holders comprise 28 percent of scientists and engineers.[14]

Our leaders have recognized that something must be done to better ensure that holders of student visas are actually studying in educational institutions, and partnerships are starting to emerge. After some initial difficulties, the higher education community responded positively and worked closely with Senator Dianne Feinstein (D-CA) and other public officials to address the vulnerabilities in our nation's student-visa program. The higher education community is now meeting regularly with the Immigration and Naturalization Service, which is implementing the Student and Exchange Visitor Information System.

However, if we perceive that the risk of abuse of our visa system is so high that we have to restrict foreign students, that decision will make sense only if we can also develop a policy that secures our supply of scientists and engineers in the future. A major issue for our nation is that our native-born students either are not sufficiently interested or are not being inspired to pursue science and engineering degrees. If we block access to foreign students, who is going to do the research of the future, and who will be our faculty of the future? This is a serious question that will impact directly on our long-term national economic security. If universities are restricted in their opportunities to attract students from other countries, we must increase incentives for U.S. students to study science, engineering, and mathematics. Again, working in partnership with our government, we must consider our options and develop new policies to manage this serious risk to our future national security.

There can and should be more such interactions with governmental leaders to reach solutions that serve national needs. If the United States decides to restrict access to foreign students, we would have to develop new policies *now* to prevent a net loss of science and engineering personnel at all levels in the next generation.

Proposal for Action

To that end, I propose a contemporary version of the National Defense Education Act (NDEA)—with a twist. It would be responsive to the current challenges we face.

NDEA was a direct result of an increase in the perceived risk to national security by the launch of Sputnik. It marked a change in national science policy in response to emerging national security concerns. The Act increased support for large numbers of students who became scientists and engineers from the late 1950s through the 1970s. One result was a rise in Ph.D.s awarded annually by U.S. colleges and universities from 8,600 in 1957 to 34,000 in 1973.[15]

In fact, I was a beneficiary of NDEA. Many scientific careers were launched in part, or in whole, because of policies that were put in place as the result of this Act. We need a new version of this program, designed with current challenges in mind, which will yield comparable results.

There may, however, be an even more compelling reason for a new federal initiative to draw U.S. students into science and engineering. Our homeland defense and national security needs should motivate us to tap into the large pool of women and minorities who have so far been underrepresented in science and engineering. Some critics of the research university argue that our encouragement of foreign students to populate our graduate and research programs is a result of our nation's unwillingness to provide significant incentives to our own young people, especially women and minorities, to get serious about science and technology careers. They argue that as a nation, and as research universities, we are unwilling to spend the needed resources to prepare, recruit, and then support all kinds of students to pursue these careers.

A contemporary federal initiative could finally tap into that huge sector of the population that has not been readily welcomed before. And a call to our young people from our government would be consistent with the President's call for national service. It would draw our most talented young people from all sectors of society to explore areas of scholarship that are important to national security, including all fields of science and technology and some fields in the social sciences and the humanities.

All sectors of our society, including science and technology, security and intelligence, defense, foreign relations, and economic development, need well-educated students in these areas for the future. This is, therefore, yet another important area that should be discussed within the framework of a new partnership between government and research universities.

Need for a New Partnership

With discussion of these three risks, I hope I have been convincing that a new partnership is needed to work on viable solutions to the great challenges that face us.

I am reminded of H.L. Mencken's famous quote: "For every complex problem, there is a solution that is simple, neat, and wrong."

I propose instead that we pull smart, committed people together into new partnerships to develop solutions that are simple, straightforward, and *right*. That means a new partnership involving the research community working with public officials to make wise and fully informed choices now to ensure our national security in the long term.

Research Universities Reconsidered

I alluded to a major issue above that I would like to conclude with. Research universities have another critically important role to play in the immediate future that is not discussed nearly enough in the S&T community. That role is to help our nation better understand the complex social and cultural forces that are changing our world. In Karen Armstrong's book *The Battle for God*, she reflects on the struggle between modernity and fundamentalism in many religions and notes, "All over the globe, people have been struggling with these new conditions and have been forced to reassess their religious traditions, which were designed for an entirely different type of society."[16] We face this difficult struggle today, and will continue to face it for a long time to come. We must try to understand it and to help the next generation.

In short, there are many scholars in our universities who can help us to understand some of these issues as the first step of many steps toward finding some solutions.

These will be among the great challenges for the next generation of research universities. We can excel in science and technology, and the education of scientists and engineers. And we can excel in preparing humanists and social scientists. But that is not enough. If we do no more than that, then the age-old two-cultures war will rage on at a time when the stakes are simply too high for disciplinary isolation. We must have a broader education to help all of us understand the complexity of the world around us. Perhaps reaching across the disciplines is one of the greatest challenges for the research university.

What will define a well-educated student and scholar in the next generation? Let me return to one of our scientific colleagues, E.O. Wilson, and his assertion in *Consilience: The Unity of Knowledge*:

> Every college student should be able to answer the following question: What is the relation between science and the humanities, and how important is it for human welfare? Most of the issues that vex humanity daily—economic conflict, arms escalation, overpopulation, abortion, environment, poverty—cannot be solved without integrating knowledge from the natural sciences with that of the social sciences and humanities. Only fluency across the boundaries will provide a clear view of the world as it really is…[17]

Preparing this truly well educated student is our most risky business in the next generation, and we must step up to the challenge now.

The scientific and technological creativity and innovation that support our national security in so many ways—economic, military, health, environment, education—will advance:

- if our research priorities are broad enough to enable exploration and discovery into new areas from which unanticipated benefits may be derived,

- if the free flow of information is not restricted without considerable deliberation and acknowledgement of risks to the overall R&D effort, and

- if we create pathways for our own students as well as the brightest foreign students to study and succeed in our research universities.

I am convinced that our universities have much to offer in this new globally oriented world of ours. I call on our community and our government to work together to address these new challenges constructively. If we do not, we will become a weaker country, and we will have allowed the terrorists to progress. If we are able to work together in ways that are respectful of each other's needs and strengths, we will emerge as a much stronger country, as well as a much better country.

Endnotes

1. The author wishes to thank Donna Gerardi Riordan for her substantial assistance in preparing this lecture.
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