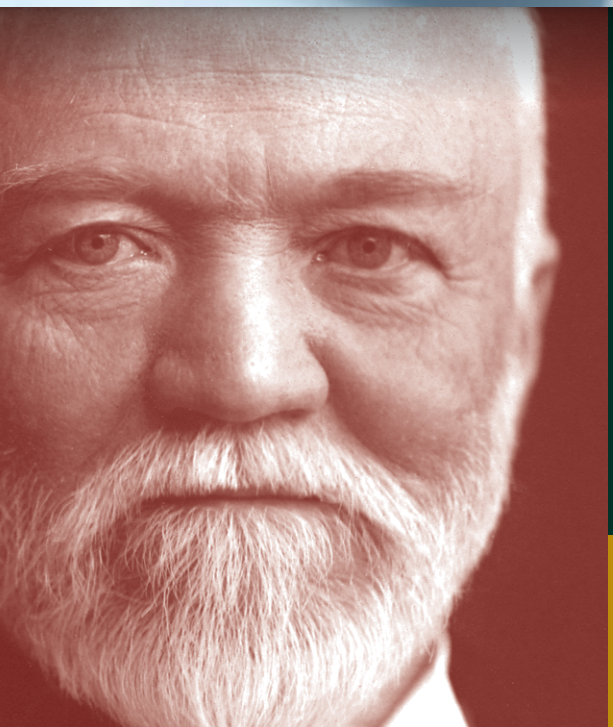
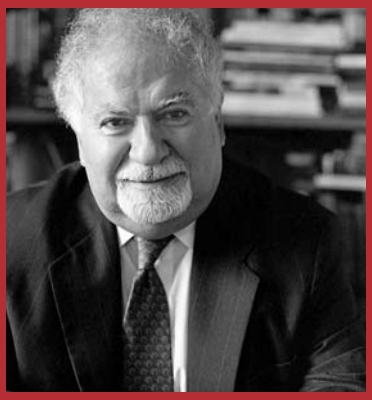
CARNEGIE REVIEW



Crafting Strategies to Control Biological Weapons

Carnegie Corporation *of* New York



In reviewing the legacy of Andrew Carnegie, arguably the 20th century's most important philanthropist, it becomes clear that, of all the concerns he addressed by establishing institutions devoted to particular causes and by his other philanthropic undertakings, the one that seems to have been of paramount importance to him, especially as he grew older, was the pursuit of peace. When he was in his seventies, he said about the subject of peace, "I am drawn more to this cause than to any."

Andrew Carnegie was always a tireless promoter of ways to further the cause of peace. In a 1907 speech he argued that war might be eliminated if a global organization, which he later proposed calling a "league of nations," were established with authority to settle international disputes through arbitration and the use of economic sanctions. After World War I, President Woodrow Wilson's proposal for the League of Nations had much in common with Carnegie's ideas, as did subsequent proposals for the United Nations.

Carnegie Corporation of New York began to systematically build on our founder's legacy during the Cold War era when it became abundantly clear that there was great danger to world peace posed by the superpower confrontation and weapons of mass destruction. One result was the establishment of the Carnegie Commission on the Prevention of Deadly Conflict in 1994, which examined the principal causes of deadly ethnic, nationalist and religious conflicts within and between states and the circumstances that foster or deter their outbreak. The Commission concluded its work in 1999, but as we crossed the threshold of the 21st century, it became clear that the Corporation's efforts in this area should continue because grave threats to international peace and security still loomed. For example, the presence and proliferation of nuclear, chemical and biological weapons had been hardly diminished by what were in other respects great steps forward in the sweep of human events: the end of the Cold War, the demise of the Soviet Union and the independence of eastern and central European states. The terrorist attacks of 9/11 and the anthrax-laced letters that turned up soon afterwards in news media and Senate offices added to our understanding that not only were old threats still with us, but new ones had now appeared.

As Sam Nunn, former senator and past member of the Corporation's Board of Trustees observed, the world had moved from an era of high risk and high stability into one of low risk but also low stability. Signs of danger were visible on many fronts. Russia, for instance, not only held a huge stockpile of nuclear and chemical weapons and materiel, it was also known to have biological weapons, as well as a tremendous pool of scientific talent. Where such weapons were once viewed as the exclusive property of advanced nation-states, with the advent of globalization they had become available in a virtual international supermarket, where both state and nonstate actors—including terrorist groups representing a variety of beliefs and interests—were potentially eager customers.

Together with nuclear and chemical arms, biological weapons comprise the "unholy trinity" of weapons of mass destruction. At the close of the 20th century, more countries possessed chemical and biological

weapons capabilities than nuclear arsenals. And while the monitoring provisions of the Chemical Weapons Convention were far from perfect, at least they represented an effort to rein in that deadly sector. By contrast, similar attempts to address the problem of biological weapons were almost nonexistent. Negotiations around the verification measures for the 1972 Biological and Toxin Weapons Convention dragged on for years, with little progress, resulting in a toothless treaty that consisted of merely a pledge by states never to "develop, produce or stockpile" biological agents or toxins. Pledges, as we all know, are often made to be broken.

For these reasons, in 2000, the Corporation's Board of Trustees approved a cluster of grants dedicated to building a more robust biological weapons treaty. But when efforts to advance the treaty continued to lag, it became clear that a new direction would have to be pursued in order to promote nonproliferation. Responding to strategies outlined by noted experts and scholars in the field, the Corporation refocused its support on programs that, among other objectives, aimed for enhanced communication between policymakers and scientists, while educating researchers about the potentially dangerous dual-use aspects of their work. It is with some pride that we reflect on our legacy of catalyzing a response from others in the field who have taken up this work in influential universities and at the highest levels of government as well as internationally.

It is our hope that this review of our grantmaking in the biosecurity area will be a source of ideas and motivation for others who may strive to mitigate this still real and present danger by promoting research on policy implications, strategies for raising public awareness and efforts to educate policymakers about these critically important issues. The world and its people are still waiting for the day when we can put these dangers behind us for good.

Vartan Gregorian
President, Carnegie Corporation of New York

"The more that sophisticated capabilities… spread around the globe, the greater the potential that terrorists will use them to develop biological weapons. The challenge for U.S. policymakers is to prevent that potential from becoming a reality by keeping dangerous pathogens—and the equipment, technology and know-how needed to weaponize them—out of the hands of criminals, terrorists and proliferant states."[1]

On December 2, 2008, this warning appeared in *World at Risk,* a report released by an expert commission appointed by the U.S. Congress to investigate the current state of weapons of mass destruction (WMD). The commission based its sobering conclusion and policy recommendations on site visits and interviews with government officials and nongovernmental experts in the United States and abroad. While some have questioned its pessimistic tone, the report's recommendations for prevention of bioweapons proliferation and bioterrorism echo the basic convictions of Carnegie Corporation's International Peace and Security program. It recommends a culture of security awareness in the life sciences community, "integrated into a program of mandatory education and training for scientists and technicians in the life sciences field, whether they are working in the academy or industry; such training should begin with advanced college and graduate students and extend to career scientists." Toward this end, the Corporation has already provided nearly a decade of support and invested over $11.5 million for work in the bioweapons realm.

Biological weapons, which involve the cause or spread of disease by biological agents, have the potential to bring about immense human harm, panic and societal disruption. Their development today is most affected by the speed and nature of advances in the biological sciences. Compared with nuclear and chemical weapons of mass destruction, biological weapons are in some ways the most dangerous; they are easy to produce and their ingredients are readily available and equally usable for either harmful or benign purposes. That's why they have been referred to as the "poor man's atom bomb."

Potentially deadly biological weapons are not new. Military historians trace their use back through the centuries, and they have never really disappeared from the scene. In medieval times, for instance, bodies of dead soldiers and animals were catapulted over castle walls to spread infection. Blankets contaminated with smallpox were distributed to Native Americans in the 18th century, with deadly results. In World War II, the Japanese army reputedly used disease agents against the Chinese, and during the Cold War, bioweapons programs in the Soviet Union and United States explored the potential use of bacteria, viruses and biological toxins. Relatively recent incidents involving anthrax and ricin have demonstrated the availability of bioweapons to disturbed individuals and extremist groups, raising awareness among experts and the general public that more and better controls are urgently needed.

The Geneva Protocol (signed in 1925 and entered into force in 1928) made the use of "bacteriological methods of warfare" a violation of international law. Nevertheless, research on these weapons continued through World War II, with every major combatant pursuing a biological weapons program of some sort. The U.S. program originated in 1942 and employed thousands of workers; yet political and military authorities ultimately decided against using germ warfare. After the war, interest in bioweapons in the United States and the Soviet Union, which had the largest biological weapons complex anywhere, continued for decades. Secret state-sponsored biological weapons

1 *World at Risk: The Report of the Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism*; 2008; www.preventwmd.gov/12_2_2008

programs in several countries, including at various times France, Japan and the United Kingdom, were also extensive.

By 1969, steadily increasing negative expert and public opinion influenced President Richard Nixon to order the U.S. to unilaterally discontinue its biological weapons program. The government strongly supported the Biological and Toxin Weapons Convention prohibiting the possession, development and stockpiling of biological weapons, which was approved in 1972 and went into force three years later. By the time Carnegie Corporation began its activities on the biosecurity issue, 143 countries including the U.S. and the U.S.S.R. had long since signed the Biological and Toxin Weapons Convention. Many in the field saw it as a clear standard against the development of this class of weapons—yet the treaty had no provision for inspections or other means of determining compliance, and lacking mechanisms for dealing with the pharmaceutical and chemical industries or with terrorists and other nonstate actors, biosecurity experts came to realize it was the least effectual of constraints.

Achieving a Biological and Toxin Weapons Convention that was more robust and enforceable was the goal of the first in Carnegie Corporation's three stages of work in the biosecurity field. The momentum for this initial round of grantmaking started soon after Vartan Gregorian joined the Corporation in 1997, when the decision was made to add biological weapons to the existing Weapons of Mass Destruction (WMD) portfolio. Former senator Sam Nunn, then a trustee of Carnegie Corporation of New York, argued strongly for this expansion of the Corporation's nonproliferation work. "Clearly in this age of terrorism, the threat posed by biological weaponry becomes even more frightening, and it is incumbent on American leadership to move now to curb the production and deployment of microorganisms that can cause specific diseases in humans and animals and plants," he said.

The grants created in 2000 for this purpose funded a group of organizations the Corporation already knew well and had some investment in, and whose efforts would complement each other in hopes of achieving timely results. Supporting prestigious research and advisory programs in the U.S. and abroad, these grants targeted the treaty review conference on implementation of a verification mechanism scheduled for the following year in Geneva. In anticipation of this event, the International Peace and Security program provided broad support for policy research on critical compliance issues, the first of the program's many steps in a sustained effort to reduce the risk of misuse of biological research.

"The specific goal was to create an opportunity to move ahead with the verification protocol that would, after more than 25 years, provide the teeth for the Biological and Toxin Weapons Convention," explains Patricia Moore Nicholas, project manager, International Peace and Security Program. "Without verification compliance there was no legitimate way to go in and do an inspection, for example, and consequently no way to make sure countries weren't breaking the rules. However, in 2001 when the verification amendment was up for adoption in Geneva, the U.S. would not support the amendment after all."

American concerns over verification and compliance issues, especially in light of belatedly disclosed Soviet and Iraqi bioweapons programs (developed while both countries were signatories of the treaty) were the main reasons the Biological and Toxin Weapons Convention fell apart, insiders contend. Given the nature of the threat, putting "teeth" into the convention required such extreme intrusiveness into legitimate commercial and biodefense activities that the Bush Administration was reluctant to go forward. Failure in this arena pushed the Corporation's behind-the-scenes biosecurity efforts into other directions. Because issues such as biological weapons are so complex, and the levers of power and influence are

so dispersed, the Corporation has employed a wide range of approaches to push against multiple doors in the hopes that one or more would open.

In early 2009, as this review is being written, Carnegie Corporation support for these myriad programs has entered its closing phase. While the threat of biological weapons has not gone away, today its nature is better understood. And, due to the considerable efforts of our grantees, critical steps have been taken to improve communication and strengthen the commitment of key stakeholders to work toward nonproliferation. This review, which features commentary from leaders of the organizations involved in the Corporation's Biological Weapons program, summarizes what years of grantmaking have achieved and where the greatest challenges remain.

Carnegie Corporation Biological Weapons Grants

Henry L. Stimson Center, Washington, D.C.

Project on chemical and biological weapons nonproliferation

A decade after the end of the Cold War, the Washington, D.C.–based Center addressed critical security concerns by working to reduce the global threat posed by chemical and biological weapons through forceful implementation of robust international treaties designed to control their use. In the aftermath of September 11, the Chemical and Biological Weapons Nonproliferation project addressed chemical and biological issues at both the national and sub-national actor levels.

Federation of American Scientists Fund, Washington, D.C.

Working Group on Biological Weapons Verification treaty negotiation work; Bioscientist Education Project

The Working Group of scientists skilled in biological research, formed to strengthen the Biological Weapons Convention through an effective compliance regime, played a valuable role in bridging the gap between scientists and policymakers in the multilateral negotiating process, also acting as liaison to U.S. administration officials, the biotech industry and others. (This group moved to the Center for Arms Control and Non-Proliferation in 2003.)

The FAS later took the lead in educating advanced degree scientists about the possible misuse of biology as a threat to international security and conducted a multiyear effort to facilitate engagement of the two groups. FAS also created multimedia tools to raise awareness of biosecurity, including the Virtual Biosecurity Center, to inform and engage the wider biosecurity community.

Harvard University, Cambridge, Massachusetts
University of Sussex, Brighton, U.K.

Harvard Sussex Program on the global elimination of biological and chemical weapons

This joint program aimed to eradicate biological weapons through university-based research, publication and training designed to confront already-developed biological weapons and hostile exploitation of biotechnology. The program built its Information Bank to be the world's principal archival database on biological weapons matters and published a quarterly journal reporting biological warfare news items and commentary. The program's ultimate objective was a new bioweapons treaty that would criminalize the individual production or use of chemical or biological weapons.

University of Bradford, West Yorkshire, U.K.

Preventing the proliferation of biological weapons

Bradford University's Department of Peace Studies operated the Project on Strengthening the Biological and Toxins Weapons Convention and Preventing Biological

Warfare to research and disseminate information on the treaty and related issues. Through a Web site jointly operated with the Stockholm International Peace Research Institute, the project provided specialist publications and official treaty negotiation documentation to the public and policymakers. The site was later expanded into a gateway to capture higher public interest and achieve more widespread understanding of biosecurity.

National Academy of Sciences, Washington, D.C.

Program on enhancing bioscience in the formulation and implementation of U.S. foreign policy

The Jefferson Science Fellows program at the Department of State, administered by the National Academy of Sciences, was established as a new model for engagement of the American academic scientific community in U.S. government policy. Tenured senior academic scientists and engineers from U.S. institutions of higher learning spend a year assigned to the State Department, its embassies or missions, to provide expertise on science or technology. Fellows remain available for five additional years to the U.S. government as consultants.

In a separate program, responding to the National Research Council's "Fink Report" on biotechnology, the International Biosecurity Project was set up to build linkages among the research community, governments, international organizations and the private sector leading to an international forum, with the goal of reducing the risk that advances in life sciences research could be misused.

Princeton University, Princeton, New Jersey

Project to develop recommendations for academia, industry and government regarding the management of potential biological weapons agents. Seminar series integrating life science and security studies research communities

Princeton University's Program on Science and Global Security (PSGS) designed a project to reduce the danger that domestic biological research would facilitate bioterrorism, advising on best practices for research on potential biological weapons agents at universities and industrial laboratories. Subsequently, as part of the Corporation's Biosecurity Integration Initiative, seminars and workshops were held for the university's life sciences community to foster a culture of responsibility among bioscientists, post-doctoral students, faculty members and research staff (at Princeton and other universities) as well as area pharmaceutical-industry scientists.

Center for Arms Control and Non-Proliferation, Washington, D.C.

Establishment of the American Scientists Working Group on Biological and Chemical Weapons and meetings on global approaches to biosecurity

With escalating biotechnology advances and their potential application for hostile purposes, the American Scientists Working Group considered the acceptable standard against biological weapons to be in danger. The group's activities aimed to expose the long-term risk of these weapons and put the issue on the public agenda, eventually establishing an individual norm against their use. Because the problem is by nature an international one, guidelines had to be established collectively and on a global level. International discussions were held to facilitate this process.

University of California, San Diego, La Jolla, California

Creation and implementation of a program on biological weapons threats and policy

As part of a Corporation-supported effort to overcome a cultural divide and integrate the security and bioscience communities, the University of California Institute on Global Conflict and Cooperation (IGCC) created a two-week intensive training program for participants from the University of California system, national and international universities, laboratories and sectors, to enable them to interact with defense and international security professionals. The program's webcasts and policy briefings were presented in Washington, D.C. to disseminate the results to the broader policy community.

Center for Strategic and International Studies, Washington, D.C.

Toward a project on biological weapons threat reduction

While the threat of biological weapons use had been recognized as a worldwide problem with international implications, it failed to mobilize concerted action among key constituencies in a timely way. The Center for Strategic and International Studies (CSIS) designed a conceptual model, the Biological Threat Reduction Project, to minimize the risks posed by bioweapons, building an international consortium of think tanks, scientific, public health and safety organizations, universities and individuals to develop an agenda for a global program. In the second phase of the project, CSIS conducted workshops and outreach activities to advance the model.

Massachusetts Institute of Technology, Cambridge, Massachusetts

For a seminar series on biosecurity and national security

Unlike the physics community, which since the start of the nuclear age has been included in security planning, the biosciences community has no tradition of working with national security experts. To help bridge this gap, the Security Studies program at the Massachusetts Institute of Technology, in partnership with the Committee on International Security Studies of the American Academy of Arts and Sciences, launched a seminar series to allow participating scientists to gain a deeper understanding of the security implications of life sciences research and for national security practitioners to learn about the threats and opportunities presented by the biotechnology revolution. Resulting seminars were summarized and archived.

University of California, Berkeley

Toward a pilot project to train researchers in synthetic biology in the policy relevant aspects of their work

To adequately address the challenges posed by the emerging field of synthetic biology, policymakers must understand how synthetic biological weapons complicate traditional proliferation issues, and scientists should recognize the security implications of their discipline. Toward this end, the Berkeley Center for Synthetic Biology designed workshops, seminars and course offerings developed jointly by Berkeley Center scientists and security experts at the Goldman School of Public Policy to train a new generation of students in both science and security policy.

Partnership for Global Security, Philadelphia, Pennsylvania

For workshops on building support for global biosecurity

Well after the threat of international bioterrorism and the potential for the misapplication of beneficial research appeared on the radar screens of governments and science policymakers, a comprehensive action plan for addressing key scientific issues related to biological security had yet to emerge. The relevant parties still approached the issue of biosecurity from many different perspectives with no accord among stakeholder groups on strategies, methods and approaches. To help fill that void, the Partnership for Global Security called together key groups in roundtable meetings to identify priority issues with the goal of conducting a sustainable dialogue leading to widespread agreement on a results-driven global strategy. The Partnership's first Global Biosecurity Convention, endorsed by local legislators and life scientists, is being planned for late 2009.

Cornell University, Ithaca, New York

One-time funding for an oral history of the U.S. and Soviet bioweapons programs

The Soviet Union's offensive biological weapons program was the world's largest and most complex; the U.S. program was smaller but equally sophisticated. When these programs were dismantled, their stockpiles and munitions were destroyed and their scientists redeployed to peaceful projects, while the opportunity to document bioweapons development in the two countries was lost. A team from Cornell University is analyzing the two former programs to produce a unique report of their findings.

First Steps

With dramatic advances in biotechnology in the 1990s, weapons protocols devised decades earlier quickly lost their relevance. In addition, the international political landscape had shifted dramatically, resulting in a world no longer neatly divided between two superpowers. "With no ready framework to replace the Cold War despite multiple efforts to redefine security, the anticipated 'New World Order' of international cooperation, once expected to replace the bi-polar struggle, never materialized," says Stephen Del Rosso, Carnegie Corporation program director, International Peace and Security. "The peace and security field soon had to contend with a conception of security including both newer threats and unfinished business from the Cold War."

Long in the arms control frontlines, the Corporation, in the late 1990s at the urging of its new president, turned its attention to strategies that would attempt to limit the development and spread of increasingly destructive biological weapons. Years of negotiations had done little to strengthen the Biological Weapons Convention, convincing the Corporation that a more innovative approach was called for. "The goals of the 1972 Biological Weapons treaty have not been attained partially because there has been too little attention paid to this lethal family of weapons," Vartan Gregorian stated, announcing board approval of a new group of grants intended to "elevate the issue, re-invigorate the protocol debate and help the public understand what is at stake should these deadly weapons be available to terrorists."

The Federation of American Scientists (FAS) received one of the Corporation's early bioweapons grants in 2000 for technical advisory work by scientists skilled in biological research. The data and analysis produced by Federation researchers was seen as a bridge between science and policy on technical issues, and was used regularly to inform the work of health organizations, the U.S. administration and the bio-industry as well as by the ad hoc group of scientists, formed ten years earlier, who had been working steadily to negotiate a legally binding verification protocol for the Biological and Toxin Weapons Convention. The group was seen as an unbiased technical resource and the only one available since the early stages of treaty negotiations. The organization's studies were already known to have had a direct impact at the international level.

Early on, the founding scientists recognized that science had become central to many key public policy questions, and they believed they had a unique responsibility…

FAS was founded in 1945 by scientists who had worked on the Manhattan Project to develop the first atomic bombs, and it currently provides nonpartisan technical analysis on complex global issues that hinge on science and technology. Early on, the founding scientists recognized that science had become central to many key public policy questions, and they believed they had a unique responsibility to both warn the public and policy leaders of potential dangers from scientific and technical advances, and to demonstrate how good policy could increase the benefits of new scientific knowledge. With 70 Nobel Laureates currently on its Board of Sponsors, FAS has the ability to bring together people from many disciplines and organizations to address critical policy topics not well covered by other organizations. When it was founded, the FAS ad hoc group was virtually the lone nongovernmental organization monitoring and contributing to the Biological and Toxin Weapons Convention negotiations. By the time the Corporation began funding the FAS, it had been joined by the University of Bradford, National Academy of Sciences and Harvard Sussex Program—all of which were also receiving support from the Corporation's initial Biosecurity grantmaking program.

Patricia Moore Nicholas

Project Manager
International Peace and Security Program

What happened on September 11, 2001 should remind us that even the best of strategies can be changed by events. After the anthrax attacks, which revealed the potential for catastrophic bioterrorism, it was clear that biotechnology had the capacity to be used for peaceful purposes—or not. We understood that although the Biological and Toxin Weapons Convention was not a bad treaty per se, it just wasn't the right tool for this challenge. It wouldn't cover the wide spectrum of bioweapons threats that we now realized existed. A revolution was going on in the biosciences, which were advancing at an alarming rate with the potential for truly horrific uses, according to experts like Harvard biology professor and Corporation grantee Matthew Meselson, who had played a leading role in organizing scientists against bioweapons development in the 1960s.

With this realization a new phase of grantmaking—the Biosecurity Integration Initiative—took root. The Corporation's view was that effective biosecurity policy in the United States required expertise at the nexus of science and security. That integrated expertise did not exist, so we set out to create it and in so doing, catalyzed the development of a new field and a next generation of experts. The work began with an exploratory phase where, in conversation with scientists, it became clear to us that they worked in silos and that an opaque curtain existed between biological science and security policy.

The scientists we spoke with admitted that they had little or no awareness of the dangers of dual use—the possibility that their labs might be conducting experiments that were violating the Biological Weapons Convention, for example. Our focus became the development of an enhanced role for those with experience combining biological science and international security. This group would have the training to recognize inappropriate biological research whatever the setting and, more critically, could act as sophisticated participants in the debate over biological weapons policy— perhaps, it was hoped, choosing to work directly in the policy field.

Realistically, when compared to the massive funds that the government puts into the field, we sometimes wondered what our million-a-year contribution would accomplish. But Carnegie Corporation has always had "more cachet than cash," and we had the potential for creating linkages. We were always aware of limits to the absorptive capacity in the community for our type of expertise; we also count on the multiplier effect, knowing that for each person we reach and train, many more will ultimately be affected. Each step of the way, from the initial decision to get into biological weapons work through many refinements of our strategy, we have always followed up internal discussion by seeking advice and validation from external experts.

A particular point of pride has been the evolution of the Jefferson Science Fellows. The program was developed with our grantee Dr. George Atkinson, former Science and Technology Adviser to the Secretary of State, and has been supported by grants from the Corporation and the MacArthur Foundation and partner universities. This program brings experienced scientists and engineers from the academic community into the U.S. Department of State for a year to act as advisors and educators, bridging the science and policy worlds. Several cohorts have already graduated and a new group has been chosen for 2009–2010.

Good relationships with our grantees and an overall agreement on what needed to be done have helped to make this work extremely satisfying. And we have not done it alone. The MacArthur Foundation has contributed significantly, although they were working from the top down, giving large grants to beef up science

and technology at universities and advancing nonproliferation. We were best suited to address human capital, working from the bottom up, institution by institution, increasing the quality and quantity of trained individuals. It is clear our ideas were more important than our deep pockets. As a funding group we have come to the understanding that what needed to be done was to provide education and capacity building: training the experts who would create policies and meet challenges. Vartan Gregorian is an enthusiastic supporter of such partnerships and we have all witnessed the positive effects of working together.

Progress in the biosecurity field can be seen as a continuum, which means our role, including the Initiative, doesn't have a beginning middle and end. Instead, we entered at an optimum spot, made improvements and are now about to make our exit. It's satisfying to see that our work has had an impact that will outlast our participation. The relationships, the synergy and the productivity are self-sustaining.

Starting Over

"What ended the first grantmaking phase and changed everyone's thinking was 9/11," Patricia Nicholas says. "The events of that day affected what happened in Geneva [where the treaty negotiations took place] and solidified what we at the Corporation had learned earlier. Subsequently we held a meeting with our grantees, scholars and other funders on "defining the debate" to determine what should happen next. The result of this meeting was a sort of epiphany that changed our point of view and propelled us into the next phase of grantmaking."

This reassessment of the Corporation's bioweapons work led to a major midcourse correction. Future strategy needed to move away from work on the existing Biological and Toxin Weapons Convention and toward controlling proliferation and enhancing knowledge of the field. While winding down its treaty work, the Corporation adopted some new goals:

1. Investigating the possibility of a new type of treaty that could criminalize bioweapons use;
2. Informing the public about the dangers of biological weapons;
3. Educating Congress;
4. Creating a community of individuals grounded in both science and international security.

By this stage, it had become clear that nonproliferation policy called for collaboration between security experts and members of the biological research community—two cultures that rarely had cause to come together. To help facilitate that partnership, the Corporation conceived and developed the Biosecurity Integration Initiative, a cluster of projects aimed at facilitating interaction between policymakers and scientists within the United States through an array of educational programs and forums at five American universities: Harvard, the Massachusetts Institute of Technology, Princeton, the University of California, San Diego and the University of California, Berkeley. Since 2003, the Initiative has produced upwards of 200 scientifically competent experts versed in both policy formation and security concerns, some of whom have already entered the policy realm.

Because of the dual-use nature of biological research—the techniques needed to engineer a bioweapon are the same as those needed to pursue legitimate research—chances of misuse of research have increased as technical milestones have been reached, stresses Federation president Henry Kelly, a physicist who previously spent more than seven years as assistant director for technology in the White House Office of Science and Technology Policy. There he managed the expansion and refocusing of federal information technology research and was instrumental in creat-

ing major federal programs in learning technology for children and adults, including training federal civilian and military employees. Scientists not only have a moral obligation to prevent the misapplication of research technologies or findings, according to Kelly, they are also in the best position to understand the potential for misuse. Since science will always move faster than government, scientists must take the lead in this area. The risk of *not* doing so may be governmental imposition of blanket restrictions and cumbersome rules that slow down legitimate research while having little impact on real security.

With Corporation funding, the Federation of American Scientists has created a multimedia program to raise awareness of biosecurity within the research community and simultaneously improve the effec-

Henry Kelly, Ph.D.

President
Federation of American Scientists (FAS)

Unlike uranium in physics, in biology there is no bright line between legitimate and dangerous work. This is coupled with no history of biologists moving in and out of security. Consequently, there was fear and confusion whenever FBI investigators showed up in the bio lab. These were cultural problems and, regarding dual use, deep cultural problems. We needed to know: What can be done that will be unambiguously helpful in terms of biosecurity, without clamping down and retarding legitimate research? This is such a difficult area to take on in a way that's constructive. Making things illegal or putting on constraints goes to the core of biological research, you could grind it to a halt.

Not all biological research can be converted to something dangerous. But the most valuable research designed to cure medical conditions can have the potential for malicious intent, even where you would never have thought any such implications existed. For instance, one researcher trying to find better ways to cure asthma was making finely encapsulated powder that would be easier to inhale. But that's precisely what you would want to do with a harmful biological agent. This poor guy had spent all his life trying to cure sick children but people were saying "What are you doing?!" We need to be more alert to that potential.

It was while we were wrestling with these issues that we started talking to Carnegie Corporation. With Pat Nicholas's help we worked out several ideas that were very well received, and we've gotten a lot of very strong interest. A new development scheduled to go live in early 2009 is the Virtual Biosecurity Center. In this field there's a lot of work but not much communication. At the FAS we have lots of training materials, and we repeatedly hear of the need for a clearinghouse, which the Center will be. The Corporation's support has leveraged something; it's launched something with lasting impact.

These days we're feeling more optimistic about research and policy integration, with a new science advisor about to be appointed and a Nobel Prize winner for energy secretary; these are people who understand where you can use science and where you can't. Our concerns had been that the Office of Science and Technology Policy had been weakened; that politics was standing between scientists and people. We had deep concerns that the process was breaking down. There continues to be concern about a painful weakening of the science community's ability to contribute. This needs to get fixed, but I think it's getting noticed. Recently, Speaker of the House Nancy Pelosi was quoted as saying "Our priorities are science, science, science and science."

tiveness of policymakers. A series of case studies on its Web site[2] offering real world examples of dual-use ethical dilemmas has been used to educate members of the biological science and security policymaking communities. The Federation has since taken their biosecurity program to the next level by creating the collaborative Virtual Biosecurity Center, which aggregates information from many sources in a convenient format, providing multimedia educational materials and much more, according to geneticist Michael Stebbins, FAS director of biology policy, who heads the project.

Dramatic changes had been taking place, and raising concerns, in the biosecurity field for some time even before the events of 9/11 thrust the science and policy worlds into a new reality.

The main problem, as he sees it, has been a total lack of communication between the policy and science factions. "You have to recognize that people are not paid to collaborate, but to do one-off projects," he explains. "But reports don't mesh with the way people are currently communicating. I realized this a couple of years ago when I was invited to a meeting at Google. It was crystal clear that we had to build something completely new and change the way policy should be communicated, cutting out redundancies and forming a community."

With the Virtual Biosecurity Center (VBC) communication has fundamentally changed, Stebbins says. The VBC is an information hub, a one-stop shop for all biosecurity and public health preparedness information—"a *New York Times* front page for info on biosecurity" in his words. Its goal is "to push other people's products," and to overcome the fact that great materials exist but people are not aware of them. The National Academy of Science, the American Association for the Advancement of Science and the Center for Strategic and International Studies are all equal partners in the Virtual Biosecurity Center. It's hoped that by bringing together four such well-respected groups, a team has been created that will be able to leverage the policy community.

In 2008, Stebbins gave a talk about the Virtual Biosecurity Center to the FBI, after which he received a call from the CIA requesting a briefing. The lack of centralized information was exactly what they had identified as a major problem, and they wanted in. In early 2009, the CIA was considering taking the unusual step of funding the project completely. A key component of the Center program is a biosecurity reporting system. When scientists suspect something is wrong, it allows them to ask questions and, if something illegal is occurring or is about to occur, the legal system is immediately notified. "One of Pat Nicholas's goals was to bring together the work of all the groups that were getting funded by the Corporation," says Stebbins. "We would take a lecture from Princeton, for example, stream it and then archive it. We would disseminate other groups' reports. I had my doubts, thinking 'it can't be this easy to get an idea, fund it and have the government adopt it.' But that's what happened."

Dramatic changes had been taking place, and raising concerns, in the biosecurity field for some time even before the events of 9/11 thrust the science and policy worlds into a new reality. Globalization was facilitating the rapid spread and application of new science and technology, transforming patterns of industrial production in the life sciences, and involving new players from government and the private sector. The emergence of nongovernmental entities with disproportionate impact, and the escalating number of regions in the world where knowledge could be exploited to do harm, made it much harder to determine noncompliance with global norms and led to uncertain enforcement and response at every level. Carnegie Corporation's Biosecurity Integration Initiative met this challenge with an array of programs aimed at bridging science and security,

2 Case Studies in Dual Use Biological Research
http://www.fas.org/biosecurity/education/dualuse/index.html

emphasizing the exchange of ideas on a global basis. The grantees had established international partnerships with access to stakeholders, governments, industry, public health and security agencies, all of whom needed to come together to address this urgent issue.

Princeton University was one institution well positioned for such a pioneering role. A grant in 2003 supported the university's Program on Science and Global Security (PSGS), intended to help the bioscience community understand the international implications of biomedical weapons and the options for dealing with them. The program's organizers stressed the importance of the community developing its own understanding of the dangers of their work in order to provide its input into the best means of protecting against bioterrorism without impeding biomedical advances. This research and seminar project has engaged university, biotech and pharmaceutical industry scientists (many headquartered near the university) on issues that affect the seriousness of the bioterror threat. The resulting set of policy analyses and recommendations to come out of these convenings was intended to become a model for other universities and research laboratories in the U.S. and worldwide.

Laura H. Kahn, MD, MPH, MPP

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I had started a public policy masters at Princeton in fall 2001—and then came 9/11, followed by the anthrax letters, which were mailed in Princeton so the university had a particular interest in the case. I enrolled in Professor Frank Von Hippel's course in Weapons of Mass Destruction and was very interested. I thought what he was doing was very important and asked if I could work with him. He took me on as a research associate in spring of 2002. Scott Steel, who was getting his Ph.D. in molecular biology, also joined the group. The seminar series was his brainchild, designed to introduce molecular biology content to these issues.

Professor Von Hippel contacted Pat Nicholas, who was positive about the project and gave us the funding. Then Scott up and went to work at the FBI and I took over. At the time I was a public health physician, so there was a steep learning curve. The actual process of running a seminar series was new to me and it took time to get into the swing of it. One thing I learned: If you want microbiologists to come to your seminar you have to have it in the building where they work —and provide food. Make it simple. We were able to get high-level people in and it has really influenced a number of students who have decided to pursue security policy. To me that's the greatest success of the series: its influence on people.

Among the presenters who stand out in my mind are Nancy Connell from the University of Medicine and Dentistry of New Jersey (UMDNJ) who talked about whistleblowers; Mark Wheelis from the University of California, Davis made a presentation on transparency that prompted me to write a paper on the subject of Secrecy and Safety; and Marcie Leighton from the New York Health Department discussed how select agent laws don't require informing public health departments, so they don't know about secret labs, which is dangerous to say the least. Arturo Casadeval from Yeshiva University, an internist specializing in infectious diseases, discussed the weapons potential of a microbe. His talk was about fungi—the ultimate bioweapon because it can have an effect across all species. Drew

Endy from Stanford [previously from MIT] and other speakers discussed synthetic biology and novel life forms and Edward Tenner spoke on unintended consequences. I was so inspired I got his book, *Why Things Bite Back*. Global warming is a case in point of the kind of unanticipated results of technological advancement he discussed.

In my opinion the greatest danger is human hubris. Any agent, depending on the host, can be dangerous. There's no one agent that's worst; yeast could kill you. The 1999 West Nile outbreak was a bellwether event. There were two outbreaks: in crows and humans. A veterinarian first raised the issue and no one wanted to talk to her. Only when exotic birds at the Bronx Zoo were dying did it attract attention. The vet was sure there was a link but the Centers for Disease Control would only deal with humans. She persisted and they discovered West Nile, from Africa, was the cause. But vets and MDs don't talk to each other.

The benefit of this program is that it's brought oxygen into subject matter scientists wouldn't necessarily think about. Even in the late 20th century we still don't think beyond our silos. It's important to share, to be willing to question what we're doing as a society, an industry and as scientists. The Biological Weapons Convention had no means of verification. Soviets and Americans each thought the other was building up a stockpile, so they did it too. I shudder to think what might be going on behind the scenes today. Codes of conduct won't stop anyone.

I'd like to see this program be pushed to the next level—educating new policymakers. The incoming administration brings a new opportunity to give information and correct mistakes; to facilitate and get a fresh start and assess what we've done as we look at underlying issues. The goal should remain the same one we've had since the beginning: to engage in communication. This is very important.[3]

3 The Biosecurity Seminar Series http://www.princeton.edu/~globsec/BW_series/

Building Bridges

Although scientists played a role in Washington—the White House Office of Science and Technology Policy (established in 1973) is but one prominent example—there was a growing recognition that the present system wasn't meeting the demands of modern society. By 2003, there was clearly a critical need for more accurate and timely understanding of rapidly advancing science and technology issues for establishing sound governmental policy. This fact was recognized by Secretary of State Colin Powell, who, along with other policy leaders, appreciated the value of "accurate science for statecraft." In October of that year he instituted the Jefferson Science Fellows (JSF) program at the U.S. Department of State as a new model for engaging the American academic science and technology communities in the formulation and implementation of U.S. foreign policy.

The Jefferson Science Fellows program, which is administered by the National Academy of Sciences, takes a small group of tenured, research-active scientists and engineers from the U.S. academic community into the U.S. Department of State (DOS) for twelve-month, on-site assignments in Washington, D.C. and U.S. foreign embassies. Carnegie Corporation partnered with the MacArthur Foundation to fund the launch of the program's three-year pilot implementation phase, and the first cohort of fellows began their tenure in 2004.

To be chosen as a Jefferson Science Fellow, nominees and applicants are evaluated according to the following criteria:

- Ability to articulate science and technology issues to the nonspecialist/general public.
- Ability to rapidly and accurately understand scientific advancements outside their discipline area and to effectively integrate this knowledge into U.S. Department of State policy discussions.

- Open-mindedness and receptive attitudes toward public policy discussions at the U.S. Department of State/USAID.
- Stature, recognition and experience in the national and international scientific or engineering community.
- Successful completion and maintenance of security clearances required to undertake State Department duties.

Besides providing up-to-date information on science and technology matters that impact policy decisions within the Department of State, Fellows are expected to develop an understanding of the policy realm. Following the fellowship year, the scientists return to their academic careers, but remain available for short-term government projects over the following five years.

George H. Atkinson, Ph.D.

Science and Technology Adviser to Secretaries of State Colin Powell and Condoleezza Rice (2001 to 2007)
Director of the Institute on Science for Global Policy

Dr. George Atkinson came to Washington, D.C. in 2001 to serve as the first American Institute of Physics Senior Fellow for Science, Technology, and Diplomacy at the U.S. Department of State, having been selected as the result of a national competition conducted by the Institute and the State Department. In 2003 Secretary of State Colin Powell appointed Dr. Atkinson his Science and Technology Adviser, where he was responsible for increasing science and technology capacity and for addressing related issues affecting U.S. foreign policy. Dr. Atkinson recognized the importance of state-of-the-art science, technology and engineering knowledge to the formulation and implementation of U.S. government policy, domestic and foreign. To meet this need he initiated the Jefferson Science Fellows program at the Department of State.

I got involved in this field because of a personal interest in how science relates to politics. I had no direct policy experience and looked on the American Institute of Physics scholar/diplomat position as an unexpected opportunity. In fact, I'm still trying to find out who sent my name in! I thought my wife and I would go to D.C. for a year and I'd learn what I could and come home. We arrived in 2001. Consequently I was in the capital on 9/11. I stayed for six years in all.

There were fewer hard and fast rules at the State Department back then. I was given top secret clearance and worked on various international projects with many fine people. As I learned about the government, I began to realize that the science profession was respected but no one knew what to do with us. Science is especially difficult for the diplomatic community because they could not engage on subject matter. At the same time science was becoming increasingly critical: infectious disease, climate change, energy, etc. At the time only a few scientists were in Washington. Some Foreign Service people might have had science degrees but once they entered the service that was drummed out of them. So they were not up to speed on science at all. I came away feeling that we needed to bring in many more adaptable scientists.

Scientists are really interested in the consequences of their work. My experience in the Department of State gave me many examples of the science community asking, "Where's the payoff to society?" During my appointment we organized Global Dialogs on Emerging Science and Technology—extensive joint meetings in several continents covering biotech, nanotech, computer issues and the like, attended by an impressive

group of scientists and policymakers. Articulate scientists were invited to the State Department and a couple of hundred people turned up to hear their perspective on the future of science and technology or a debate on issues like vaccine development. Some new programs started just because of that experience.

Early in my tenure with General Powell I began thinking there must be a way to get more senior scientists in. I went and talked to people at nineteen universities and there was tremendous interest. Eighteen institutions agreed to identify faculty members who were interested and to fund them for one year if they got into the program. Now well over 100 universities participate. Even then I recognized it was not enough money, and that's when I went to Carnegie Corporation and the MacArthur Foundation to see if they'd be willing to give a major grant for stipends to make the program more financially feasible.

Here's how it worked: The National Academy of Sciences National Research Council would advertise the fellowships and screen the first cut for science qualifications. Then candidates would submit a resume and write a policy paper and the finalists would be invited to come to D.C. for the extensive interview process. I had a policy of explaining to everyone why they were or weren't chosen, so although they might not have gotten in, they liked the process. Some later even reapplied!

The foundations put up money for the pilot program for three years, with the stipulation that the State Department would pick up the cost after that. State agreed, and then we arranged that Fellows would consult for five years afterwards, which would enable the program to influence the academic community and at the same time keep a long-term relationship at State.

Jefferson Science Fellows were so senior, they were used to being treated as experts. One thing I realized from the beginning was that the State Department needed to be prepared for scholars of this caliber and be ready to accept them, otherwise this program might have turned out like other similar programs that had been disappointing. I went office by office at State requesting a written explanation of what they would do with a scientist, and we printed all the responses in a booklet and gave it to the Fellows. Their job was to go interview the State people and choose an assignment. Acculturation was needed and I encouraged them to talk to everybody and then decide. In the end they spread themselves out as widely as possible.

Wherever the Fellows went they brought in a rational way of thinking and were integrated into debate, even if not through the front door. Jefferson Fellows had large tentacles that reached far into government. The government itself was paralyzed in the area of policy and research; it could never have done this. The program happened because of the support of the foundations and the science community combined with the Fellows' willingness. A good result. It's hard to think of another society where this would happen, where you have 40 or 50 people who hopefully can begin to change the culture. Carnegie Corporation and the MacArthur Foundation should take a bow for this accomplishment.

A groundbreaking report published in 2004 established that, while scientists and policymakers were both aware of the potential for misuse of biotechnology, there were still gaps when it came to effectively addressing the looming biosecurity problem. "The driver of our second and, ultimately, our third grantmaking phase was the release of the Fink Committee Report,[4]" says Patricia Nicholas. This publication by the nonprofit National Research Council considered how best to minimize threats from biological warfare and bioterrorism without hindering the

4 *Biotechnology Research in an Age of Terrorism*; Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology; Development, Security and Cooperation Policy and Global Affairs, National Research Council of the National Academies; The National Academies Press, Washington, D.C.; 2004.

The Fink Report makes the following seven recommendations:

1. Educate the scientific community.
2. Review plans for experiments.
3. Review research at publication stage.
4. Establish a national science advisory board for biodefense (NSABB).
5. Protect against misuse with adequate oversight.
6. Engage life sciences in security policy.
7. Harmonize international oversight.

progress of biotechnology. Recognizing that almost all biotechnology in service of human health can be subverted for misuse by hostile individuals or nations, it concluded that open communication—especially between scientists and policymakers—was the best form of security.

"Coming at a time when we were already refining our program, the recommendations in this report, which is now considered the bible of the biosecurity field, helped us realize the importance of marrying science and security. Our 2004 to 2008 grants and those continuing until 2010 aim to meld the two vital communities while nurturing both spheres of expertise," Nicholas says.

At the time of the Fink Report's publication, a cloud of secrecy still surrounded biodefense programs, ratcheting up the risk, and making biological weapons more appealing, particularly to nonstate actors. To increase awareness among the public, media and policymakers about these potential threats and effective ways to address them, the Center for Arms Control and Non-Proliferation received a grant from the Corporation in 2004 toward the American Scientist Working Group on Biological and Chemical Weapons. The volunteer members of the Working Group brought biological, medical, political, diplomatic and industrial expertise to their mission—increasing transparency in the field by compiling information on biological weapons, publishing reports and holding workshops in cooperation with the International Committee of the Red Cross.

Also in 2004, the Security Studies program at the Massachusetts Institute of Technology (MIT) launched a new effort to improve biosecurity by addressing the need for open dialogue between the life sciences and national security establishments. In partnership with the Committee on International Security Studies of the American Academy of Arts and Sciences, MIT organized a seminar series on biosecurity issues featuring experts from MIT, the John F. Kennedy School of Government and the Olin Institute at Harvard University as well as agencies and nongovernmental organizations in Washington, D.C.[5]

That same year, a grant to the University of California, San Diego (UCSD), provided funding for its Institute on Global Conflict and Cooperation (IGCC) to create a multidisciplinary training and research program on biological threats and public policy for doctoral students and mid-career professionals. In keeping with the Corporation's science and security integration efforts, the IGCC recruited a cohort of scholars from a range of disciplines—biology, epidemiology, international relations and others—exposing them to a broader context for considering policy problems, and launching a community of scientific experts envisioned as "the first generation of truly multidisciplinary leaders in biosecurity policy."

Informally known as "biological boot camp," this intensive ten-day summer session, *Public Policy and Biological Threats*, was modeled on a similar successful IGCC program that had trained dozens of doctoral students on the political complexities surrounding nuclear weapons. With the Corporation's initial two-year funding, the new program planned to leverage additional foundation support to continue into the future and extend throughout the university system.

5 http://web.mit.edu/ssp/seminars/seminars_biosecurity.html

The program runs the gamut of biosecurity topics, such as: domestic and international intelligence; disease outbreak and detection; risk-scenario planning; regime building and ethical and legal aspects of responses. "Constructing a relevant curriculum was the primary concern in the early years," recalls the program's co-leader, Sam Bozette, a senior natural scientist at the RAND Corporation, adjunct professor of medicine and of international relations at UC San Diego and executive director of health outcomes at Amylin. "It was challenging because while there were precedents for multidisciplinary modalities in biology, nothing before merged it with the security field. That's where we came in."

Originally we thought "this is just like nuclear threats, only with bugs," Bozette says. "But as time went on we realized that the structure and nature of biological threats are unique, and much broader." Although the program began with the idea that biological threats meant attack by infectious agents, it eventually became clear that the effects of naturally occurring diseases; of trade, travel, encroachment and other social and economic aspects were important factors, along with agriculture—food animals and grain.

Over the years this ten-day program has attracted an applicant pool that gets stronger and stronger, according to Bozette, with multiple people from the same programs as word gets around. One unexpected outcome is its popularity with veterinarians, largely because of the agricultural implications. Other attendees have been agricultural economists and plant biologists, science reporters, social scientists, fire department and EMS workers, even someone from Scotland Yard. The program is now approaching the challenge of sustainability. One encouraging sign is that communication among attendees has grown spontaneously along with such secondary gains as dissertations, collaborations, interactions and synergies. The enthusiasm that helped facilitate the program initially now seems to have a long life expectancy.

Thinking Globally

Aware that at least ten countries and two terrorist groups were known to possess or have in development biological warfare capability, in 2005 the nonpartisan public policy institution Center for Strategic and International Studies (CSIS) put together a biological weapons threat reduction project. CSIS was convinced that a coordinated web of activities to counter state sponsored and terrorist efforts to develop, acquire, produce, deploy and benefit from biological weapons and bioterror was urgently needed. They aimed to lay an international foundation on which new partnerships would be developed, innovative policies advanced and a new cooperative effort on biosecurity established.

The plan was to build an international consortium of experts who would, over a period of several years, conduct research, publish papers, hold seminars and ultimately form multinational briefing teams to visit international capitals and promote their biological weapons threat reduction agenda. The project was co-directed by former White House science staffer and director of CSIS's Homeland Security Program, David Heymann, and senior fellow and former National Security Council Senior Director of Science and Technology, Gerald Epstein, two respected experts in the biosecurity field.

Understanding the threat means recognizing that building a nuclear weapon puts deep demands on a country's resources, with rare materials and difficult processing and delivery challenges, Epstein contends. It's a huge commitment in terms of activities and investment. But with biological weapons, it's a much shorter distance to creating a pathogen and spreading it around. Without the need for infrastructure, he warns, it's relatively easy to hit hard and quickly. Biologists becoming terrorists is a greater danger than terrorists becoming biologists. This is a new problem, and to deal with it, traditional military

and diplomatic approaches must be supplemented by new partnerships among the international scientific, public health, medical and law enforcement communities; local governments; private industry and others—communities with widely differing values, objectives and modes of behavior.

In its first two years, the grant accomplished its goals of convening an international consortium of representatives from think tanks, and scientific, educational and public health and safety organizations. Having achieved consensus on the definition of the biosecurity challenge and a baseline of policies and activities across various regional and functional communities, the group began the process of disseminating concepts to a wider international audience at various high-level briefings and conferences. In addition, CSIS's Homeland Security Program is partnering in the Virtual Biosecurity Center, which they envision acting as a common front door, providing a way to dialog, merge, blend, coordinate and keep up.

On yet another front, the emerging field of synthetic biology has complicated traditional bioweapons policy, suddenly introducing the potential for constructing components of biological systems artificially, thus making it possible to create new features of existing living systems (primarily bacteria) as well as entirely new organisms. The field, particularly gene synthesis, has progressed to such an extent over the past ten years that synthetic genes can now be produced on demand, with virtually no limits in quantity and length. These developments open up new opportunities and raise serious concerns that such potential could be misdirected.

To address this growing challenge, policymakers have had to learn how synthetic biological weapons alter proliferation issues; and synthetic biologists in turn have had to become aware of the security implications of their discipline. Very few people possessed this combined knowledge in 2005, when the Berkeley Synthetic Biology Security Program (BSBSP) was instituted to train students in both the new science and security policy, tapping into expertise from the Berkeley Center for Synthetic Biology and the Goldman School of Public Policy. At the same time, the program began developing responses from within the synthetic biology community to supplement government imposed steps to reduce accident or injury.

Much has been accomplished, and has been summarized in two reports: A white paper in 2005[6] described as part of a sustained effort by the Berkeley SynBio Policy Group to help members learn about security issues and facilitate community self-governance; and a workshop report in 2008 to promote the development and implementation of technical measures that address current and future biosecurity threats on a global scale. According to organizers, this workshop, born out of a responsibility to the scientific field for which synthetic biology services and products are provided, was a unique opportunity to develop and implement reasonable, cost-effective responses to potential biosecurity threats and build a foundation for future developments.[7] "Everyone I talk to is very clear that none of this ever would have happened without Carnegie's support," says the Goldman School's Stephen Maurer.

In early 2009, Maurer announced the creation of a Web site designed to provide scientists with advice about dual-use research or experiments of concern, in order to minimize the risks of biology research being misused. Scientists who access the site will be able to enter information about proposed experiments for review by an expert panel including security experts and biologists. They in turn will determine whether the work raises any security concerns and suggest how

6 *From Understanding to Action: Community-Based Options for Improving Safety and Security in Synthetic Biology,* Stephen M. Maurer, Keith V. Lucas & Starr Terrell; Goldman School of Public Policy; University of California at Berkeley; http://gspp.berkeley.edu/iths/UC%20White%20Paper.pdf

7 Report on the workshop; *Technical Solutions for Biosecurity in Synthetic Biology;* held on April 03rd, 2008 in Munich; Dr. Hubert Bernauer, Jason Christopher, Dr. Werner Deininger, Markus Fischer, Philip Habermeier, Dr. Klaus Heumann, Prof. Stephen Maurer, Dr. Heinz Schwer, Peer Stähler, Tobias Wagner; http://www.ia-sb.eu/wp-content/uploads/2008/09/iasb_report_biosecurity_syntheticbiology.pdf

such concerns might be addressed. Unlike some existing mechanisms that consider security implications of experiments at a late stage, this new portal is meant to provide feedback before the work begins, and to do it as quickly and painlessly as possible. The site's designers believe it will be widely used throughout the bioscience community, since the idea originally came from the scientists and a good number of them have agreed to serve as expert reviewers.

In January 2009 a new study, "Reducing Biological Risks to Security: International Policy Recommendations for the Obama Administration," coordinated by the Center for Arms Control and Non-Proliferation and supported by Carnegie Corporation, reported that the United States' vulnerability to a significant biological event has increased. Although the U.S. government has strengthened its national preparedness and response capabilities for catastrophic disease events including bioterrorism, the study finds, inadequate attention has been paid to prevention and response measures internationally. At the same time, other countries have become increasingly skeptical about the U.S. commitment to either improving global public health or reducing deliberate and accidental biological risks to global security.

"Because of the global diffusion of the life sciences, global approaches are needed to reduce these risks while securing the benefits of biotechnology," the study asserts, "yet efforts to advance global action face significant political and economic challenges." In the United States, bioterrorism remains a primary concern. But developing countries generally do not want counter-bioterrorism initiatives to impede or divert resources from efforts to strengthen public health and agriculture. And the increasing importance of the private sector and academia in biotechnology and the life sciences further complicates the challenge. Greater involvement, interaction and communication among all stakeholders are key to effectively addressing 21st century biological threats, the study concludes, recommending that the Obama Administration take strong action (spelled out in the report[8]) to reduce biological risks to security.

As this report and others make clear, many challenges remain as the Biological Weapons Program approaches closure, and much work is being done by the individuals and programs the Corporation has helped launch and has supported through the years. "Grant programs end for a variety of reasons," explains Stephen Del Rosso. "Sometimes a particular goal—for example, a treaty or major governmental reform—has been achieved and grantmaking is no longer needed. Admittedly, major problems are rarely if ever solved in the peace and security field; more often, after a foundation's initial catalytic objectives have been met, they move on with the expectation that other funders will come to the fore."

In the case of Carnegie Corporation's work in biosecurity, some projects will continue to be funded near term, while others already are robust and self-sustaining. Virtually all have contributed to the legacy of risk reduction, many influencing policy at the highest levels, particularly through greater awareness of the dangers of dual-use research and the importance of linking scientists with policymakers. And the future? "In the coming years, U.S. pursuit of its bio-risk reduction objectives will take place in a world of increasing multipolarity and deepening fiscal and economic challenges," predicts the report from the Center for Arms Control and Non-Proliferation. "These trends and challenges make the task of achieving greater security for the United States more difficult. They also highlight the need, and provide opportunities, for our nation to renew its commitment to productive global partnerships and engagement."

Written by Karen Theroux.
Theroux is an editor/writer in the Corporation's Public Affairs department with many years' experience in educational publishing and communications.

8 The study can be downloaded at: http://www.armscontrolcenter.org/policy/biochem/articles/011509_reducing_biological_risks/

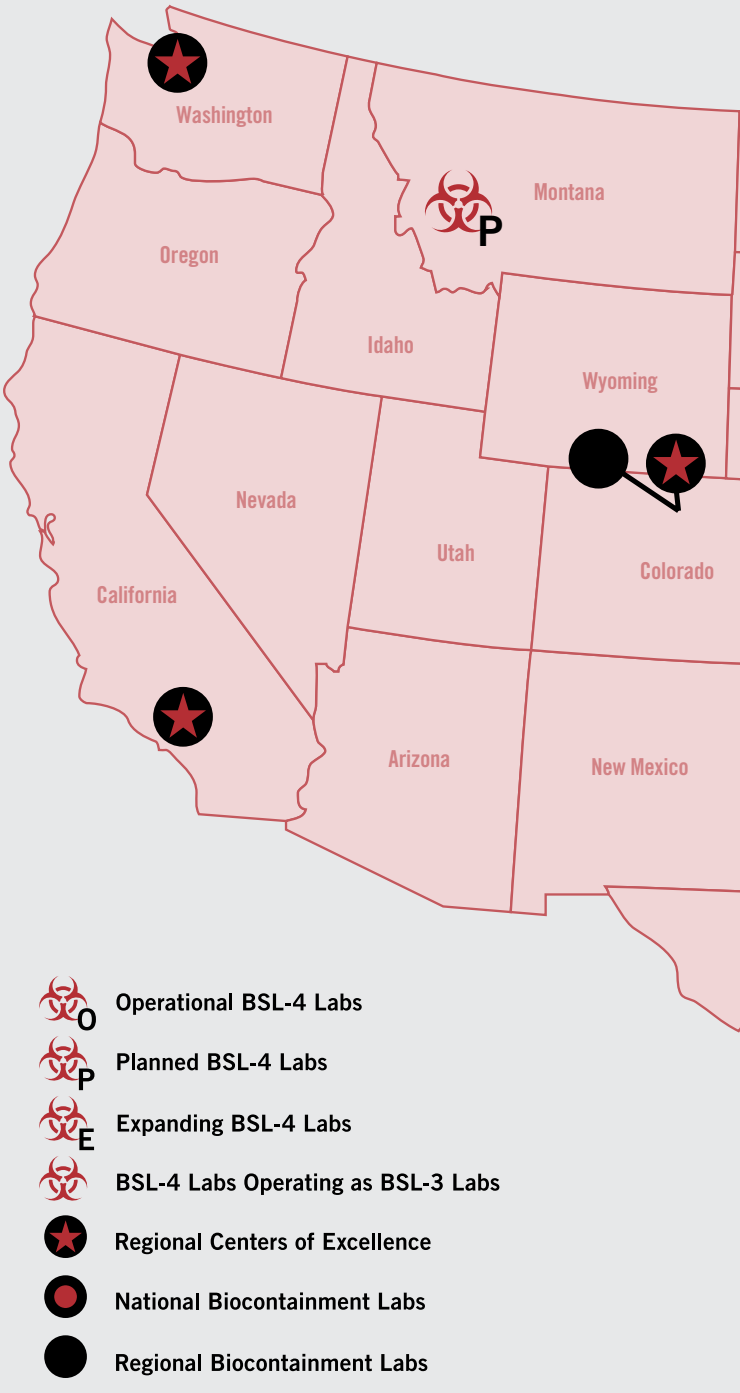
U.S. Biodefense Research Map

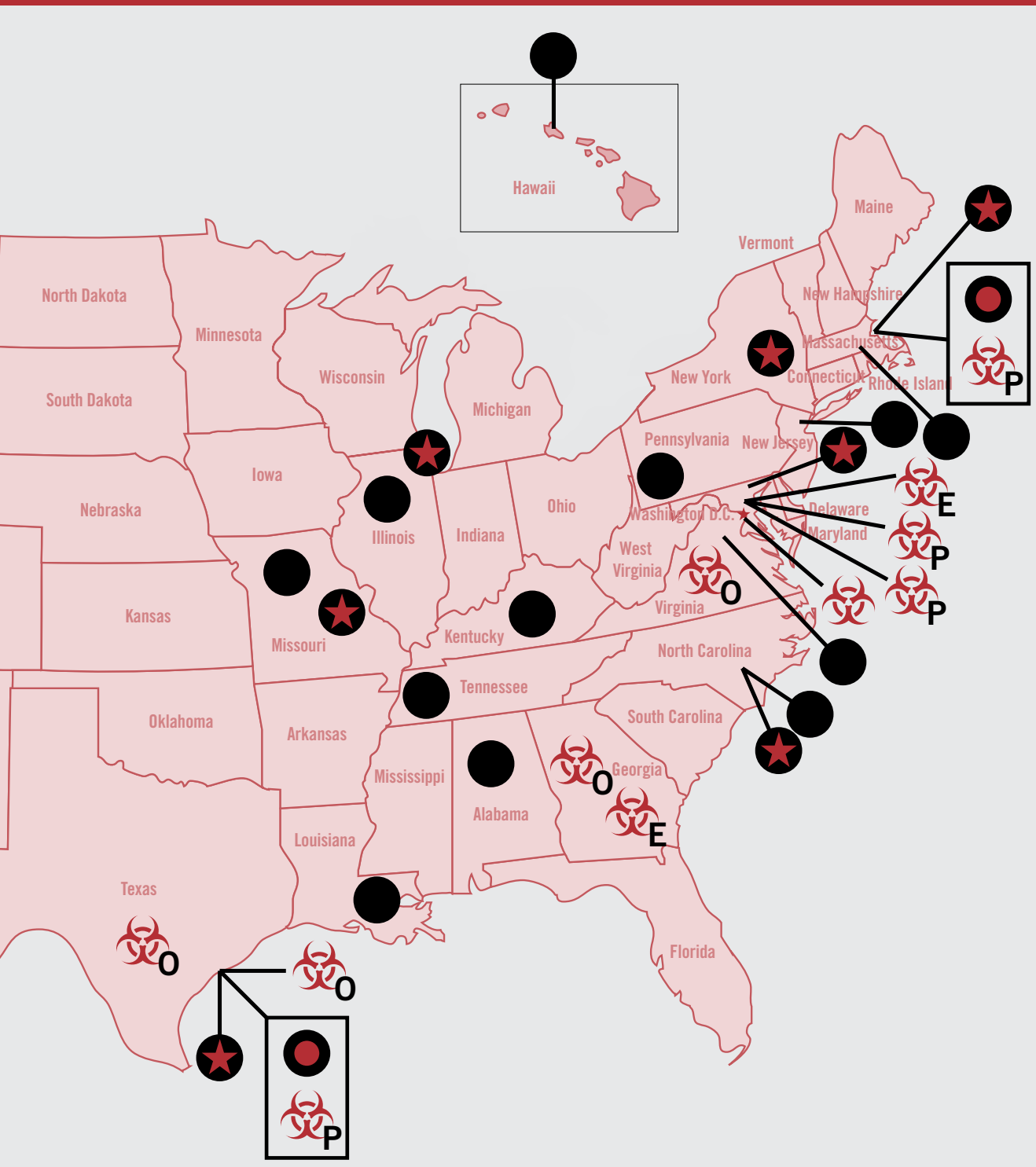
This map provides the locations of both operational and planned Biosafety Level-4 (BSL-4) laboratories in the United States as well as the National Biocontainment Laboratories (NBLs), the Regional Biocontainment Laboratories (RBLs), and the Regional Centers of Excellence (RCE) for Biodefense and Emerging Infectious Diseases, both established by the National Institute of Allergy and Infectious Diseases (NIAID).

Biosafety Level 4: Required for work with dangerous and exotic agents which pose a high individual risk of life-threatening disease. The Biosafety Level 4 laboratory has special engineering and design features to prevent microorganisms from being disseminated into the environment.

Biocontainment Laboratories (Regional or National): These labs support biodefense and emerging infectious diseases research as resources that provide lab space for basic research of dangerous pathogens and development of new vaccines and treatments. In addition, these labs are available to provide assistance to national, state, and local public health efforts during a biological attack.

Regional Centers of Excellence for Biodefense and Emerging Infectious Diseases (RCEs): These consortia of universities and research institutions pursue research with the intention of producing therapeutics, vaccines, and diagnostics for pathogens that could be used in a bioterrorist attack or could become more widespread. The RCEs also develop effective treatments and treatment strategies from basic research findings and provide first-line responders with facilities and support during a biological attack.





Map provided by the Federation of American Scientists.
An interactive version of this map and detailed explanations of the types of facilities indicated can be found at http://www.fas.org/programs/ssp/bio/resource/index.html

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