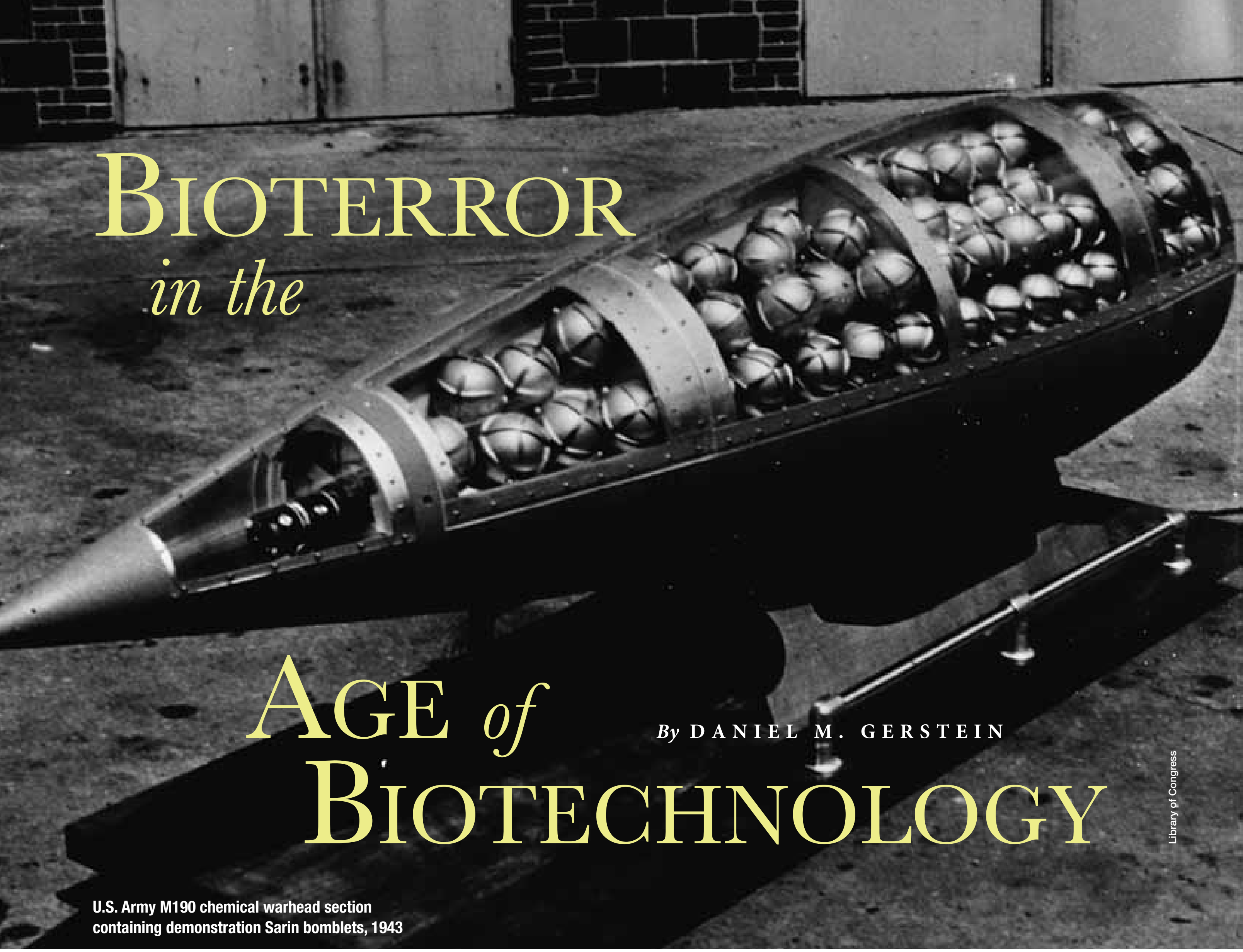
BIOTERROR in the AGE of BIOTECHNOLOGY

By DANIEL M. GERSTEIN



Library of Congress

U.S. Army M190 chemical warhead section containing demonstration Sarin bomblets, 1943

The Commission believes that unless the world community acts decisively and with great urgency, it is more likely than not that a weapon of mass destruction will be used in a terrorist attack somewhere in the world by the end of 2013.

The Commission further believes that terrorists are more likely to be able to obtain and use a biological weapon than a nuclear weapon. The Commission believes that the U.S. government needs to move more aggressively to limit the proliferation of biological weapons and reduce the prospect of a bioterror attack.[1]

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This powerful statement from the most recent Commission on the Prevention of Weapons of Mass Destruction (WMD) Proliferation and Terrorism serves as ample warning of the dire threats faced by the United States and indeed the world from a bioweapon successfully deployed by a determined and knowledgeable terrorist. In thinking about the potential for such a bioterror attack, several important questions serve to frame the discussion. Do terrorists have the desire to employ WMD, and in particular biological weapons? Under what conditions might biological weapons be an attractive choice for use by terrorists? Would they have the requisite knowledge, equipment, and organizational capacity to mount a biological warfare (BW) attack? Would they be successful in such an attack? What could we do to mitigate the effects of a bioterror attack?

This article provides a framework for understanding the potential for a BW attack now and in the future by a terrorist or terrorist organization. In developing this framework, the findings hinge less on the technical capabilities than on the intentions of the potential perpetrator. State use of biological weapons in either large-scale strategic scenarios or as tools of assassination is not examined directly, although the framework could have equal application to a state BW program.

The Potential Perpetrator

Terrorism is a term that evokes strong emotions. Events of 9/11 brought terrorism to the forefront of the national security debate in the United States and arguably throughout the rest of the world. Despite this increased attention during the intervening period, the debate has seen little increased clarity.

No agreed definition of *terrorist* has been developed, and the word has been used seemingly interchangeably with other terms such as *insurgent*, *illegal combatant*, and *freedom fighter*. The result is a politicization of the term that hinders global cooperation and confuses the issue. This can be seen in a discussion of the rationality of the terrorist. Many believe that terrorists are pathologically damaged, violent sociopaths who employ violence for their own perverted outcomes. Others believe that terrorists are calculating and highly rational actors with real or perceived grievances, employing a range of strategies from political actions to violence in order to achieve desired outcomes. Some have gone as far as to suggest that it is possible to reach a negotiated settlement with terrorists, in the same way that one might reach a postconflict settlement following a state-to-state conflict.[2]

Regardless of the exact definition or the rationality of the terrorist, several important trends serve as the foundation for this analysis. First, terrorism is not a new phenomenon and has a long historical precedence. The direct origin of the term can be traced to the time of the French Revolution, although the period beginning in the 1970s is of the most interest for our discussion. It is during this period—with emphasis on the post-9/11 period—where we see the confluence of the use of high violence strategies, the rise of global terrorist organizations fueled by globalization, and increasing religious radicalization.[3]

Second, terrorists are continually searching for new means to facilitate increasingly violent and spectacular attacks that will gain visibility for and further their causes. Attacks have become more frequent and more violent. Prior to the Embassy bombings in Kenya and Tanzania in the late 1990s, for instance, global casualties from terrorist attacks were fewer than 500 per year.[4] The Embassy bombings caused casualties in the thousands, and then the attacks of 9/11 caused over 3,000 deaths with many more injured. In compiling terrorism trends for 2008, the National Counterterrorism Center (NCTC) identified 11,770 attacks that killed 15,765 (see figure 1).[5] A note of caution is in order for the reader who might want to directly compare the casualty figures. The different counting rules and definitions certainly contribute to some of the disparities noted. Additionally, the NCTC data include attacks in Iraq and Afghanistan, which some might consider related to an insurgency rather than terrorist action. Still, the increases in violence and number of attacks are worth considering. A statement by noted terrorism expert Brian Jenkins summarizes the trends in terrorism:

> *Over the past three decades, terrorists have multiplied the number of their victims by an order of magnitude every 15 years. In the 1970s, the bloodiest incidents involved tens of fatalities. By the 1990s, hundreds were killed and the incidents increased. In 2001, the number reached the thousands, and today we fear scenarios in which tens of thousands might die.*[6]

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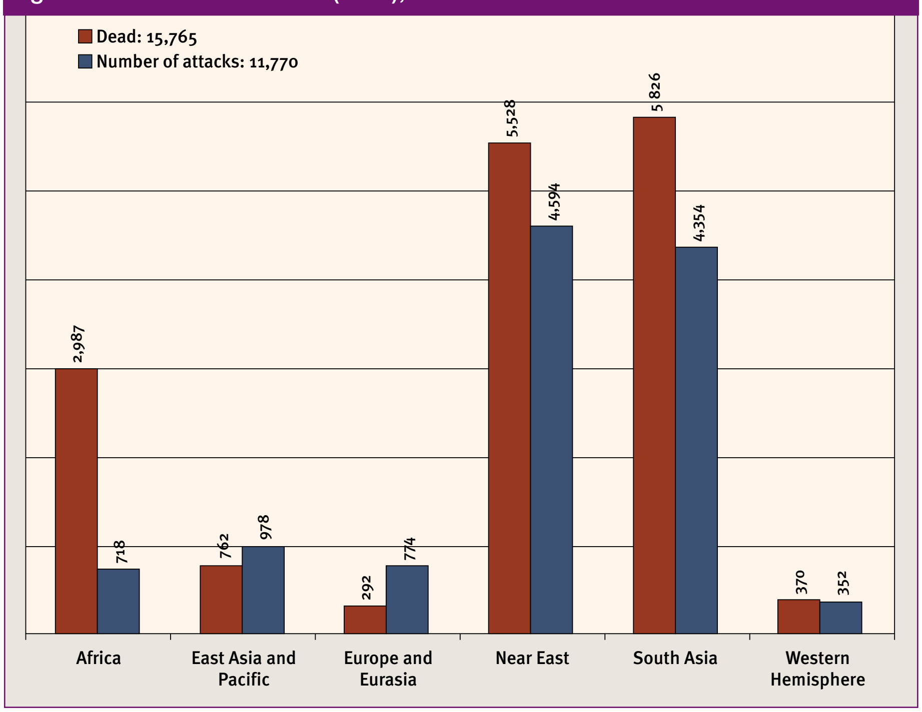
Third, general agreement now exists that terrorists are "rational" actors. Their actions may not be understood by their victims or the governments and law enforcement agencies that attempt to deal with these threats, but they are far from random irrational acts. One noted expert identifies alienation, humiliation, demographics, history, and territory as grievances that motivate terrorists.[7]

Fourth, and related to their rational actor status, terrorists have constituencies they must satisfy. High violence strategies that indiscriminately kill and maim large numbers of people are not desirable as a long-term tactic. Likewise, failure to adequately gain visibility and promote a cause will likely be seen as ineffective by these constituencies. This

Figure 1. Terrorism Statistics (2008), National Counterterrorism Center



will serve as both a motivating influence and a moderating factor that will feature prominently into the bioterror question.

Fifth, the question of whether a terrorist will employ a unique means such as biological weapons is directly related to the ability to develop the capabilities, intentions, and knowledge necessary for perpetrating a bioterror attack. Some terrorist groups will likely find it outside of their operational envelope to employ such a technique. Others may find development of these capabilities too technically challenging. Still others may determine that use of these weapons may present an existential threat to the terrorist should the attacked nation employ a massive retaliatory effort (assuming, of course, that the perpetrators can be identified).

Finally, terrorism today does not represent an existential threat to the United States or our friends and allies. However, this could change should terrorists develop or acquire the capability for conducting a WMD attack using either nuclear or biological weapons. In a harbinger of what the future might hold, Bruce Hoffman noted ominously that "many of the constraints (both self-imposed and technical) which previously limited terrorist use of WMD are eroding."[8]

What Is Biological Warfare?

Biological warfare is the intentional use of microbes to cause disease in a target population. Microbes are inherent in all life forms and include bacteria, viruses, protozoa, algae, and fungi. While some microbes are responsible for causing disease, many others serve vital functions for supporting all forms of plant and animal life. In BW, the attempt is to effectively and efficiently deploy weapons composed of biological material to attack a target and achieve a desired objective.

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The use of biological weapons is not a new tactic and in fact predates the understanding of disease. The history of biological warfare can be traced back to medieval times including the siege of Caffa on the Crimean Peninsula, the use of blood-laced arrows against enemies, and the catapulting of human and animal carcasses into enemy encampments and fortifications during the Crusades.

The modern history of biological weapons includes programs by some 20 states beginning in the 1940s to the present. Often-cited efforts include the Japanese use of BW against China and captured prisoners in the World War II period; the massive Soviet program that continued through the end of the Cold War; and the programs and cooperation among Canada, the United Kingdom, and the United States that began in the 1940s and continued until the United States unilaterally denounced biological weapons and toxins in 1969. The modern history of BW also includes the Biological Weapons Convention (BWC), which was the first arms control treaty that banned the use of an entire class of weapons for offensive purposes. Also part of

9/11 brought terrorism to forefront of national security debate

U.S. Air Force (Michelle Leonard)

this history is the limited success the BWC has had with regard to halting the development of offensive BW capabilities by some of the convention's signatory nations.

The history of bioterror incidents is also instructive. One study concluded that from 1900 to 2003, there were only 77 total incidents. The data do not encompass state-sponsored BW or hoaxes.[9] The hoaxes in particular would include a large number of "incidents" as they tend to outnumber actual events by as much as 100 to 1.[10] The small number of incidents and the uniqueness of each limit the ability to draw definitive conclusions from the data. Instead, each requires analysis to determine the key parameters and outcomes that defined it and ultimately the success or failure of the attack. An important note is that during combat operations in Afghanistan in 2001, documents were seized indicating al Qaeda's interest in developing a BW capability; few details have emerged concerning the intended purpose of the weapons or how far their developmental effort have progressed.

In understanding BW, several factors contribute directly to the ability to develop and employ an effective biological weapon, including the agent or pathogen, deployment method, formulation, manufacturing process, and meteorological and terrain conditions.[11]

It is instructive in understanding the potential for a bioterror attack to appreciate the choices that must be made. Will the agent be a bacteria, virus, or toxin? Should a contagious or noncontagious pathogen be selected? Should a lethal or an incapacitating agent be used? These initial decisions begin to determine the type of attack that will be possible and even the manner in which it should be conducted.

In examining the deployment method, will the agent be delivered by aerosol, vector, food, or water? Will the pathogen be delivered using an explosive device or a spray nozzle? The formulation of the pathogen is also important. Will a wet or dry agent be used? Will the material be stabilized to make it more efficient and able to remain airborne for a longer period? What is the manufacturing process? How and in what quantities will the material be grown to mount an attack against the envisioned target? Will the material be dried and milled? What size are the particles? Do they support efficient respiratory infection or are they too large to be inhaled and remain deeply embedded in the alveoli within the lungs?

Even once the initial agent, deployment method, formulation, and manufacturing process have been determined, success in the attack ultimately depends on the meteorological conditions when the weapon is deployed. What is the wind speed? Will the weapon be deployed in a city or open terrain? What time of day? Is there an inversion that would keep the agent on the ground and therefore be more effective against the intended target?

These questions relate to the potential effectiveness of the biological weapon; however, another set of considerations is directly related to the effectiveness of the attack. They include the concentration, dose, stability, and target susceptibility. In considering these factors, the goal of the bioweaponeer is to have the highest concentration of organisms per milliliter or gram (depending on whether a liquid or dry formulation is used) of material. Another consideration is the lethal dose (LD) or infective dose (ID), which is normally measured in LD_{50} and ID_{50}, respectively, and relates to the dose required to cause mortality or infection in 50 percent of the people exposed. This becomes a major factor in considering the agent for weaponization. Consider that for the disease tularemia, the LD_{50} is approximately 50 organisms, while for anthrax it is approximately 8,000 spores. However, there are always tradeoffs to be made. *Francisella tularensis*, the organism responsible for tularemia, is highly susceptible to the environment and experiences biological decay at a rate of 2.5 to 5 percent per minute (depending on meteorological conditions and the weaponization of the pathogen), while *Bacillus anthracis*, the anthrax organism, is a hearty spore that experiences virtually no biological decay.

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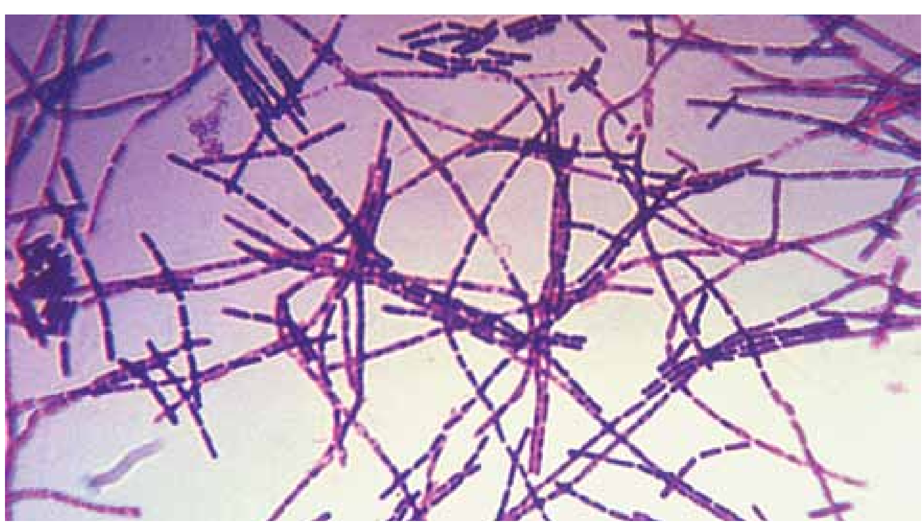
The final consideration of target susceptibility is another important factor. Ultimately, the success of an attack will be determined by whether the deployed BW weapon will infect the target population in the appropriate manner to cause disease. If the target population has been vaccinated or is not susceptible to the weapon or if protective measures have been taken, the attack will fail. For example, if an anthrax attack against troops is initiated, but the soldiers all have personal protective equipment and have been vaccinated against the pathogen, the attack most likely will not be successful.

An important note is in order at this point. When terms such as LD_{50} and ID_{50} are used, they normally are based on what the medical and public health community knows about the effect of the naturally occurring strains of the bacteria and viruses. But what if the biological material has been altered such that fewer particles cause disease or the virulence of the material reduces the incubation time? This would be the likely goal of a bioweaponeer.



Centers for Disease Control and Prevention

Photomicrograph of *Bacillus anthracis* bacteria

This previous set of questions contains a mix of operational and technical issues that the bioterrorist would need to master for a successful attack. It also serves as fodder for those who claim that developing a BW capacity is a nontrivial task too difficult for a terrorist to master. But what are the *facts*?

Dual-use Technologies

Central to the question of the potential for a bioterror attack is the ability of the terrorist to develop a viable BW capability, implying mastery of the biology, the technology for dispersing the pathogen, and the development of a scenario aligned with the objectives sought.

Some believe that the technology is too sophisticated for mastery by a terrorist and that specialized capabilities are required. Advocates of this position state that other terrorists such as Aum Shinrikyo and the Rajneeshee cult failed to acquire, process, weaponize, and successfully deploy a biological weapon. In another example, a postdoctoral student was given a year to develop this scenario using the pathogen *Francisella tularensis*. At the end of that period, when the results were briefed, the student had made three fatal errors that would have doomed the effort and prevented a successful attack.[12] In yet another anecdote that alludes to the difficulties of developing a biological weapons capability, Jerzy Mierzejewski, the retired director of the Polish biological defense laboratories who spent his career working with *Clostridium botulinum*, lamented that "one culture cycle would produce toxin that was lethal and a few months later the next would not, and so on over the years."[13]

one study concluded that capabilities in several key technologies are experiencing a doubling every 6 months—a 400 percent increase per year

Others argue that the development of biological weapons is almost trivial. One author wrote that producing biological weapons was "about as complicated as manufacturing beer and less dangerous than refining heroin." In seminar presentations a few years ago, former Central Intelligence Agency Director James Woolsey claimed that "a B-plus high school chemistry student" could produce biological agents, and at a January 2000 meeting he described producing biological agents as being "about as difficult as producing beer." In her book *The Ultimate Terrorist*, Jessica Stern quotes Kathleen Bailey who, after interviewing professors, graduate students, and pharmaceutical manufacturers, concluded that several biologists with only $10,000 worth of equipment could produce a significant quantity of biological agent.[14] In fact, the U.S. Government conducted an experiment in which a small team of experts was tasked with determining the feasibility of developing an "anthrax" weapon using readily available capabilities and equipment. The initiative—Project Bacchus—was sponsored by the Defense Threat Reduction Agency (DTRA) and demonstrated that the development of these capabilities is not particularly complex or costly.[15]

Does this important issue really come down to a question of whom one believes? Other insights can be gleaned from examining the trends in biotechnology that are placing ever increasing knowledge and capabilities in the hands of more people around the globe, undoubtedly including some who would use the technology for other than noble purposes.

Members of Georgia National Guard CBRNE response force conduct search, extraction, and decontamination drills

U.S. Air Force (Dennis J. Henry, Jr.)

In fact, many believe that we have entered the Age of Biotechnology. On the face of it, such a statement means little without further examining the likely impact for key technologies that could be used for the benefit of humankind or just as readily turned into deadly weapons of mass destruction.

One study conducted by the Department of Defense (DOD) concluded that capabilities in several key technologies are experiencing a doubling every 6 months—a 400 percent increase per year. Areas experiencing such increases include cell growth chambers and fermenters, encapsulization and stabilization, the human genome, pathogen efficacy, DNA engineering, sensors, vaccines and antibiotics, and nucleic acid synthesis.[16]

By way of an example, the rate of vaccine development doubled every 5 years from 1940 to 1970. From 1970 to 1980, the rate increased fivefold such that the time to double the capabilities in the field of vaccines was 1 year. Over the next 20-year period from 1980 to 2000, the time to double in capability decreased to 6 months. Another field, DNA engineering, not even in existence until 1982, has doubled in capacity every 6 months since. This area is critically important to a variety of biotechnical advances including gene therapy, vaccine development, and sensors, as well as the potential of ominously increasing the virulence of a pathogen. The same is true for encapsulization and stabilization, which have potential for enhancing personal protection and therapeutics as well as making BW weapons more effective and stable in the environment.[17]

As an example of what the future might hold, a recent article discusses the development of an artificial polio virus synthesized with nonliving components combined using specialized equipment and chemicals.[18] While this early work provides a proof of concept, genetic engineering and combinatorial chemistry in the future will allow for large-scale, rapid synthesizing of peptides, polynucleotides, and other low weight molecular material, allowing for manipulation of the very building blocks of life. The polio virus, with its relatively simple structure and 8,000 base pairs in its genomic sequence, provides a glimpse into the possibilities as well as highlighting the potential for the development of, for instance, the smallpox virus in this manner. Artificial development of the smallpox virus, with 200,000 base pairs and a considerably more complex structure, in this manner remains out of reach for the moment, but the Age of Biotechnology will likely make this development possible in the future. Couple this with the ready availability of the genomic sequences from a wide variety of disease-causing pathogens and organisms, and one can easily predict the potential for artificially developing pathogens, manipulating current pathogens to make them more virulent, or perhaps developing antibiotic-/antiviral-resistant pathogens.

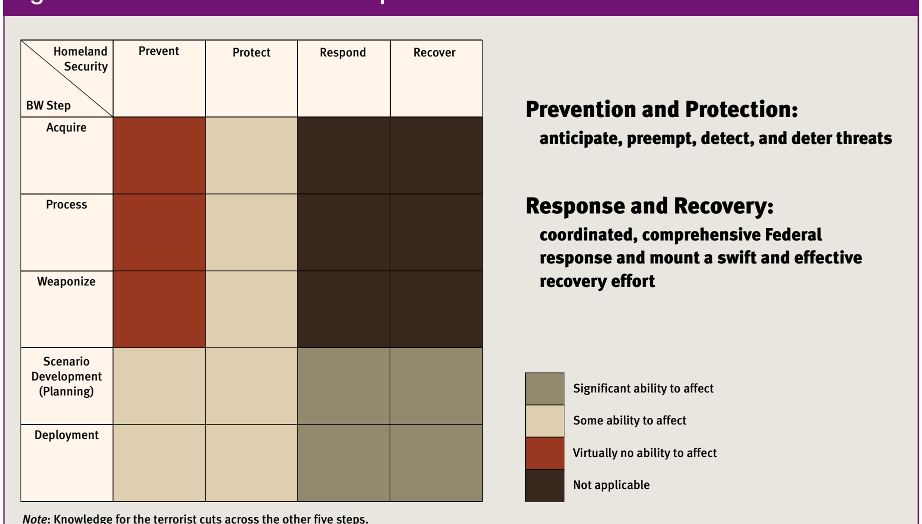
Attempts to control or limit advances in biotechnology seem fruitless with an industry that has such potential for improving the quality of life and that comprises such a large part of the U.S. and global economies. Additionally, the dual-use nature of biotechnology—that is, the very capabilities that allow for developing prophylaxes and treatments and can be employed just as effectively for developing biological weapons—results in a conundrum that we cannot fail to recognize.

Framework for Analysis

Successful employment of a bioterror weapon implies that a lone terrorist or terrorist organization has mastered five steps: acquire, process, and weaponize a pathogen, and plan the attack and deploy the weapon so as to cause disease in a target population. However successful, employment of a bioterror weapon should not be considered in isolation, but rather should be thought of as a two-sided proposition where our capabilities in preparedness and response as articulated in the Department of Homeland Security's doctrine of prevent, protect, respond, and recovery interact to either facilitate or hinder the terrorists' capabilities in varying degrees across each of the five steps. This framework forms a matrix that allows us to consider this two-sided equation in detail (see figure 2). For our purposes, the matrix has been color-coded to reflect our ability to affect each of the bioterrorist's necessary steps. A useful exercise is to look at the matrix in greater detail to gain an understanding of the potential for a bioterror incident and our ability to positively affect outcomes.

Our ability to prevent a terrorist from acquiring, processing, and weaponizing biological material is limited. Deadly pathogens are naturally occurring, and with the proliferation in the life sciences of knowledge, equipment, and capabilities, these collective steps have experienced a lowering of thresholds that allows for more biotechnology in the hands of a larger number of people, some of whom may desire to employ these capabilities as weapons. Equipment for fermentation, freeze drying, and milling—which can be found readily in local hardware stores or ordered from the comfort of one's home—allows for developing and weaponizing these biological capabilities. This is not to say that all pathogens will be available to all terrorists. International efforts to prevent biological proliferation activities such as the Australia Group and the Proliferation Security Initiative have limited effectiveness given that pathogens are naturally occurring and that the equipment requirements for processing pathogens are not particularly sophisticated. Some will prove to be too difficult or dangerous to work with; however, a determined terrorist hoping to develop a basic BW capability would see thresholds lowered. In short, biological material suitable for use in an attack has become less technically

Figure 2. Bioterror's Two-sided Equation



challenging and therefore made these biological capabilities more readily available.

Impacting the terrorists' ability to acquire, process, and weaponize a pathogen is also limited by the modest requirements for developing a BW capability. Unlike nuclear weapons that have a requirement for highly specialized equipment and radioactive material with a large footprint and distinctive signature, BW weapons can be constructed in a small, confined space with little need for complex equipment and no discernible signature. In fact, the DTRA study conducted as part of Project Bacchus established this clearly.

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We do have some ability to prevent terrorists from successfully planning and deploying such weapons. For example, buildings can be designed to prevent employment of biological weapons in certain scenarios. Standoff distances and limiting access to air intake systems will limit use of biological weapons against these types of hardened targets.

In the category of protection, we do have greater ability to affect outcomes. Terrorists desiring to acquire, process, and weaponize a pathogen such as anthrax would likely be deterred from doing so if they intended to employ the BW weapon against a population that had been fully immunized against the pathogen. Development of vaccines and therapeutics can have an important deterrent effect as well. Likewise, conducting an attack against a building that has defensive measures built into the air handling system would probably not result in a successful attack and therefore would also serve as a deterrence measure.

Developing and fielding new real-time sensors that provide a detect-to-warn capability will also be important. Today, the current suite of sensors, such as those in the BioWatch[19] program, are detect-to-treat with relatively long periods between exposure and establishing that an attack has occurred. This period may be as long as a day or more. In the future, new age biotechnological capabilities should begin to allow for real-time detection that will permit warning of the attack as it is occurring so people can be moved out of the attack area and begin receiving immediate treatment, and potential victims can be prevented from entering contaminated areas.

Protection also implies the employment of risk-based strategies to determine where attacks are most likely, and the deployment of deterrence and countermeasures to ensure adequate coverage of important locations and facilities.

Examining the last two categories, respond and recover, we reach two important conclusions. First, these actions have no applicability to the terrorists' ability to acquire, process, or weaponize a biological weapon. Second, these areas offer the greatest potential for us to affect outcomes with well considered and emplaced programs.

Response begins with the ability to sense that an attack is in progress or has occurred. It is related to our sensor technology as part of the BioWatch program, but also includes improved biosurveillance, stockpiling of critical treatments and vaccines, increased resilience in the health care system to handle surge requirements envisioned from a bioterror attack, and trained and ready first responders. The BioSense[20] and BioShield[21] programs are a start at improving biosurveillance and stockpiling, respectively, but more can and must be done.

The readiness of our public health community and first responders is also a vital link in this system. Homeland Security Presidential Directive 21, "Public Health and Medical Preparedness," of October 2007 identified the four most critical components of public health and medical preparedness as biosurveillance, countermeasure distribution, mass casualty care, and community resilience.[22]

Today, we have no national biosurveillance system. Rather, we have a collection of state and local systems that have been cobbled together and that continue to rely on the capabilities of astute clinicians, doctors, and public health personnel. The picture is even worse globally as much of the reporting is spotty and incomplete at best, and even subject to politicization. Certainly, we have the technical capability to develop an automated disease tracking system linked to hospitals, clinics, and public health facilities. Perhaps the more relevant question is whether we have the political will. On a positive note, the World Health Organization International Health Regulations that establish requirements for global disease reporting by 2012 represent an important step in global biosurveillance.

Just as advances in biotechnology allow for the proliferation of increasingly dangerous dual-use capabilities, they also provide a greater capacity to develop new age treatments and prophylaxes. In the future, developing technologies such as DNA engineering and combinatorial chemistry combined with emerg-

Marines prepare samples in simulated chemical lab during Chemical Biological Incident Response Force demonstration

U.S. Marine Corps (Leslie Palmer)

ing technology such as nanotechnology will provide new opportunities for fighting naturally occurring disease as well as bioterror attacks.

The importance of casualty care and community resilience cannot be overstated. A bioterror attack will likely result in a mass casualty situation with large numbers of affected individuals and worried well converging on hospitals, clinics, and treatment facilities. The ability to rapidly assess and treat, instill public confidence, and communicate effectively will be essential for a quick response and recovery effort.

The implications of the framework are important to developing comprehensive programs that are both effective and efficient in dealing with an attack. In an era of scarce resources, we must ensure that we are spending wisely. Biological laboratory safety and control of dual-use technologies have received much attention recently. Deficiencies at biological safety level (BSL) laboratories, both in the labs and in their physical security, have been publically noted. Better controls are necessary for BSL facilities, but they are not sufficient. Likewise, efforts such as those by the Australia Group[23] and through the Proliferation Security Initiative[24] have less applicability for biological weapons where the pathogens are naturally occurring, and there are only modest requirements for developing and deploying BW weapons. This strongly implies that novel approaches must be developed for preventing, responding to, or recovering from a potential bioterror attack.

Bioterrorism is a very real and growing threat. We have seen a new type of terrorist emerge since the 1970s with a greater tendency toward taking global action and employing high violence strategies. This emerging terrorist has also demonstrated the propensity to employ nontraditional means such as airliners and fertilizers as weapons of mass destruction. It is becoming increasingly likely with trends in biotechnology that terrorists will turn to the use of biological pathogens for perpetrating bioterror attacks.

The nature of BW suggests that our ability to prevent such bioterror attacks cannot be assured, given the natural availability of disease-causing pathogens and advances in biotechnology that are allowing proliferation of potentially dangerous biological capabilities. However, we control our own destiny with regard to protecting populations and mounting an effective response and recovery. All indications are that the time to prepare is now. **JFQ**

NOTES

[1] Commission on the Prevention of WMD Proliferation and Terrorism, *World at Risk: The Report of the Commission on the Prevention of WMD Proliferation and Terrorism* (New York: Vintage, 2008), xv.

[2] David A. Lake, "Rational Extremism: Understanding Terrorism in the Twenty-First Century," *Dialog-IO* (Spring 2002), 1–29.

[3] Bruce Hoffman, *Inside Terrorism* (New York: Columbia University Press, 2006), 3–40.

[4] See "Statistics on Terrorism" at <www.johnstonsarchive.net/terrorism/intlterror.html>.

[5] National Counterterrorism Center, *2008 Report on Terrorism* (Washington, DC: Office of the Director of National Intelligence, April 30, 2009), available at <http://wits.nctc.gov/ReportPDF.do?f=crt2008nctcannexfinal.pdf>.

[6] See <www.rand.org/publications/randreview/issues/spring2004/enemy3.html>.

[7] Jessica Stern, *Terror in the Name of God: Why Religious Militants Kill* (New York: HarperCollins, 2003), 148.

[8] Hoffman, 209.

[9] The Monterey Institute of International Studies maintains a database on terrorist incidents that was used in the study.

[10] Raymond A. Zilinskas, "Final Report and Commentary: Bioterrorism Threat Assessment and Risk Management Workshop," presented to the U.S. Department of Energy, Monterey Institute of International Studies, June 24, 2003, 6.

[11] According to Robert Baker at George Mason University.

[12] Vernellia R. Randall, seminar entitled "Bioterrorism, Public Health and the Law," University of Dayton syllabus, available at <http://academic.udayton.edu/health/syllabi/bioterrorism/3bioterror/bioterror05.htm>.

[13] Ibid.

[14] Ibid.

[15] Jerry Seper, "Secret Project Manufactured Mock Anthrax," *The Washington Times*, October 26, 2001.

[16] Department of Defense, Office of the Under Secretary of Defense for Acquisition, Logistics, and Technology, *The Militarily Critical Technologies List Part II: Weapons of Mass Destruction Technologies (ADA 330102)*, "Section III: Biological Weapons Technology," February 1998, available at <www.fas.org/irp/threat/mctl98-2/p2sec03.pdf>.

[17] Ibid.

[18] Joby Warrick, "Custom-Built Pathogens Raise Bioterror Fears," *The Washington Post*, July 31, 2006, A1.

[19] Project BioWatch is a cooperative effort among the Department of Homeland Security (DHS), Environmental Protection Agency (EPA), and the Centers for Disease Controls (CDC) Laboratory Response Network to provide an early warning system for biothreats. There are currently over 4,000 atmospheric monitoring stations nationwide for the detection of atmospheric pollutants. Under the auspices of Project BioWatch, atmospheric samples in numerous cities are monitored around the clock for select agents. Filters from the sampling apparatus are analyzed by the CDC network for numerous biological threat agents. If any such agents were detected, mechanisms and protocols are in place for DHS, EPA, and CDC to reach crucial public health decisions rapidly, and promulgate a uniform course of action for local public health officials on the front lines.

[20] Project BioSense is intended to reduce the lag time between the detection of a possible bioagent and an appropriate response. Distinct from Project BioWatch, but integrated in function, Project BioSense relies upon multiple streams of information to facilitate rapid decisionmaking. Monitored parameters include environmental data from Project BioWatch, epidemiological information from hospitals administered by the Department of Defense and Veterans Affairs, reports from pharmacies across the Nation, and other sources of relevant syndromic and nontraditional data. All this information converges at the CDC Biointelligence Center, first for analysis, and then, if warranted, for coordinated response. Having this single center examine data from many different sources permits the detection of patterns and anomalies that may not be apparent through other means. Moreover, the CDC has long been entrusted with both gathering information from and disseminating information to frontline health care providers. This new role is a logical extension of that mission in which the CDC works hand in glove with clinicians at the local level to determine if an emergency response is warranted, and the necessary magnitude of that action.

[21] Project BioShield is a national security measure to stockpile drugs and treatments against terrorist threats first proposed by President George W. Bush in January 2003. The Project BioShield Act of 2004 was passed nearly unanimously by Congress and signed by the President on July 21, 2004, 560 days after Bush's initial proposal. Project BioShield was allocated $5.6 billion over the next 10 years to fund research and the purchase of vaccines, therapeutics, and other products (all pharmaceutical) against chemical, biological, and radiological attacks.

[22] Available at <www.dhs.gov/xabout/laws/gc_1219263961449.shtm#1>.

[23] The Australia Group, formed in 1985, is a body of approximately 40 likeminded nations that collaborate to restrain proliferation through a series of licensing measures on chemicals, biological agents, and dual-use equipment.

[24] The Proliferation Security Initiative, announced by President George W. Bush in 2003, was designed as a cooperative measure with nine European allies, Australia, and Japan to interdict WMD trafficking.