

Pathogens as Weapons

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The International Security Implications of Biological Warfare

Biological weapons have become one of the key security issues of the twenty-first century.¹ Three factors that first emerged in the 1990s have contributed to this phenomenon. First, revelations regarding the size, scope, and sophistication of the Soviet and Iraqi biological warfare programs focused renewed attention on the proliferation of these weapons.² Second, the catastrophic terrorist attacks on September 11, 2001, and the anthrax letters sent to media outlets and Senate offices in the United States during the following month, demonstrated the desire of terrorists to cause massive casualties and heightened concern over their ability to employ biological weapons.³ Third, significant advances in the life sciences have increased concerns about how the biotechnology revolution could be exploited to develop new or improved biological weapons.⁴ These trends suggest that there is a greater need than ever to answer several fundamental questions about biological warfare: What is the nature of the threat? What are the potential strategic consequences of the proliferation of biological weapons? How ef-

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1. The arguments made in this article are developed further in Gregory Koblentz, "Pathogens as Weapons: The International Security Implications of Biological Warfare," Ph.D. dissertation, Massachusetts Institute of Technology, forthcoming.

2. Ken Alibek with Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told from the Inside by the Man Who Ran It* (New York: Random House, 1999); and Raymond A. Zilinskas, "Iraq's Biological Weapons: The Past as Future?" in Joshua Lederberg, ed., *Biological Weapons: Limiting the Threat* (Cambridge, Mass.: MIT Press, 1999), pp. 137–158.

3. The letters, containing spores of *B. anthracis* (the organism that causes anthrax), killed five and infected another seventeen. Elin Gursky, Thomas V. Inglesby, and Tara O'Toole, "Anthrax 2001: Observations on the Medical and Public Health Response," *Biosecurity and Bioterrorism*, Vol. 1, No. 2 (2003), pp. 97–110.

4. Matthew Meselson, "Averting the Hostile Exploitation of Biotechnology," *CBW Conventions Bulletin*, No. 48 (June 2000), pp. 16–19; and Claire M. Fraser and Malcolm R. Dando, "Genomics and Future Biological Weapons: The Need for Preventive Action by the Biomedical Community," *Nature Genetics*, No. 29 (November 2001), pp. 253–256.

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fective will traditional security strategies such as deterrence and arms control be in containing this threat? How do answers to these questions inform policies to reduce the danger of biological weapons?

A rich literature already exists on the history and capabilities of biological weapons.⁵ In addition, the security studies community has begun to pay increased attention to the threat posed by these weapons.⁶ Few attempts have been made, however, to apply theories from the field of security studies to assess the broader international security implications of biological weapons.⁷ Previous studies addressed the potential lethality of biological weapons and concluded that state or terrorist use of these weapons in indiscriminant attacks on indefensible civilian populations represents the primary danger.⁸ Biological weapons, however, possess other attributes that pose less obvious but more insidious threats to international security. These destabilizing features are mutu-

5. United Nations Secretary-General, *Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use* (Geneva: United Nations, 1969); World Health Organization (WHO), *Health Aspects of Chemical and Biological Weapons* (Geneva: WHO, 1970); Stockholm International Peace Research Institute (SIPRI), *The Problem of Chemical and Biological Warfare*, Vols. 1–6 (New York: Humanities, 1971–75); and Erhard Geissler and John Ellis van Courtland Moon, eds., *Biological and Toxin Weapons: Research, Development, and Use from the Middle Ages to 1945*, SIPRI Chemical and Biological Warfare Study No. 18 (Oxford: Oxford University Press, 1999).

6. Susan Wright, ed., *Preventing a Biological Arms Race* (Cambridge, Mass.: MIT Press, 1990); Marie I. Chevrier, "Deliberate Disease: Biological Weapons, Threats, and Policy Responses," *Environment and Planning C: Government and Policy*, Vol. 11, No. 4 (1993), pp. 395–417; Malcolm Dando, *Biological Warfare in the 21st Century: Biotechnology and the Proliferation of Biological Weapons* (New York: Brassey's, 1994); Brad Roberts, "The Proliferation of Biological Weapons: Trends and Consequences," in Oliver Thranert, ed., *Enhancing the Biological Weapons Convention* (Bonn, Germany: Dietz, 1996), pp. 57–70; John D. Steinbruner, "Biological Weapons: A Plague upon All Houses," *Foreign Policy*, No. 109 (Winter 1997–1998), pp. 85–96; Richard K. Betts, "The New Threat of Mass Destruction," *Foreign Affairs*, Vol. 77, No. 1 (January/February 1998), pp. 26–41; Christopher F. Chyba, "Toward Biological Security," *Foreign Affairs*, Vol. 81, No. 3 (May/June 2000), pp. 122–136; Lederberg, *Biological Weapons*; and Raymond Zilinskas, ed., *Biological Warfare: Modern Offense and Defense* (Boulder, Colo.: Lynne Rienner, 2000).

7. George H. Quester, "Chemical and Biological Warfare," *American Political Science Review*, Vol. 68, No. 3 (September 1974), pp. 1285–1291; Marie Isabelle Chevrier, "Impediment to Proliferation? Analysing the Biological Weapons Convention," *Contemporary Security Policy*, Vol. 16, No. 2 (August 1995), pp. 72–102; Peter R. Lavoy, Scott D. Sagan, and James J. Wirtz, eds., *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons* (Ithaca, N.Y.: Cornell University Press, 2000); and Susan Martin, "The Role of Biological Weapons in International Politics: The Real Military Revolution," *Journal of Strategic Studies*, Vol. 25, No. 1 (March 2002), pp. 63–98.

8. Raymond A. Zilinskas, "Biological Warfare and the Third World," *Politics and the Life Sciences*, Vol. 9, No. 1 (August 1990), pp. 71–72; Steve Fetter, "Ballistic Missiles and Weapons of Mass Destruction: What Is the Threat? What Should Be Done?" *International Security*, Vol. 16, No. 1 (Summer 1991), pp. 22–26; Martin, "The Role of Biological Weapons in International Politics," p. 76; and Steinbruner, "Biological Weapons," pp. 85–86.

ally reinforcing and make biological weapons even more dangerous than suggested by assessments based solely on potential lethality.

The article begins with an examination of the major characteristics of pathogens as weapons. The next four sections assess the security implications of biological weapons in four key areas of concern for international security—proliferation, deterrence, civil-military relations, and threat assessment—and suggest the following conclusions. First, it is extremely difficult to prevent the spread of biological warfare capabilities to actors motivated by a desire to challenge the status quo. Second, biological weapons do not confer the deterrent benefits associated with nuclear weapons and pose special difficulties for states seeking to prevent their use. Third, the intense secrecy that shrouds biological warfare programs impedes civilian control over them. Fourth, states tend to have flawed assessments of the biological warfare capabilities and intentions of their opponents. A common theme throughout this article is that secrecy produces a variety of destabilizing effects: Not only does it impede verification, but it also undermines deterrence, hinders civilian oversight, and significantly complicates threat assessments.⁹ After addressing potential objections to this analysis, I offer several policy prescriptions for reducing the biological weapons threat.

Pathogens as Weapons

Modern biological weapons are designed to disseminate pathogens or toxins in an aerosol cloud of microscopic particles that can be readily inhaled and retained in the lungs of the exposed population.¹⁰ These aerosols are most effective when composed of particles ranging from 1 to 10 microns that can stay airborne longer and cause more severe cases of disease.¹¹ Aerosols are taste-

9. On the broader security implications of secrecy, see Stephen Van Evera, *Causes of War: Power and the Roots of Conflict* (Ithaca, N.Y.: Cornell University Press, 2000), pp. 140–141.

10. Disease-causing microorganisms such as bacteria, rickettsiae, viruses, and fungi are called pathogens. Another class of biological warfare agents are toxins, which are nonliving molecules that do not replicate in the body. For technical background on biological weapons, see Office of Technology Assessment (OTA), *Proliferation of Weapons of Mass Destruction: Assessing the Risks* (Washington, D.C.: U.S. Government Printing Office [U.S. GPO], 1993), pp. 71–117; Richard O. Spertzel, Robert W. Wannemacher, and Carol D. Linden, *Global Proliferation: Dynamics, Acquisition Strategies, and Response*, Vol. 4: *Biological Weapons Proliferation* (Washington, D.C.: Defense Nuclear Agency, September 1994); and William C. Patrick III, “Biological Warfare: An Overview,” Director’s Series on Proliferation No. 4 (Livermore, Calif.: Lawrence Livermore National Laboratory, May 1994), pp. 1–7.

11. Leroy Fothergill, “The Biological Warfare Threat,” in American Chemical Society, *Nonmilitary*

less, odorless, and invisible, thus facilitating clandestine attacks. They can be generated either by bomblets loaded into cluster bombs or missile warheads or by spraying devices that are mounted on aircraft, helicopters, cruise missiles, ships, or vehicles, or that are carried by hand.¹² The key drawbacks to biological weapons include their delayed effects; their sensitivity to environmental and meteorological conditions, which could result in uncertain area coverage and effects; the risk of infecting friendly forces; and the prospect of long-term contamination. For example, wind speed and direction, humidity, atmospheric stability, and the presence of sunlight can all influence the performance of a biological weapon.¹³ The careful selection of agents, delivery systems, and targets, however, as well as the timing of the attack, could compensate for most of these limitations.¹⁴

The offense-defense balance in biological warfare strongly favors the attacker because developing and using biological weapons to cause casualties is significantly easier and less expensive than developing and fielding defenses against them.¹⁵ Whether the biotechnology revolution will strengthen the defender or allow attackers to maintain their edge in this competition is unknown.¹⁶ The most common method of operationalizing the offense-defense balance is to construct a cost ratio of offense to defense: the more resources the attacker must invest to overcome the defender's investment in defensive forces, the greater the shift in the balance toward defense.¹⁷ Qualitative factors that affect the ease of attack or defense are also important. Four factors help to determine the attacker's advantage in biological warfare: (1) the potency of

Defense: Chemical and Biological Defenses in Perspective, Advances in Chemistry Series No. 26 (July 1960), p. 26.

12. Spertzel, Wannemacher, and Linden, *Global Proliferation*, Vol. 4, pp. 28–30.

13. Patrick, "Biological Warfare," p. 5.

14. Graham S. Pearson, "Prospects for Chemical and Biological Arms Control: The Web of Deterrence," *Washington Quarterly*, Vol. 16, No. 2 (Spring 1993), pp. 147–148; and Patrick, "Biological Warfare."

15. This feature of biological warfare has been recognized for more than fifty years. Theodor Rosebury, *Peace or Pestilence: Biological Warfare and How to Avoid It* (New York: Whittlesey, 1946), p. 135; Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare*, Vol. 2: *CB Weapons Today* (New York: Humanities, 1973), p. 90; and Joshua Lederberg and George Whitesides, *Biological Defense: Report of the Defense Science Board/Threat Reduction Advisory Committee* (Washington, D.C.: Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, June 2001), p. 2, released under the Freedom of Information Act (FOIA).

16. Raymond A. Zilinskas, "Conclusion," in Zilinskas, *Biological Warfare*, pp. 247–254; and Lederberg and Whitesides, *Biological Defense*.

17. Charles L. Glaser and Chaim Kaufmann, "What Is the Offense-Defense Balance and Can We Measure It?" *International Security*, Vol. 22, No. 4 (Spring 1998), pp. 50–51.

biological weapons, (2) the diversity of threat agents, (3) the ease of surprise, and (4) the difficulty in defending against such an attack.

THE POTENCY OF BIOLOGICAL WEAPONS

Biological weapons combine a relatively low cost of production with the capability for infecting large numbers of people over a wide area. According to a 1969 United Nations study, the cost of causing one civilian casualty per square kilometer was about \$2,000 with conventional weapons, \$800 with nuclear weapons, \$600 with chemical weapons, and only \$1 with biological weapons.¹⁸ The ability of biological weapons to cause mass casualties is well documented. A 1970 World Health Organization (WHO) study found that 50 kilograms of anthrax could result in 200,000 casualties in a medium-sized city such as Boston.¹⁹ The U.S. Office of Technology Assessment (OTA) has estimated that an attack with less than 100 kilograms of aerosolized anthrax spores could cause as many as 3 million casualties, rivaling the lethality of a thermonuclear weapon.²⁰

The creation of an offensive biological weapon capability is also relatively inexpensive, both in absolute terms and in comparison to the cost of developing defensive capabilities. According to OTA, a simple fermentation plant suitable for the production of biological warfare agents would cost \$10 million to construct.²¹ In 1999, the U.S. Defense Threat Reduction Agency built a small facility that could be used to produce biological warfare agents for only \$1.6 million.²² A comparison of the costs of modern state-sponsored biological warfare programs is also illustrative. In 1991, the U.S. Defense Intelligence Agency (DIA) put the cost of Iraq's biological warfare program at \$100–\$200 million.²³ In comparison, the Department of Defense's program to vaccinate U.S. soldiers

18. United Nations Secretary-General, *Chemical and Bacteriological (Biological) Weapons and the Effects of Their Possible Use*, p. 40. The methodology used to determine these figures is not known.

19. World Health Organization, *Health Aspects of Chemical and Biological Weapons*, p. 99.

20. Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction*, pp. 53–54.

21. Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction* (Washington, D.C.: U.S. GPO, 1993), p. 86. In contrast, nerve agent plants cost tens of millions of dollars, and fissile material production facilities cost hundreds of millions of dollars. Total program costs for these weapons are also significantly higher. *Ibid.*, pp. 27, 156–158.

22. Judith Miller, Stephen Engelberg, and William Broad, *Germes: Biological Weapons and America's Secret War* (New York: Simon and Schuster, 2001), pp. 297–298.

23. The agency also estimated that a significant capability without the redundancy of the prewar program could be attained for less than \$100 million. Defense Intelligence Agency, *Iraq's Chemical and Biological Warfare Capabilities: Surviving Assets and Lack of Use during the War*, Defense Intelligence Memorandum 88-91, March 1991, p. 3, declassified under FOIA.

against *Bacillus anthracis* has cost more than \$250 million over the past six years, and only a fraction of the force has been fully vaccinated.²⁴ In addition, developing a new biodefense vaccine costs \$300–\$400 million and typically takes eight to ten years; transforming a pathogen into a weapon takes only two to three years.²⁵ Although these comparisons are somewhat crude, they indicate the highly favorable cost ratio of offense to defense in biological warfare.

THE DIVERSITY OF BIOLOGICAL WARFARE AGENTS

Biological warfare agents are characterized by a relatively high degree of diversity, which provides terrorists and military planners with significant flexibility. The open literature discusses some thirty pathogens as having the physical and biological characteristics needed for a mass casualty-producing biological weapon. Most national biological warfare programs have focused on ten to fifteen agents.²⁶ Even this short list of biological warfare agents, however, offers a range of possibilities from the lethal *B. anthracis* to incapacitating agents such as *Coxiella burnetii* (which causes Q fever) and Venezuelan equine encephalitis. Pathogens that cause contagious diseases that have been developed as biological weapons include *variola major* (the causative agent of smallpox) and *Yersinia pestis* (the cause of plague).

This list of agents, however, reflects only known threats. Unexpected or novel pathogens may also emerge as threats. U.S. experts were surprised to learn of some of the agents that Iraq and the former Soviet Union had chosen to produce and weaponize.²⁷ Because biological terrorism is generally less sophisticated and less demanding than the military use of biological weapons,

24. As of January 2003, only 83,000 of 2.4 million service members had completed the six-shot series. Department of Defense, *Chemical and Biological Defense Program*, Vol. 1: *Annual Report to Congress* (Washington, D.C.: Department of Defense, April 2003), p. 59, <http://www.acq.osd.mil/cp/vol1-2003cbdpannualreport.pdf>.

25. Department of Defense, *Report on Biological Warfare Defense Vaccine Research and Development Programs* (Fort Belvoir, Va.: Defense Technical Information Center, July 2001), p. 2, <http://www.acq.osd.mil/cp/bwdvrdp-july01.pdf>; William Broad and Judith Miller, "Once He Devised Germ Weapons; Now He Defends against Them," *New York Times*, November 3, 1998, p. D1; and Kenneth Alibek, "Research Considerations for Better Understanding of Biological Threats," in Institute of Medicine, *Biological Threats and Terrorism: Assessing the Science and Response Capabilities* (Washington, D.C.: National Academy Press, 2002), p. 64.

26. Spertzel, Wannemacher, and Linden, *Global Proliferation*, Vol. 4, p. 11; and David R. Franz, "Medical Countermeasures to Biological Warfare Agents," in Alexander Kelle, Malcolm Dando, and Kathryn Nixdorff, eds., *The Role of Biotechnology in Countering BTW Agents* (Dordrecht, Netherlands: Kluwer, 2001), p. 228.

27. Chemical and Biological Arms Control Institute, *Responding to the Biological Weapons Challenge: Developing an Integrated Strategy* (Alexandria, Va.: Chemical and Biological Arms Control Institute, 2000), p. 43.

the range of possible agents for terrorists is even larger and more varied.²⁸ The application of molecular biology to the development of advanced biological weapons could significantly increase the diversity of biological warfare agents, but efforts along these lines are believed not to have advanced beyond the research stage.²⁹ As a result, because of the difficulty in assessing threat agents in a timely manner, defensive programs tend to lag behind offensive programs.³⁰

THE EASE OF SURPRISE

The element of surprise is crucial for an effective biological weapon attack and is relatively easy to achieve. The small quantity of agent required for an attack, the ability to launch an attack with a spray system from several miles upwind from a target or to in some other way clandestinely deliver biological weapons, and the difficulty of detecting biological aerosols makes these weapons well suited for surprise attacks.³¹ The nonspecific nature of the early symptoms of most diseases of concern can mask the beginning of a man-made outbreak and enhance the likelihood that such an attack will catch an adversary unprepared. Numerous exercises and simulations have demonstrated current U.S. vulnerability to clandestine attacks with biological weapons.³²

This reliance on surprise, however, exposes an Achilles' heel of biological weapons. Accurate intelligence on an adversary's biological warfare capabilities can substantially reduce the effectiveness of a biological attack by providing the defender with sufficient information to organize public health and medical measures to mitigate the consequences of an attack.

28. This wider range of agents, however, may not be well suited to large-scale, outdoor aerosolization and would thus be limited to aerosol dissemination inside buildings or the contamination of food and water supplies.

29. Lederberg and Whitesides, *Biological Defense*, p. 12. This assessment is apparently based on information regarding the former Soviet biological weapons program. It is not known, however, to what extent Russia has continued the work initiated during the Soviet era or what other nations have accomplished in this field.

30. Edward Eitzen and Ernest Takafuji, "Historical Overview of Biological Warfare," in Frederick Sidell, Ernest Takafuji, and David Franz, eds., *Medical Aspects of Chemical and Biological Warfare* (Washington, D.C.: Office of the Surgeon General, 1997), pp. 443–444.

31. Field tests by the U.S. Army in the 1950s and 1960s demonstrated the ease of conducting covert attacks with biological weapons against buildings, subway systems, air bases, and cities. William C. Patrick III, "Biological Warfare Scenarios," in Scott P. Layne, Tony J. Beugelsdijk, and C. Kumar N. Patel, eds., *Firepower in the Lab: Automation in the Fight against Infectious Diseases and Bioterrorism* (Washington, D.C.: Joseph Henry Press, 2001), pp. 215–223.

32. Judith Miller, "Exercise Finds U.S. Unable to Handle Germ War Threat," *New York Times*, April 26, 1998, p. A1; Thomas V. Inglesby, Rita Grossman, and Tara O'Toole, "A Plague on Your City: Observations from TOPOFF," *Clinical Infectious Diseases*, Vol. 32, No. 3 (February 2001), pp. 436–445; and Tara O'Toole, Michael Mair, and Thomas V. Inglesby, "Shining Light on Dark Winter: Lessons Learned," *Clinical Infectious Diseases*, Vol. 34, No. 7 (April 2002), pp. 972–983.

THE DIFFICULTY OF DEFENSE

Defensive biological warfare includes measures to prevent, mitigate, and treat the effects of a biological weapon attack. Biological defenses include vaccines and other pharmaceuticals, early warning systems, and physical protection. Given the range of available agents, the agent-specific nature of most defenses, the time lag required to develop new vaccines, and the ease with which an attacker can achieve surprise, defending a large population against a significant number of threat agents is a daunting task that would require a huge investment. Biological weapons, however, are in some ways more vulnerable to countermeasures than high explosives, chemical weapons, or nuclear weapons. They are unique among weapon systems in that vaccines can protect soldiers and civilians before an actual attack.³³ Although licensed vaccines are currently available for only two of the most dangerous biological warfare agents—*B. anthracis* and *variola major*—the U.S. Department of Defense and the National Institutes of Health are developing more than twelve new biodefense vaccines.³⁴ Even though immunizing vulnerable populations against the full range of biological warfare threats is not feasible or desirable, the availability of sufficient stockpiles of appropriate vaccines is still valuable as a deterrent to potential attackers, as a defensive measure if warning of an attack is received, as a form of postexposure prophylaxis for anthrax and smallpox, and as a reassuring symbol of preparedness.

Given the limitations of vaccines, defenses against biological weapons rely more on early detection of a biological attack and postexposure prophylaxis with antimicrobial drugs. The incubation period following infection with a pathogen, typically several days, provides a window of opportunity for the detection of a biological attack and the preparation of a response.³⁵ Aerosol detection devices and public health surveillance systems can provide the early warning necessary to launch a medical intervention to mitigate the consequences of a biological attack. Although current systems do not yet offer rapid,

33. For vaccines to be effective, defenders must be able to meet the following conditions: identification of the target population, knowledge of the specific threat agent, availability of the appropriate vaccine, and time for the vaccine to be administered to the target population before an attack. David R. Franz, "Physical and Medical Countermeasures to Biological Weapons," Director's Series on Proliferation No. 4 (Livermore, Calif.: Lawrence Livermore National Laboratory, May 1994), pp. 59–60.

34. Department of Defense, *Chemical and Biological Defense Program*, Vol. 1, p. 62; and Tara Palmore, Greg Folkers, Carole Heilman, John R. La Montagne, and Anthony S. Fauci, "The NIAID Research Agenda on Biodefense," *ASM News*, Vol. 68, No. 8 (August 2002), pp. 376–377.

35. Arnold Kaufmann, Martin I. Meltzer, and George Schmid, "The Economic Impact of a Bioterrorist Attack: Are Prevention and Postattack Intervention Programs Justifiable?" *Emerging Infectious Diseases*, Vol. 3, No. 2 (April–June 1997), pp. 83–94.

accurate, and broad-spectrum detection and identification capabilities, new capabilities are under development.³⁶ Administered promptly after infection or the onset of symptoms, antibiotics can significantly reduce the morbidity and mortality of most bacterial and rickettsial agents. In contrast, there are few effective medical treatments for viral infections. Quarantine and vaccination can reduce the impact of contagious diseases such as smallpox.³⁷

Physical defenses prevent exposure to biological warfare agents by filtering the air to remove dangerous particles. Simple masks, such as those used to prevent the inhalation of dust as well as more harmful materials, have been touted as being able to provide relatively inexpensive protection to civilian populations and military forces.³⁸ To be effective against a surprise attack, the use of these masks would have to be triggered by real-time detection of an attack, a capability that does not yet exist. Alternatively, military and health care personnel and others could wear masks when the threat of a biological attack is heightened, such as during a crisis or conflict. The prolonged use of such masks, however, would be difficult for several reasons: growing discomfort, especially during intense physical activity; the erosion of mask integrity and fit with rugged use; interference with face-to-face and radio communication; and the need to unmask to eat and drink.³⁹ Finally, masks do not prevent exposure if improperly fitted or if the concentration of agent goes beyond a certain level. Given the inability to detect a biological attack in real time, the most feasible type of physical defenses are buildings and vehicles equipped with filters and positive pressure systems that prevent the infiltration of biological aerosol clouds. Because of their expense, such systems are rare outside of the military. Nonetheless, they hold much promise for defending against biological attacks because they are not agent specific and can function continuously.⁴⁰

36. Gregory Koblenz, "Biological Terrorism: Understanding the Threat and the Response," in Arnold Howitt and Robyn Pang, eds., *Countering Terrorism: Dimensions of Preparedness* (Cambridge, Mass.: MIT Press, 2003), pp. 123–143.

37. Martin I. Meltzer, Inger Damon, James W. LeDuc, and J. Donald Millar, "Modeling Potential Responses to Smallpox as a Bioterrorism Weapon," *Emerging Infectious Diseases*, Vol. 7, No. 6 (November–December 2001), pp. 959–969.

38. Karl Lowe, Graham S. Pearson, and Victor Utgoff, "Potential Values of a Simple Biological Warfare Protective Mask," in Lederberg, *Biological Weapons*, pp. 263–281; and Stanley L. Weiner, "Strategies for the Prevention of a Successful Biological Warfare Aerosol Attack," *Military Medicine*, Vol. 161, No. 5 (May 1996), pp. 251–256.

39. See John Martyny, Craig S. Glazer, and Lee S. Newman, "Respiratory Protection," *New England Journal of Medicine*, September 12, 2002, p. 827.

40. Lester L. Yuan, "Sheltering Effects of Buildings from Biological Weapons," *Science and Global Society*, Vol. 8, No. 3 (2000), pp. 287–313; and Richard L. Garwin, Ralph E. Gomory, and Matthew S. Meselson, "How to Fight Bioterrorism," *Washington Post*, May 14, 2002, p. A21.

Proliferation to Dissatisfied Actors

Preventing the spread of biological warfare capabilities to dissatisfied actors seeking a means to challenge the status quo is extremely difficult. The proliferation of biological weapons is facilitated by the dual-use nature of biotechnology, which also complicates verification of the 1972 Biological Weapons Convention (BWC). The BWC prohibits the development, production, stockpiling, acquisition, and retention of biological weapons.⁴¹ It does not include provisions for verification. In 2001, negotiations to develop a protocol to strengthen the BWC were halted after the United States announced that it would not accept the draft protocol. According to U.S. officials, the proposed protocol was not intrusive enough to detect clandestine biological weapons activities, yet it was too invasive to adequately safeguard proprietary and classified information.⁴²

Actors pursuing biological weapons are motivated by a variety of factors.⁴³ The secrecy that shrouds biological weapons programs and the lack of reliable information regarding decisions to develop such programs, however, complicate efforts to study their motivations more thoroughly.⁴⁴ Nevertheless, an examination of the characteristics of biological weapons strongly suggests that they are attractive primarily to dissatisfied actors—whether states or terrorists. Biological weapons have military utility across the spectrum of conflict, rely on

41. The BWC does not prohibit research on biological and toxin agents, and it allows their development and production for protective, prophylactic, or other peaceful purposes. The convention, however, does not define activities that constitute research or are considered protective, prophylactic, or peaceful. Barend ter Haar, *The Future of Biological Weapons* (New York: Praeger, 1991), p. 16.

42. Ambassador Donald Mahley, "Statement by the United States to the Ad Hoc Group of Biological Weapons Convention States Parties," Geneva, Switzerland, July 25, 2001, <http://www.state.gov/t/ac/rls/rm/2001/5497.htm>.

43. See Chevrier, "Deliberate Disease," pp. 395–417; Jonathan B. Tucker, "Motivations For and Against Proliferation: The Case of the Middle East," in Zilinskas, *Biological Warfare*, pp. 27–52; and W. Seth Carus, "The Proliferation of Biological Weapons," in Brad Roberts, ed., *Biological Weapons: Weapons of the Future?* (Washington, D.C.: Center for Strategic and International Studies, 1993), pp. 19–27.

44. States also have an incentive to misrepresent their programs as being provoked by others or for the purpose of deterrence. In 1995, Iraq claimed that it developed strategic chemical and biological weapons as part of a deterrent strategy, but the United Nations Special Commission (UNSCOM) uncovered evidence that Iraq also planned on using these weapons for surprise attacks. United Nations Security Council, *Report of the Secretary-General on the Status of the Implementation of the Special Commission's Plan for the Ongoing Monitoring and Verification of Iraq's Compliance with Relevant Parts of Section C of Security Council Resolution 687 (1991), S/1995/864* (New York: United Nations, October 11, 1995), p. 11.

surprise, and do not destroy property. These characteristics favor the use of such weapons in offensive operations and asymmetric strategies against stronger opponents. The outlaw status of biological weapons renders them undesirable to status quo states interested primarily in self-defense. In addition, the relative ease of accessibility, high levels of potency, and potentially huge psychological impact combine to make biological weapons attractive to extremist religious terrorist groups interested in maximizing casualties and fear. In sum, dissatisfied actors—both states and terrorists—have the opportunity and motivation to acquire these weapons.

OPPORTUNITY TO OBTAIN BIOLOGICAL WEAPONS

Traditional arms control and nonproliferation measures are significantly less successful at halting the spread of biological weapons than other proscribed weapons. Effective biological disarmament faces two high hurdles: (1) the ease of acquiring the dual-use materials and technologies required to develop biological weapons, and (2) the difficulty in verifying that these resources are not being used for hostile purposes.

The dual-use nature of biotechnology means that materials, equipment, skills, and facilities designed for peaceful endeavors can also be exploited for hostile purposes. These resources are widely available on the open market and are highly sought by countries interested in economic development.⁴⁵ Export controls may slow national biological weapons programs and block access to the most advanced technologies, but they cannot prevent a determined state from acquiring a desired capability.⁴⁶ Although domestic access to dangerous pathogens in the United States has been regulated since 1996, these pathogens (with the exception of *variola major*) are available in nature and from a number of germ banks around the world.⁴⁷ In addition, domestic acquisition of dual-use equipment remains unfettered, greatly facilitating the development of biological weapons by terrorists.⁴⁸ This is not to say that the technical obstacles to

45. Brad Roberts, "Rethinking Export Controls on Dual-Use Materials and Technologies: From Trade Restraints to Trade Enablers," *Arena*, No. 2 (June 1995).

46. David A. Kay, "Denial and Deception Practices of WMD Proliferators: Iraq and Beyond," *Washington Quarterly*, Vol. 18, No. 1 (Winter 1995), pp. 85–105; and Gordon Vachon, "The Australia Group and Proliferation Concerns," *UNIDIR NewsLetter*, No. 33 (1996), pp. 59–61.

47. Michael Barletta, Amy Sands, and Jonathan B. Tucker, "Keeping Track of Anthrax: The Case for a Biosecurity Convention," *Bulletin of the Atomic Scientists*, Vol. 58, No. 3 (May/June 2002), pp. 58–59.

48. Barry Kellman, "Biological Terrorism: Legal Measures for Preventing Catastrophe," *Harvard Journal of Law and Public Policy*, Vol. 24, No. 2 (Spring 2001), pp. 457–462.

developing a biological weapon are trivial, but given the proper materials, skills, and equipment, these obstacles are surmountable.⁴⁹

Preventing the acquisition of biological weapons through arms control and disarmament is extremely difficult.⁵⁰ Verification, the ability to confirm whether a nation is complying with its treaty obligations, is the foundation of effective arms control and disarmament.⁵¹ The core problem in verifying compliance with biological disarmament is that the capabilities for conducting the research, development, production, and testing of biological weapons are virtually identical to those employed by defensive programs and in legitimate civilian enterprises.⁵² There are few aspects of a biological weapons program that are unique to offensive applications and are readily detectable by outsiders. Advanced biotechnologies make it unnecessary to maintain large dedicated production plants, stockpiles of bulk agents, or filled munitions that would provide intelligence agencies or inspectors with a “smoking gun.” States suspected of failing to meet their obligations under the BWC might seek to portray certain biotechnology-related capabilities and activities that cannot be justified as having a civilian purpose—such as working with dangerous pathogens or experimenting with aerosols of biological agents—as being part of a defensive program permissible under the BWC.⁵³ The BWC does not di-

49. On the difficulties of developing biological weapons outside of a state-run program, see General Accounting Office, *Need for Comprehensive Threat and Risk Assessments of Chemical and Biological Attacks*, GAO-NSIAD-99-163 (Washington, D.C.: GAO, September 1999).

50. For optimistic views on this issue, see Marie Isabelle Chevrier, “Verifying the Unverifiable: Lessons from the Biological Weapons Convention,” *Politics and the Life Sciences*, Vol. 9, No. 1 (August 1990), pp. 93–105; Milton Leitenberg, “Biological Weapons and Arms Control,” *Contemporary Security Policy*, Vol. 17, No. 1 (April 1996), pp. 1–79; Raymond A. Zilinskas, “Verifying Compliance to the Biological and Toxin Weapons Convention,” *Critical Reviews in Microbiology*, Vol. 24, No. 3 (September 1998), pp. 195–218; and Malcolm Dando, *Preventing Biological Warfare: The Failure of American Leadership* (London: Palgrave, 2002). For pessimistic views, see Kathleen C. Bailey, “Problems with Verifying a Ban on Biological Weapons,” Director’s Series on Proliferation No. 3 (Livermore, Calif.: Lawrence Livermore National Laboratory, January 1994), pp. 59–63; Michael Moodie, “Arms Control Programs and Biological Weapons,” in Roberts, *Biological Weapons*, pp. 47–57; and Robert P. Kadlec, Allan P. Zelicoff, and Ann M. Vrtis, “Biological Weapons Control: Prospects and Implications for the Future,” in Lederberg, *Biological Weapons*, pp. 95–111.

51. Arms Control and Disarmament Agency, *Verification: The Critical Element of Arms Control* (Washington, D.C.: U.S. GPO, 1976); and Allan S. Krass, *Verification: How Much Is Enough?* (London: Taylor and Francis, 1985).

52. Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction*, pp. 84–87; Zilinskas, “Verifying Compliance to the Biological and Toxin Weapons Convention,” pp. 198–199; Susan Berger, “The Challenges of Chemical and Biological Weapons Arms Control Treaty Verification,” in Elizabeth J. Kirk, W. Thomas Wander, and Brian D. Smith, eds., *Trends and Implications for Arms Control, Proliferation, and International Security in the Changing Global Environment* (Washington, D.C.: American Association for the Advancement of Science, 1993), pp. 175–189.

53. As a result of the ambiguities between prohibited and legitimate activities, making definitive

rectly address these types of activities.⁵⁴ Intrusive methods aimed at uncovering evidence of the development of biological weapons will inevitably require inspections of facilities engaged in biodefense and civilian activities. Defensive and civilian activities frequently have legitimate needs for a limited degree of secrecy to protect national security and proprietary business information.⁵⁵ The safeguards for protecting sensitive information insisted on by states uninterested in developing biological weapons necessarily makes it easier for noncompliant states to hide their illicit activities. The failure of the negotiations on the BWC protocol demonstrates the difficulty of striking a widely accepted balance between the competing needs of transparency and secrecy.

Even advocates of strengthening the BWC acknowledge that a verification regime that is sensitive to national security and commercial concerns will likely be unable to reliably detect violations of the treaty.⁵⁶ Instead, they contend that even a low probability of detection will deter states from violating the treaty because the costs and risks of such a violation being discovered would outweigh its benefits.⁵⁷ Proponents of this argument predicate it on the

judgments regarding the compliance of a state believed to be cheating could be difficult. Jonathan B. Tucker, "Strengthening the Biological Weapons Convention," *Arms Control Today*, April 1995, p. 11; and Berger, "The Challenges of Chemical and Biological Weapons Arms Control Treaty Verification," p. 185.

54. The *New York Times* highlighted this ambiguity in September 2001 when it revealed the existence of biodefense projects sponsored by the Department of Defense and Central Intelligence Agency that involved the construction of a small biological agent production facility, the testing of Soviet-designed biological bomblets, and the creation of a genetically engineered strain of *B. anthracis*. The agencies claimed that the purpose of these research projects was defensive and legal under the BWC, but the combination of capabilities under development and the secrecy of the work raised questions at home and abroad about the commitment of the United States to enforcing the treaty. Judith Miller, Stephen Engelberg, and William J. Broad, "U.S. Germ Warfare Research Pushes Treaty Limits," *New York Times*, September 4, 2001, p. A1; Judith Miller, "When Is a Bomb Not a Bomb? Germ Experts Confront U.S.," *New York Times*, September 5, 2001, p. A5; Elisa Harris, "Research Not to Be Hidden," *New York Times*, September 6, 2001, p. A27; and Barbara Hatch Rosenberg and Milton Leitenberg, "Who's Afraid of a Germ Warfare Treaty?" *Los Angeles Times*, September 6, 2001, p. B15.

55. In 1970, the U.S. government committed itself to conducting its defensive program as openly as possible, but determined that the performance of detection systems, threat assessments, and vulnerability studies may require classification. Interdepartmental Political Military Working Group, *Annual Review of United States Chemical Warfare and Biological Research Programs as of 1 November 1970*, December 5, 1970, pp. 23–24, <http://foia.state.gov/documents/FOIADocs/000050DB.pdf>. On industry concerns regarding the protection of intellectual property, see Al Homberg, "Industry Concerns Regarding Disclosure of Proprietary Information," Director's Series on Proliferation, No. 4 (Livermore, Calif.: Lawrence Livermore National Laboratory, May 23, 1994), pp. 91–100.

56. Chevrier, "Verifying the Unverifiable," p. 99; Zilinskas, "Verifying Compliance to the Biological and Toxin Weapons Convention," p. 211; and Barbara Rosenberg, "U.S. Policy and the BWC Protocol," *CBW Conventions Bulletin*, No. 52 (June 2001), p. 2.

57. Chevrier, "Impediment to Proliferation?" pp. 72–102; and Elisa Harris, "Bioweapons Treaty

assumption that biological weapons lack military utility and therefore are of marginal interest to most states.⁵⁸ The nature of international politics, however, provides a strong motivation to dissatisfied actors to pursue biological weapons, even if it means violating treaty commitments, because these weapons offer a potent means of challenging the status quo.

MOTIVATION TO OBTAIN BIOLOGICAL WEAPONS

Biological weapons appeal to both states and terrorists seeking a powerful, terrifying, and flexible weapon. This does not mean, however, that the widespread proliferation of these weapons is inevitable. Most states are satisfied with their overall security and position in the international system. However, deeply dissatisfied states that are willing to use violence to achieve their goals are likely to view biological weapons as a desirable force multiplier.⁵⁹ Similarly, among terrorist groups, only a limited number have the kind of radical religious philosophy or apocalyptic worldview that could justify the use of these weapons. This section challenges the myth that biological weapons lack military utility, it describes the properties of biological weapons that would appeal primarily to dissatisfied states, and it discusses the characteristics of terrorist groups interested in these weapons.

MILITARY UTILITY OF BIOLOGICAL WEAPONS. The widespread belief that biological weapons lack military utility is rooted in the United States' unilateral renunciation of biological weapons in 1969 and U.S. ratification of the BWC in 1975.⁶⁰ The government publicly justified these decisions in large part on the basis of the unpredictable and uncontrollable consequences of these weapons as well as their supposed lack of military utility.⁶¹ It made these decisions at

Still a Good Idea," *Christian Science Monitor*, August 24, 2001, <http://www.csmonitor.com/2001/0824/p11s3-coop.html>.

58. Chevrier, "Impediment to Proliferation?" p. 95; Elisa Harris, "The Biological and Toxin Weapons Convention," in Albert Carnesale and Richard Haass, eds., *Superpower Arms Control: Setting the Record Straight* (Cambridge, Mass.: Ballinger, 1987), p. 205.

59. For a discussion of the role of revisionist states in international politics, see Randall L. Schweller, "Bandwagoning for Profit: Bringing the Revisionist State Back In," *International Security*, Vol. 19, No. 1 (Summer 1994), pp. 72–107; and Alastair Iain Johnston, "Is China a Status Quo Power?" *International Security*, Vol. 27, No. 4 (Spring 2003), pp. 8–11.

60. For the decisionmaking process leading to the 1969 decision, see Jonathan B. Tucker, "A Farewell to Germs: The U.S. Renunciation of Biological and Toxin Warfare, 1969–70," *International Security*, Vol. 27, No. 1 (Summer 2002), pp. 107–148.

61. "Remarks of the President on Announcing the Chemical and Biological Defense Policies and Programs," Office of the White House Press Secretary, The White House, November 25, 1969, Folder 5: Chemical, Biological Warfare (Toxins, etc.), Vol. 1, Box 310, National Security Council Subject Files, Nixon Presidential Materials, National Archives, College Park, Maryland [hereafter Nixon papers]; and Senate Committee on Foreign Relations, "Prohibition of Chemical and Biologi-

least in part, however, after concluding that the destructive power of these weapons and their relative accessibility posed a serious proliferation threat.⁶² In addition, given its formidable nuclear and conventional forces, the United States did not believe that it needed biological weapons to cause massive civilian casualties or to deter the use of biological weapons by other states. For the United States, the contribution of these weapons to achieving other missions was not worth the price of a heightened risk of proliferation.⁶³ It is a mistake to extrapolate from this decision, however, that biological weapons are, in the words of Thomas Schelling, “ridiculous weapons that nobody is interested in having even if the other side is foolish enough to procure them.”⁶⁴ Although biological weapons may have had marginal military utility for the United States in 1969, history has shown that this calculation is not universally applicable. Indeed, shortly after the U.S. decision to abandon these weapons, the Soviet Union decided to dramatically expand its own program and develop a new generation of biological weapons.⁶⁵ In addition, since 1972 the number of states suspected of developing these weapons has more than tripled from four to thirteen.⁶⁶

Although biological weapons have not been used in modern times, it is possible to assess their military utility based on the characteristics of these weapons, the types of weapons developed and fielded, and the doctrines adopted. The diversity of available agents and the range of their effects could provide military planners with a flexible weapon system capable of carrying out a range of missions against a broad selection of targets.⁶⁷ At the tactical level, the

cal Weapons,” 93d Cong., 2d sess., December 10, 1974, p. 10; and Arms Control and Disarmament Agency, *Verification*, pp. 17–18.

62. Matthew Meselson, “The Problem of Biological Weapons,” undated, <http://www.pugwash.org/reports/cbw/cbw5.htm>; Julian P. Perry Robinson, “Some Political Aspects of the Control of Biological Weapons,” *Science in Parliament*, Vol. 53, No. 3 (May/June 1996), pp. 6–11; Graham S. Pearson, “Biological Weapons: A Priority Concern,” Director’s Series on Proliferation No. 4 (Livermore, Calif.: Lawrence Livermore National Laboratory, May 1994), p. 42; and Gradon Carter, “Biological Warfare and Biological Defence in the United Kingdom, 1940–1979,” *RUSI Journal*, Vol. 137, No. 6 (December 1992), p. 72.

63. Han Swyter, “Political Considerations and Analysis of Military Requirements for Chemical and Biological Weapons,” *Proceedings of the National Academy of Sciences*, Vol. 65, No. 1 (January 15, 1970), pp. 261–270.

64. Thomas C. Schelling, *Choice and Consequence* (Cambridge, Mass.: Harvard University Press, 1984), p. 253, as cited in Chevrier, “Impediment to Proliferation?” p. 84.

65. Alibek, *Biohazard*; and Anthony Rimmington, “The Soviet Union’s Offensive Program: The Implications for Contemporary Arms Control,” in Susan Wright, ed., *Biological Warfare and Disarmament: New Problems/New Perspectives* (Lanham, Md.: Rowman and Littlefield, 2002), pp. 103–150.

66. General Accounting Office, *Arms Control: Efforts to Strengthen the Biological Weapons Convention*, GAO-02-1038 (Washington, D.C.: GAO, September 2002), pp. 10–11.

67. Brad Roberts, “Between Panic and Complacency: Calibrating the Chemical and Biological

delayed effects of biological agents and the susceptibility of aerosol clouds to vagaries in meteorological and environmental conditions limit their utility to static battles of attrition. The ability of aerosol clouds to penetrate fortifications and buildings could provide an attacker with a means of “softening up” a hardened enemy position before an assault.⁶⁸ The risk of infecting one’s troops could be minimized by vaccinating them ahead of time, employing biological weapons far from friendly forces, or using only noncontagious or short-lived agents. States lacking precision-guided munitions and cluster bombs may find the cost effectiveness of these weapons attractive. Iraq under Saddam Hussein, for example, experimented with biological warheads for short-range artillery rockets during the final stages of its war of attrition with Iran (1980–88).⁶⁹

Biological weapons may have their greatest military utility at the operational or theater level of warfare.⁷⁰ The goal of attacks on logistical networks, reinforcements, and command and control facilities is “to induce operational paralysis, which reduces the enemy’s ability to move and coordinate forces in the theater.”⁷¹ At various times, the United States, the Soviet Union, and Iraq developed biological weapons and doctrines for their use at the operational level of warfare.⁷² Targets in the enemy’s rear area could be selected so that the effects of an attack were at their height when friendly forces plan on attacking the objective. The ability of some biological agents to sicken victims for weeks or months could also outweigh the delayed effects of such agents.⁷³ In addition, the use of incapacitating agents instead of lethal ones might allow an aggressor to seize its objectives without provoking regime-threatening retaliation

Warfare Problem,” in Stuart E. Johnson, ed., *The Niche Threat: Deterring the Use of Chemical and Biological Weapons* (Washington, D.C.: National Defense University Press, 1997), pp. 9–41.

68. U.S. Army, *Employment of Chemical and Biological Agents*, Army Field Manual No. 3–10 (Washington, D.C.: Department of the Army, March 31, 1966), p. 47.

69. International Institute for Strategic Studies, *Strategic Survey, 1996/1997* (Oxford: Oxford University Press, 1997), p. 38.

70. This potential, however, has been ignored in many analyses of these weapons. Zilinskas, “Biological Warfare and the Third World”; and Richard Novick and Seth Shulman, “New Forms of Biological Warfare?” in Wright, *Preventing a Biological Arms Race*, pp. 105–106. An exception to this view is W. Seth Carus, *The Poor Man’s Atomic Bomb? Biological Weapons in the Middle East*, Policy Paper No. 23 (Washington, D.C.: Washington Institute for Near East Policy, 1991), pp. 36–37.

71. Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, N.Y.: Cornell University Press, 1996), p. 72.

72. See, respectively, U.S. Army, *Employment of Chemical and Biological Agents*; Jonathan B. Tucker, “Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek,” *Nonproliferation Review*, Vol. 6, No. 3 (Spring–Summer 1999), p. 2; and Timothy McCarthy and Jonathan B. Tucker, “Saddam’s Toxic Arsenal: Chemical and Biological Weapons in the Gulf Wars,” in Lavoy, Sagan, and Wirtz, *Planning the Unthinkable*, p. 62.

73. The use of incapacitating agents instead of lethal ones would have the additional benefit of burdening the target with large numbers of wounded soldiers, who typically absorb more resources than fatalities.

from a nuclear-armed opponent. Power projection forces that rely on a small number of large facilities with primarily civilian workforces are particularly vulnerable to such disruptive attacks.⁷⁴ As a result, the employment of biological weapons against theater targets could serve as a potent force multiplier for a conventional military operation.⁷⁵ For this reason, the use of biological weapons as part of an asymmetric strategy to deter, prevent, or disrupt the intervention of U.S. forces in the Middle East or Northeast Asia is a major concern for American defense planners.⁷⁶

At the strategic level of warfare, the goal is to reduce the willingness or ability of the enemy to continue to prosecute a war. States can achieve this objective either through attacks targeted at civilians, with the goal of increasing pressure on the government to yield, or through attacks aimed at damaging the enemy's economy to the point where the state can no longer effectively resist.⁷⁷ Biological warfare can target civilians directly with antipersonnel agents or indirectly with antilivestock or anticrop agents that could be used against agricultural targets to reduce an enemy's food supply. The ability of biological warfare agents to be disseminated over large areas and for agents such as *variola* virus and *y. pestis* to cause epidemics makes them well suited for strategic attacks.⁷⁸ The delayed effects of biological weapons and uncertainties surrounding the downwind travel of the aerosol cloud are less important for strategic attacks that do not require precision or immediate results. In addition, the disproportionate fear that these "dreaded" weapons evoke could amplify the psychological impact of even a small-scale biological attack.⁷⁹ In their offensive programs, the United States, the Soviet Union, and Iraq developed a

74. Robert J. Larsen and Robert P. Kadlec, *Biological Warfare: A Post-Cold War Threat to America's Strategic Mobility Forces*, Ridgway Viewpoint 95-3 (Pittsburgh, Penn.: Matthew B. Ridgway Center for Strategic Studies, 1995), pp. 12-15.

75. *Assessment of the Impact of Chemical and Biological Weapons on Joint Operations in 2010: A Summary Report* (McLean, Va.: Booz, Allen, and Hamilton, November 1997).

76. Department of Defense, *Report of the Quadrennial Defense Review* (Washington, D.C.: U.S. GPO, May 1997), p. 13; and George W. Bush, *National Security Strategy of the United States of America* (Washington, D.C.: White House, September 2002), pp. 13-16.

77. Pape, *Bombing to Win*, pp. 42-47.

78. There are also a number of viral agents and fungal agents that can cause epidemics among livestock and crops, respectively. See Simon M. Whitby, *Biological Warfare against Crops* (New York: Palgrave, 2002); and Terrance M. Wilson, Linda Logan-Henfrey, Richard Weller, and Barry Kellman, "Agroterrorism, Biological Crimes, and Biological Warfare Targeting Animal Agriculture," in Corrie Brown and Carole Bolin, eds., *Emerging Diseases of Animals* (Washington, D.C.: ASM Press, 2000), pp. 23-57.

79. Jessica Stern, "Dreaded Risks and the Control of Biological Weapons," *International Security*, Vol. 27, No. 3 (Winter 2002/03), pp. 102-106.

range of aircraft- and missile-delivered biological weapons and doctrines for use against urban populations and agricultural targets.⁸⁰ According to John Steinbruner, Soviet military planners “might have calculated that with judicious selection of the agents and timing of their delivery, the urban populations of Western Europe might be sufficiently weakened to allow an occupying army to accomplish an otherwise impossible task.”⁸¹

ATTRactions OF BIOLOGICAL WEAPONS TO DISSATISFIED STATES. Biological weapons are more attractive to dissatisfied states than status quo states for three reasons. First, pathogens and poisons have long been the subject of international opprobrium and efforts to control or eliminate them.⁸² The 1925 Geneva Protocol banned the use of chemical and biological weapons, and the BWC prohibited the development and possession of biological weapons.⁸³ As a result, states that are satisfied with the status quo are unlikely to pursue these weapons. Not only are such states unlikely to develop these weapons, but they are also unlikely to use them during wartime to repulse an aggressor for fear of alienating the international community or key allies.⁸⁴ On the other hand, states that plan on using violence to challenge the status quo would not likely demonstrate similar respect for international treaties. The history of chemical warfare supports this proposition. During the twentieth century, the state that initiated hostilities was always the first to use lethal chemical weapons.⁸⁵

80. See Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project* (New York: Henry Holt, 1999), pp. 138–157; Christopher Davis, “Nuclear Blindness: An Overview of the Biological Weapons Programs of the Former Soviet Union and Iraq,” *Emerging Infectious Diseases*, Vol. 5, No. 4 (July–August 1999), pp. 509–512; Zilinskas, “Iraq’s Biological Weapons,” p. 141; Whitby, *Biological Warfare against Crops*, pp. 10–21, 94–117; and Rimmington, “The Soviet Union’s Offensive Program,” pp. 113–115.

81. Steinbruner, “Biological Weapons,” p. 90.

82. John Ellis van Courtland Moon, “Controlling Chemical and Biological Weapons through World War II,” in Richard Burns, ed., *Encyclopedia of Arms Control and Disarmament*, Vol. 2 (New York: Charles Scribner’s Sons, 1993), pp. 657–674.

83. Ironically, the development of biological weapons by revisionist states such as the Soviet Union and Imperial Japan may have been partly inspired by these agreements. On Japanese interest in chemical and biological weapons due to the Geneva Protocol, see Peter Williams and David Wallace, *Unit 731: Japan’s Secret Biological Warfare in World War II* (New York: Free Press, 1989), pp. 7–8. The Soviet Union launched new efforts to develop biological weapons in the 1920s and 1970s following the creation of both the Geneva Protocol and the BWC. See Valentin Bojtsov and Erhard Geissler, “Military Biology in the USSR, 1920–1945,” in Geissler and Moon, *Biological and Toxin Weapons*, pp. 156–157; and Rimmington, “The Soviet Union’s Offensive Program,” pp. 105–106.

84. States that do not expect external support in the event of an attack may not feel limited in their means of self-defense.

85. Confirmed cases of the use of chemical weapons initiated by the aggressor include Germany during World War I, the Allies during their intervention into the Russian civil war from 1919 to 1921, Italy against Ethiopia from 1935 to 1936, Japan against China between 1937 and 1945, Egypt

Second, biological weapons rely on surprise for much of their effectiveness. In general, attackers, not defenders, depend on surprise to achieve their objectives. As John Mearsheimer notes, "One important advantage held by the offense is the ability to choose the main point of attack for the initial battles, to move forces there surreptitiously, and to surprise the defender."⁸⁶ Aggressors are better prepared not only to employ biological weapons but also to defend against them, because they can anticipate enemy retaliation and prepare accordingly.⁸⁷ In addition, the need for surprise reduces the utility of these weapons for other strategies such as blackmail or deterrence. According to Robert Pape, "Military strategies that depend on surprise for their effectiveness have no coercive value because they cannot be used to *threaten* the target with defeat."⁸⁸ Robert Jervis uses a nineteenth-century newspaper commentary to illustrate the implications of a weapon that relies on surprise: "As a measure of defense, knives, dirks, and sword canes are entirely useless. They are fit only for attack, and all such attacks are of murderous character. Whoever carries such a weapon has prepared himself for homicide."⁸⁹

Third, biological weapons do not damage or destroy property. By degrading enemy capabilities while preserving transportation infrastructure, biological weapons could be used to facilitate the advance of a blitzkrieg-style armored attack. Such weapons could also offer an expansionist state the means of seizing valuable resources such as cities and industrial facilities without risking their destruction. To reduce the chances of contaminating the desired assets, biological agents with a high decay rate that degrade rapidly upon release could be selected, and attacks could be timed to take place shortly before sunrise to minimize the agent's half-life.⁹⁰

TERRORIST MOTIVATION. Terrorism experts have identified extremist religious groups, particularly those with an apocalyptic worldview, as the most

against Royalist forces in Yemen between 1963 and 1967, and Iraq against Iran during the 1980s. Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare*, Vol. 1: *The Rise of CB Weapons* (New York: Humanities, 1971), pp. 125–161.

86. John J. Mearsheimer, *Conventional Deterrence* (Ithaca, N.Y.: Cornell University Press, 1983), p. 26.

87. *Concepts for Employment of Antipersonnel Biological Warfare*, Information Report No. 1 (Edgewood, Md.: Chemical Corps Board, April 1, 1958), p. 12.

88. Pape, *Bombing to Win*, p. 14 (emphasis in original).

89. Quoted in Robert Jervis, "Cooperation under the Security Dilemma," *World Politics*, Vol. 30, No. 2 (January 1978), pp. 205–206.

90. On the limited risk of serious contamination, see Patrick, "Biological Warfare," p. 6; and Graham S. Pearson, "The Essentials of Biological Threat Assessment," in Zilinskas, *Biological Warfare*, p. 71.

likely terrorists to seek nuclear, biological, or chemical weapons for the purpose of causing mass casualties.⁹¹ Traditional terrorists with ethnic, nationalist, or ideological grievances typically have political objectives that would be harmed if they were to use illegitimate weapons to kill large numbers of civilians. Extremist religious terrorist groups such as al-Qaeda and Japan's Aum Shinrikyo, on the other hand, have shown a proclivity for highly lethal attacks. These groups do not have broad constituencies that they risk alienating by using biological weapons, and their beliefs may permit the indiscriminate mass murder of nonbelievers. The association of disease and pestilence in sacred texts as forms of divine wrath and the dreaded nature of these weapons may further add to their appeal. In addition, some extremist groups may actually welcome severe government retaliation triggered by a biological attack as part of their plan to provoke an apocalyptic confrontation between the forces of good and evil.⁹² To date, the very small number of terrorist groups that have had the motivation to use biological weapons on a large scale have been unable to develop the capability to do so.⁹³ A terrorist group that can combine the capability and motivation to use biological weapons will pose the novel threat of a nonstate actor capable of inflicting catastrophic damage against a perceived enemy.⁹⁴

Biological Weapons Undermine Deterrence

Despite their frequent description as a "poor man's atomic bomb," biological weapons are not well suited to serving as a strategic deterrent.⁹⁵ Moreover, the

91. Bruce Hoffman, "Terrorists and WMD: Some Preliminary Hypotheses," *Nonproliferation Review*, Vol. 4, No. 3 (Spring/Summer 1997), pp. 45–53; Jessica Stern, "Terrorist Motivations and Unconventional Weapons," in Lavoy, Sagan, and Wirtz, *Planning the Unthinkable*, pp. 202–229; and Jerrold M. Post, "Psychological and Motivational Factors in Terrorist Decision-Making: Implications for CBW Terrorism," in Jonathan B. Tucker, ed., *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, Mass.: MIT Press, 2000), pp. 271–289.

92. Stern, "Terrorist Motivations and Unconventional Weapons," pp. 214–216.

93. Case studies of terrorist groups interested in biological weapons can be found in Tucker, *Toxic Terror*; and W. Seth Carus, *Bioterrorism and Biocrimes: The Illicit Use of Biological Agents in the 20th Century* (Washington, D.C.: National Defense University, April 2001).

94. Al-Qaeda is known to be interested in biological weapons and causing mass casualties, but it is not yet believed to have acquired the capability for conducting such an attack. Barton Gellman, "Al Qaeda Near Biological, Chemical Arms Production," *Washington Post*, March 23, 2003, p. A1.

95. Carus, *The Poor Man's Atomic Bomb?*; Neil C. Livingstone and Joseph D. Douglass Jr., *CBW: The Poor Man's Atomic Bomb* (Cambridge, Mass.: Institute for Foreign Policy Analysis, 1984); H. Lee Buchanan, "Poor Man's A-Bomb?" *U.S. Naval Institute Proceedings*, Vol. 123, No. 4 (April 1997), pp. 83–86; and Al J. Venter, "Biological Warfare: The Poor Man's Atomic Bomb," *Jane's Intelligence Review*, Vol. 11, No. 3 (March 1999), pp. 42–47.

accessibility of biological weapons and the ability to conduct anonymous biological attacks reduce a state's ability to deter the use of these weapons.

POOR SUITABILITY FOR STRATEGIC DETERRENCE

The comparison of biological weapons with nuclear weapons is not without basis. Under the right conditions, a biological attack could kill as many people as a nuclear device.⁹⁶ This similarity is the basis for most analyses that suggest that biological weapons will have similar political effects as nuclear weapons.⁹⁷ According to Susan Martin, biological weapons enable even small states to deter threats to their vital interests and intervention by major powers. Because biological weapons are more easily acquired than nuclear weapons, Martin predicts that the benefits of the "biological revolution" will be more widespread and have an even more profound impact on international affairs than the nuclear revolution.⁹⁸ I argue that despite their potential lethality, biological weapons do not possess the characteristics necessary for an effective strategic deterrent. They may, however, serve as an in-kind deterrent or contribute to a state's general deterrence posture. Nevertheless, the spread of biological warfare capabilities is not likely to exert a stabilizing influence on international peace and security, as Martin asserts.⁹⁹

The prerequisite for strategic deterrence is the capability of the target of a surprise attack to retaliate by inflicting unacceptable damage against its attacker.¹⁰⁰ During the Cold War, the possession of such forces by both superpowers gave rise to the situation of mutual deterrence described as mutual assured destruction. The nuclear revolution is a function not only of the destructiveness of nuclear weapons but also of their reliability, the lack of effective defenses, and the availability of survivable delivery systems.¹⁰¹ Although biological weapons have the potential to inflict unacceptable damage against

96. Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction*, pp. 53–54.

97. Fetter, "Ballistic Missiles and Weapons of Mass Destruction," pp. 22–26; and Martin, "The Role of Biological Weapons in International Politics," p. 77.

98. Martin, "The Role of Biological Weapons in International Politics," pp. 81–82, 86–87.

99. For additional analyses of the utility of biological weapons as deterrents, see Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare*, Vol. 2, pp. 155–159; and Chevrier, "Deliberate Disease," pp. 406–408.

100. Bernard Brodie, "Implications for Military Policy," in Brodie, ed., *The Absolute Weapon: Atomic Power and World Order: Statecraft and the Prospect of Armageddon* (New York: Harcourt, 1946), pp. 76–77, 89–91; and Robert Jervis, *The Meaning of the Nuclear Revolution* (Ithaca, N.Y.: Cornell University Press, 1989).

101. These characteristics are derived from Jervis, *The Meaning of the Nuclear Revolution*; Shai Feldman, *Israeli Nuclear Deterrence: A Strategy for the 1980s* (New York: Columbia University Press, 1982), pp. 32–33; and Van Evera, *Causes of War*, pp. 240–254.

an adversary, they are unable to offer states an “assured” capability for doing so; this shortfall undermines their suitability as a strategic deterrent. Biological weapons differ from nuclear weapons in two important ways that raise doubts about the applicability of strategic deterrence theory to biological warfare.

The first significant difference involves the level of uncertainty associated with the employment of these weapons. Based on a deep understanding of the fundamental scientific principles underlying nuclear weapons as well as extensive operational and experimental experience with them, experts have been able to document the levels of thermal radiation, nuclear radiation, and blast overpressure that cause specified effects in personnel and matériel.¹⁰² Nuclear weapons deliver instantaneous and overwhelming destruction; the effects of biological weapons, on the other hand, are delayed, variable, and difficult to predict. There are ways to reduce this uncertainty by carefully selecting the agent, the delivery system, and the conditions under which an attack is conducted. States that plan on using their biological weapons as a strategic deterrent, however, may not have the luxury of choosing the time and place for a retaliatory strike.¹⁰³ In addition, the lack of operational experience with these weapons and the inability to realistically simulate their effects (short of massive human experimentation) impede the ability of states to substantially reduce this level of uncertainty.

The second major difference between nuclear and biological weapons concerns the availability of defenses. There are no effective defenses against the effects of a nuclear attack. As discussed earlier, however, there are countermeasures that can be taken prior to or following a biological attack. This creates two problems for relying on biological weapons as a strategic deterrent. First, the availability of defenses that could significantly mitigate the consequences of a biological attack is likely to reduce the confidence of states in their ability to reliably inflict unacceptable damage against an adversary in a retaliatory strike. The full panoply of defenses need not be deployed constantly at full readiness because the very availability of these defenses may be sufficient to dissuade a state from calculating that it can inflict unacceptable damage. Although civilian populations will remain more vulnerable to biological weapons than military forces, damage limitation remains a viable option for larger,

102. Samuel Gladstone and Dolan J. Philip, eds., *Effects of Nuclear Weapons* (Washington, D.C.: U.S. GPO, 1977).

103. In contrast, a state contemplating a first strike or surprise attack with biological weapons would have more flexibility in determining when, where, and how to employ these weapons.

more advanced states facing less sophisticated adversaries. The December 2002 initiative by the United States to vaccinate nearly 1 million soldiers, public health officials, and medical workers against smallpox in advance of the looming war with Iraq illustrates how states can adopt precautionary measures to blunt the effectiveness of an anticipated threat.¹⁰⁴

Second, the availability of defenses against biological weapons also places a premium on surprise. Surprise requires strict secrecy, which reduces a state's ability to issue credible threats to inflict unacceptable damage against an adversary.¹⁰⁵ Credible deterrent threats would entail revealing details about the nature of a state's biological weapons capabilities. These revelations could reduce the effectiveness of these weapons by compromising the element of surprise and allowing the defender to take appropriate countermeasures. North Korea in the late 1960s and Iraq in the early 1990s employed deterrent strategies based on biological weapons only to have them compromised by secrecy.¹⁰⁶ Regardless of whether a state adopts a strategy of biological deterrence by denial or deterrence by punishment, neither will deter potential adversaries if the intention and capabilities to implement the strategy are unknown.

Secrecy may be an inexpensive and attractive way for gaining security for strategic forces, but it is also risky.¹⁰⁷ Forces that depend on secrecy for their protection are vulnerable to intelligence breakthroughs by an adversary. The

104. As of late 2003, fewer than 40,000 civilians had been vaccinated against smallpox, far short of the goal of 440,000. The military immunization campaign, however, was successful in vaccinating more than 500,000 soldiers and military health personnel. David Ruppe, "U.S. Military Official Praises Army Smallpox Vaccination Program," *Global Security Newswire*, October 23, 2003, http://www.nti.org/d_newswire/issues/2003_10_23.html#1AA0288D.

105. Avner Cohen and Benjamin Frankel, "Opaque Proliferation," *Journal of Strategic Studies*, Vol. 13, No. 3 (September 1990), pp. 31–32; and Feldman, *Israeli Nuclear Deterrence*, p. 19.

106. During the 1991 Gulf War, Iraq maintained a secret strategic reserve of mobile missiles armed with chemical and biological warheads. Launch authority for these weapons was predelegated in the event that a nuclear weapon struck Baghdad or that missile commanders lost contact with the leadership in the capital. This policy and the capabilities supporting it, however, were not known to Israel or the United States until revealed by Iraqi officials in 1995. McCarthy and Tucker, "Saddam's Toxic Arsenal," pp. 72–75; and Amatzia Baram, "An Analysis of Iraqi WMD Strategy," *Nonproliferation Review*, Vol. 8, No. 2 (Summer 2001), pp. 34–36. North Korea's aggressive behavior in the late 1960s was reportedly undertaken in the mistaken belief that the nation's new chemical and biological warfare capabilities would deter a strong U.S. response. The United States was not aware of these capabilities, however, and its forceful reaction led the North Korean leadership to moderate its behavior and reassess the deterrent value of their unconventional weapons. Joseph S. Bermudez Jr., "The Democratic People's Republic of Korea and Unconventional Weapons," in Lavoy, Sagan, and Wirtz, *Planning the Unthinkable*, pp. 186–187.

107. Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (New York: Pergamon, 1985), p. 37.

loss of secrecy could be massive and occur without warning. If a defender has inside information about an attacker's intentions and capabilities, it could seek to develop and stockpile new vaccines and treatments, immunize the at-risk population, distribute protective masks and treatments, enhance public health surveillance, and take other precautions that could substantially mitigate the impact of a biological weapon attack. Although such information is difficult to acquire, there have been a number of cases where high-level officials knowledgeable about their nation's biological weapons program have defected.¹⁰⁸

THE DIFFICULTIES OF DETERRING BIOLOGICAL ATTACKS

The accessibility of biological weapons to a diverse set of actors and the ease of covert attacks complicate efforts to deter their use. The proliferation of biological weapons to nondeterrable actors and the prospect of anonymous attacks could undermine reliance on deterrence as a security strategy and lead states to adopt preventive or preemptive strategies.

ACCESSIBILITY OF BIOLOGICAL WEAPONS. Because of the global diffusion of dual-use biotechnology, biological weapons can be developed by a larger and more diverse group of actors than can nuclear weapons. Even states that are incapable of effectively managing the investment of large amounts of human, financial, and physical capital over the ten years typically required to produce nuclear weapons may still be able to develop biological weapons.¹⁰⁹ In 1993, the Office of Technology Assessment estimated that more than 100 states had the capability to develop biological weapons.¹¹⁰ This greater accessibility raises the risk that biological weapons could be acquired by an actor that is insensitive to costs, values gains more than the status quo, and grossly misperceives the interests or capabilities of others. Such actors can be difficult to deter because they "do not feel the pain of punishment, or they are willing to take great

108. In 1989 Vladimir Pasechnik, the director of a major Soviet biological weapons research institute, defected to the United Kingdom. In 1992 Kenneth Alibek, a former deputy director of Biopreparat, the Soviet Union's biological weapons research and development agency, defected to the United States. In 1995 Hussein Kamel, the head of Iraq's weapons of mass destruction programs, defected to Jordan. Tom Mangold and Jeff Goldberg, *Plague Wars: A True Story of Biological Warfare* (New York: St. Martin's, 1999), pp. 91–105, 177–195, 293–294.

109. On the ten-year rule for nuclear weapon's development, see Leonard S. Spector, "Strategic Warning and New Nuclear States," *Defense Intelligence Journal*, Vol. 3, No. 1 (Spring 1994), pp. 33–52. In contrast, Iraq went from biological weapons research to production in five years. See Mitchell B. Wallerstein, "Responding to Proliferation Threats," *Strategic Forum*, No. 138 (May 1998), <http://www.ndu.edu/inss/strforum/SF138/forum138.html>.

110. Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction*, p. 85.

pains to gain their goals, or they fail to see the punishment coming.”¹¹¹ The primary actors of concern in this regard are terrorists.¹¹² Although no terrorist group has yet succeeded in developing a mass casualty-producing biological weapon, groups such as Aum Shinrikyo and al-Qaeda have demonstrated the ability to employ sophisticated weapons, the desire to cause mass casualties, and an interest in using disease as a weapon.¹¹³ Moreover, the possibility that a state sometime in the future might demonstrate some of these qualities cannot be excluded.¹¹⁴

PROSPECT OF ANONYMOUS USE. Biological weapons are relatively easy to develop in secret, are well suited for covert delivery, and do not provide signatures that can be used to identify the attacker. Aum Shinrikyo’s dissemination of biological agents in Japan on a dozen separate occasions in the early 1990s went undetected until they were revealed years later during the trial of the cult’s leadership.¹¹⁵ As the Federal Bureau of Investigation’s inability to identify the perpetrator of the 2001 anthrax letter attacks has demonstrated, forensic capabilities in this field are limited.¹¹⁶ The potential accessibility of biological weapon capabilities to large number of actors also complicates efforts to identify the perpetrator of a biological attack. If a state or terrorist group believes that it could conduct an attack anonymously and thereby escape retaliation, deterrence would be ineffective.

A second potential consequence of the anonymous use of biological weapons is catalytic war: a war between two states secretly initiated by a third party. The spread of nuclear weapons in the 1960s created concern that a third party could attack either superpower and make it appear to be the work of its rival, sparking a crisis or war.¹¹⁷ This worry faded in the 1970s with the signing of

111. Van Evera, *Causes of War*, p. 242.

112. On the difficulty of deterring terrorists, see Paul K. Davis and Brian M. Jenkins, *Deterrence and Influence in Counterterrorism: A Component in the War on al Qaeda* (Santa Monica, Calif.: RAND, 2002), pp. 3–8.

113. Gavin Cameron, “Multi-Track Microproliferation: Lessons from Aum Shinrikyo and Al Qaeda,” *Studies in Conflict and Terrorism*, Vol. 22, No. 4 (November 1999), pp. 277–309.

114. The best illustration of this is Japan in December 1941. See Scott D. Sagan, “Origins of the Pacific War,” *Journal of Interdisciplinary History*, Vol. 18, No. 4 (Spring 1988), pp. 893–922.

115. None of these attacks was successful because the group inadvertently used harmless versions of *B. anthracis* and botulinum toxin. Sheryl Wu Dunn, Judith Miller, and William J. Broad, “How Japan Germ Terror Alerted the World,” *New York Times*, May 26, 1998, p. A1.

116. Martin Enserink, “Useful Data but No Smoking Gun,” *Science*, May 10, 2002, pp. 1002–1003; and Laura Meckler, “Genetics Not Helping Anthrax Probe,” Associated Press, June 19, 2002, <http://www.ph.ucla.edu/epi/bioter/geneticsnohelpanthrax.html>.

117. Henry S. Rowen, “Catalytic Nuclear War,” in Graham T. Allison, Albert Carnesale, and Joseph S. Nye Jr., eds., *Hawks, Doves, and Owls: An Agenda for Avoiding Nuclear War* (New York: W.W. Norton, 1985), pp. 148–163.

the nuclear Nonproliferation Treaty, which helped to forestall the spread of nuclear weapons, and the advent of advanced early warning systems that allowed the superpowers to detect and track aircraft and ballistic missiles, the primary delivery systems for nuclear weapons. No such measures exist today with regards to biological weapons, so the possibility of a catalytic war sparked by the use of these weapons remains a possibility. For example, a hostile state or terrorist group in the Middle East could stage an attack on U.S. forces in the region that points to another state as the culprit.

PREVENTION AND PREEMPTION. States may adopt preventive or preemptive strategies to neutralize perceived threats posed by the prospect of anonymous biological attacks or the acquisition of biological weapons by nondeterrable actors.¹¹⁸ After the September 11 terrorist attacks, preventive and preemptive strategies became central to U.S. national security planning.¹¹⁹ These strategies, however, first emerged during President Bill Clinton's administration in response to the threat of mass casualty terrorism. In 1995, the White House issued a presidential decision directive stating that the acquisition of nuclear, biological, or chemical weapons by terrorists was "unacceptable." According to the directive, "There is no higher priority than preventing the acquisition of this capability or removing this capability from terrorist groups potentially opposed to the U.S."¹²⁰ This policy was first implemented on August 20, 1998, when the United States launched cruise missiles at the al-Shifa pharmaceutical plant in Sudan, which officials believed was linked to the development of chemical weapons for al-Qaeda.¹²¹ Despite concerns within the administration about the legal and intelligence justifications for the attack, "the perception of imminent danger was powerful enough to overcome these concerns. At the Principals meeting, [National Security Adviser] Sandy Berger asked, 'What if we do not hit it [al-Shifa] and then, after an attack, nerve gas is released in the New York City subway? What will we say then?'"¹²² Although this incident involved terrorist acquisition of chemical (not biological) weapons, it indicates

118. The goal of a preventive attack is to thwart a state or terrorist group from developing a threatening capability. Preemptive strikes are conducted when an enemy attack appears imminent. Richard K. Betts, *Surprise Attack: Lessons for Defense Planning* (Washington, D.C.: Brookings, 1982), p. 145.

119. Bush, *National Security Strategy of the United States of America*, pp. 15–16.

120. Memorandum for the Vice President, Subject: "U.S. Policy on Counterterrorism," June 21, 1995, <http://www.fas.org/irp/offdocs/pdd39.htm>.

121. Gregory Koblenz, "Countering Dual-Use Facilities: Lessons from Iraq and Sudan," *Jane's Intelligence Review*, Vol. 11, No. 3 (March 1999), pp. 48–53.

122. Quoted in Daniel Benjamin and Steven Simon, *The Age of Sacred Terror: Radical Islam's War against America* (New York: Random House, 2002), p. 260.

how states may respond to the specter of terrorist acquisition of even more lethal weapons. Preventive and preemptive attacks against suspected biological weapons facilities present significant intelligence, military, and diplomatic challenges. The potential consequences of a biological attack and the limitations of defensive and deterrent strategies, however, may influence a decision-maker's calculation that the risks of inaction outweigh the costs of action.

Obstruction of Civilian Oversight

The intense secrecy that shrouds biological warfare programs distorts political decisionmaking and restricts civilian oversight. Secrecy also leads to the compartmentalization of information and increases the likelihood of corruption and abuse by program managers. In announcing the results of a review of U.S. chemical and biological warfare programs in 1969, President Richard Nixon stated, "This has been the first thorough review ever undertaken of this subject at the Presidential level. . . . I recall during the eight years that I sat on the National Security Council in the Eisenhower Administration that these subjects, insofar as an appraisal of what the United States had, what our capability was, what other nations had, were really considered taboo."¹²³ Within the obsessively secretive Soviet Union, the biological weapons program was "one of the best-guarded secrets."¹²⁴ It operated under the highest security classification in the Soviet system, even higher than the nuclear weapons program.¹²⁵ Although all weapon programs are subject to some level of secrecy to prevent adversaries from learning about capabilities and vulnerabilities, the secrecy surrounding biological weapons programs has been unusually high.¹²⁶

States pursuing biological weapons have several reasons to subject these programs to stringent secrecy. The general revulsion against biological warfare has motivated states to conceal their research into these weapons. As a British study of chemical and biological weapons (CBW) policy noted, "For in order to avoid provoking the critics of CBW in peacetime, while forearming itself against charges of shortsightedness in case war should find the country unable to retaliate against CBW, a responsible government can hardly be blamed for

123. "Remarks of the President on Announcing the Chemical and Biological Defense Policies and Programs," p. 1, Nixon papers.

124. Russian Deputy Foreign Minister Grigory Berdennikov, quoted in John Barry, "Planning a Plague," *Newsweek*, February 1, 1993, p. 40.

125. Mangold and Goldberg, *Plague Wars*, p. 182.

126. Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare*, Vol. 5: *The Prevention of CBW* (New York: Humanities, 1974), p. 138.

procuring the weapons but keeping them dark.”¹²⁷ Secrecy has become even more important since the creation of the 1972 BWC, which reinforces the norm against developing these weapons and raises the political costs of the discovery of a weapons program. Finally, there is a strategic motivation for wrapping biological weapons in secrecy. Military capabilities that strongly favor the offense, particularly those that rely on surprise, engender higher levels of secrecy.¹²⁸

The intense secrecy surrounding biological weapons programs is inimical to effective decisionmaking and oversight. As described in the literature on opaque proliferation, the strict secrecy surrounding covert nuclear weapons programs leads to compartmentalization that restricts the information available to senior officials about the nature and conduct of these programs and limits the range and knowledge of participants involved in such oversight.¹²⁹ In addition, secrecy exacerbates existing information asymmetries between political leaders and military officers or scientists who run biological weapons programs. Such asymmetries enable subordinates to operate with too much autonomy, avoid accountability by concealing potentially embarrassing or damaging information from their superiors, and hinder the implementation of new policies with which they disagree. Large information asymmetries may allow program managers to take actions for their own benefit or for the benefit of their organization that are against the interests of their superiors.¹³⁰ Thus, programs escape review, decisions are made with incomplete or inaccurate information, and the exercise of appropriate oversight is hindered.

Three brief cases illustrate the adverse effects of secrecy on the management of major biological warfare programs. In 1975, a congressional investigation exposed a secret stockpile of toxins at the Central Intelligence Agency (CIA) that should have been destroyed years earlier when the United States decided to terminate its offensive biological warfare program.¹³¹ The toxins were the result of cooperation between the CIA and the U.S. Army to develop biological

127. United Kingdom Foreign Office, Arms Control and Disarmament Research Unit, “The Arms Control Implications of Chemical and Biological Weapons: Analysis and Proposals,” ACDRU 66(2), 2d draft, July 4, 1966, p. 25, FO 371/187448, Public Records Office, London, United Kingdom.

128. Van Evera, *Causes of War*, p. 137.

129. Cohen and Frankel, “Opaque Proliferation,” pp. 22, 34; and Peter D. Feaver, “Proliferation Optimism and Theories of Nuclear Operations,” *Security Studies*, Vol. 2, Nos. 3–4 (Spring/Summer 1993), pp. 175–178.

130. Peter D. Feaver, *Armed Servants: Agency, Oversight, and Civil-Military Relations* (Cambridge, Mass.: Harvard University Press, 2003), pp. 68–71.

131. Senate Select Committee to Study Governmental Operations with Respect to Intelligence Activities, *Hearings*, Vol. 1: *Unauthorized Storage of Toxic Agents* (Washington, D.C.: U.S. GPO, 1976).

agents and weapons for clandestine operations. An internal CIA review of the program found that it was “characterized by a compartmentation [*sic*] that was extreme even by CIA standards.”¹³² In contrast to the review of the Defense Department’s plans to destroy its stocks of agents and munitions by appropriate federal, state, and local agencies, the destruction of the CIA’s holdings of biological and toxin agents stored at Fort Detrick, Maryland, was not subject to any external oversight. As a result, CIA scientists were able to retain a small stockpile of toxins despite the presidential decision to destroy all such agents. The corrosive effects of too much secrecy on oversight was demonstrated again in 2001, when it was reported that the CIA and Defense Department were conducting classified projects to develop limited offensive capabilities for defensive purposes and that some of these activities had not been reported to the National Security Council or included in annual confidence-building declarations to the United Nations.¹³³

Political leaders in Moscow in the 1990s experienced problems in obtaining accurate information from the military regarding biological warfare activities, making informed decisions about the future of the program, and ensuring the implementation of new policies. For example, in May 1990, under pressure from the United States and the United Kingdom, Soviet President Mikhail Gorbachev issued a secret decree halting the research, development, and testing activities of Biopreparat, an ostensibly civilian organization also responsible for the development and production of biological weapons. Gen. Yury Kalinin, the head of Biopreparat, and his allies in the military manipulated the formulation and implementation of the decree, however, to preserve as much of the program as possible. The final decree included a loophole inserted by Kalinin that allowed the continued funding of the full range of Biopreparat’s activities. Kalinin then withheld the decree from the directors of Biopreparat’s institutes so that they could act on it only under orders from headquarters, which were not forthcoming. As a result, the decree had a limited impact on Biopreparat’s activities except to better conceal them from the civilians in the Kremlin.¹³⁴ According to Jack Matlock, U.S. ambassador to Moscow from 1987

132. *Summary Report on CIA Investigation of MKNAOMI*, undated (declassified September 15, 1975), p. 4, in Senate Committee on Human Resources, Subcommittee on Health and Scientific Research, “Biological Testing Involving Human Subjects by the Department of Defense,” 95th Cong., 1st sess., March 8 and May 23, 1977, p. 247.

133. Tucker, “A Farewell to Germs,” pp. 145–148.

134. Mangold and Goldberg, *Plague Wars*, pp. 109–110, 417, n. 20; and Alibek, *Biohazard*, pp. 190–191

to 1991, "From their behavior, I think the people at the top [in the Kremlin] probably did not know everything. There is plenty of evidence that shows these people were not able to get the information they wanted, because the system was so secret and the political authorities had so little control over the military and KGB. And they had no reliable way to check up on the information they did get."¹³⁵ Similar problems plagued efforts by President Boris Yeltsin to dismantle the former Soviet biological weapons program and bring Russia into compliance with the BWC.¹³⁶

Problems of control and oversight also beset South Africa's chemical and biological weapons program that ran from 1981 to 1993. The Truth and Reconciliation Commission that investigated the program, called Project Coast, found that the military committee charged with oversight was "grossly negligent in approving programmes and allocating large sums of money for activities of which they had no understanding, and which they made no effort to understand."¹³⁷ This mismanagement resulted in scientific and financial fraud by a "nepotistic, self-serving and self-enriching group of people, misled by those who had a technical grasp of what was happening."¹³⁸ In addition, the program managers misled President F.W. de Klerk and later President Nelson Mandela about the offensive orientation of the program and its role in assassination operations.¹³⁹ As a result of this lack of oversight, the program's documents and materials were not properly destroyed or accounted for when the program was terminated and thus continued to present a proliferation risk many years later.¹⁴⁰

These cases demonstrate the range of pathologies that secrecy can introduce into decisionmaking and oversight regarding biological weapons programs. The security implications are subtle but disturbing. Biological weapons programs managed by highly autonomous organizations could evade civilian oversight, manipulate ambiguous intelligence on foreign biological warfare ac-

135. Quoted in Mangold and Goldberg, *Plague Wars*, p. 109.

136. See *ibid.*, pp. 158–169.

137. Truth and Reconciliation Commission, *Truth and Reconciliation Commission of South Africa Report*, Vol. 2 (Basingstoke, U.K.: Macmillan Reference Limited, March 1999), p. 522.

138. *Ibid.*, p. 520.

139. Chandré Gould and Peter Folb, *Project Coast: Apartheid's Chemical and Biological Warfare Programme* (Geneva: United Nations, 2002), p. 118; and Marlène Burger, and Chandré Gould, *Secrets and Lies: Wouter Basson and South Africa's Chemical and Biological Warfare Programme* (Cape Town, South Africa: Zebra, 2002), pp. 9, 26.

140. Joby Warrick and John Mintz, "Lethal Legacy: Bioweapons for Sale," *Washington Post*, April 20, 2003, p. A1; and Joby Warrick, "Biotoxins Fall Into Private Hands," *Washington Post*, April 21, 2003, p. A1.

tivities or other information to mislead senior officials, and resist efforts to comply with international obligations. This lack of oversight could be especially dangerous if it allows unsafe or unauthorized experiments to develop new or improved biological weapons. In addition, decisionmakers denied the proper information and expertise may be poorly equipped to assess the strengths and limitations of these weapons. This in turn could lead them to miscalculate their ability to use these weapons covertly to avoid provoking regime-threatening retaliation or place undue confidence in them as a strategic deterrent. Finally, the lack of oversight increases the risk that such programs could become the source of expertise, materials, or weapons for terrorists or other states.

Flawed Threat Assessment

Accurate and timely intelligence has long been regarded as a crucial element in defending against biological weapons. In 1969, President Nixon stated that the unilateral renunciation of biological weapons would not “leave us vulnerable to surprise by an enemy who does not observe these rational restraints. Our intelligence community will continue to watch carefully the nature and extent of the biological programs of others.”¹⁴¹ Strict secrecy and the dual-use nature of biotechnology, however, make biological weapon programs a notoriously difficult target for intelligence agencies. According to the CIA’s top non-proliferation analyst in 1999, “Biological weapons (BW) pose, arguably, the most daunting challenge for intelligence collectors and analysts.”¹⁴² Biological threat assessments must take into account not only capabilities that are challenging to monitor but also intentions that are even more difficult to discern. As a result, intelligence on foreign biological warfare programs is usually severely deficient. Indeed, the most significant intelligence breakthroughs have resulted from defections by knowledgeable insiders.¹⁴³ Only such insiders can provide the information on intent that is required for a comprehensive understanding of a state’s biological warfare program.¹⁴⁴ Assessing the biological

141. “Statement by the President,” Office of the White House Press Secretary, November 25, 1969, p. 2, Nixon papers.

142. Statement by Special Assistant to the DCI for Nonproliferation John A. Lauder to the House Permanent Select Committee on Intelligence, *Worldwide Biological Warfare Threat*, March 3, 1999, http://www.cia.gov/cia/public_affairs/speeches/archives/1999/lauder_speech_030399.html.

143. Prominent examples include Vladimir Pasechnik, Kenneth Alibek, and Hussein Kamel.

144. Intelligence from human sources can be difficult to verify. Moreover, such sources may pur-

threat posed by terrorists is likely to be even more difficult given the intensively secretive nature of such organizations. It is possible that a terrorist group with the motivation and capability to use these weapons will emerge with little or no warning.¹⁴⁵

The historical record is replete with flawed biological threat assessments that have resulted in significant overestimates and underestimates of an adversary's biological warfare capabilities and intentions. During World War II, both the Allied and Axis powers had poor intelligence on the facilities, scientists, and agents involved in the biological warfare programs of the other side.¹⁴⁶ The U.S. military grossly underestimated the Japanese biological warfare program until it was able to interview personnel captured during and after the war.¹⁴⁷ In contrast, because of their misreading of German intentions, the Allies' fear of a German biological warfare program was greatly exaggerated.¹⁴⁸ Nonetheless, this fear spurred crash programs by the Allies to develop a range of defensive and offensive biological warfare capabilities.¹⁴⁹

During the Cold War, the United States and its allies also lacked a clear understanding of the Soviet biological weapons program. According to a 1970 U.S. interagency report, "Useful intelligence on actual production, weaponization and stockpiling remains nonexistent, and information on the Soviet biological warfare program remains incomplete in almost all important details."¹⁵⁰ This lack of intelligence led to an underestimation of the size and sophistication of the Soviet biological warfare program that was revealed in 1989

posefully or inadvertently transmit false information, thus contributing to flawed assessments, as may have been the case prior to the 2003 U.S. invasion of Iraq. Bob Drogin, "U.S. Suspects It Received False Iraq Arms Tips," *Los Angeles Times*, August 28, 2003, p. A1; and Douglas Jehl, "Agency Belittles Information Given by Iraqi Defectors," *New York Times*, September 29, 2003, p. A1.

145. Neither the United States nor Japan identified Aum Shinrikyo as posing a biological threat prior to the cult's March 1995 sarin gas attack in the Tokyo subway system. Pearson, "The Essentials of Biological Threat Assessment," pp. 79–81.

146. Erhard Geissler, John Ellis van Courtland Moon, and Graham S. Pearson, "Lessons from the History of Biological and Toxin Warfare," in Geissler and Moon, *Biological and Toxin Weapons*, pp. 260–263.

147. Sheldon H. Harris, *Factories of Death: Japanese Biological Warfare, 1932–1945, and the American Cover Up* (London: Routledge, 1994), pp. 160–204.

148. Adolf Hitler had forbidden the development of biological weapons and, as a result, Germany conducted very little offensive biological research during the war. Erhard Geissler, "Biological Warfare Activities in Germany, 1923–1945," in Geissler and Moon, *Biological and Toxin Weapons*, pp. 99–102.

149. Geissler, Moon, and Pearson, "Lessons from the History of Biological and Toxin Warfare," in Geissler and Moon, *Biological and Toxin Weapons*, pp. 259–260.

150. Interdepartmental Political Military Working Group, *Annual Review of United States Chemical Warfare and Biological Research Programs as of 1 November 1970*, p. 19.

by Vladimir Pasechnik, a high-ranking member of Biopreparat and the director of a key biological weapons research institute, following his defection to the United Kingdom. Based on his information, British and U.S. intelligence doubled their estimates of the number of Soviet biological warfare facilities.¹⁵¹

Iraq's biological weapons program under Saddam Hussein had been subject to both underestimation and overestimation by the United States. After the 1991 Gulf War, the Pentagon acknowledged that in contrast to its understanding of Iraq's chemical weapons capabilities, "intelligence assessments of the BW threat were much more tenuous."¹⁵² The United States had sufficient information to immunize portions of its forces against Iraq's primary biological warfare agents—*B. anthracis* and botulinum toxin.¹⁵³ The intelligence community, however, failed to identify many of Iraq's key biological facilities, including the main production plant at al-Hakam. According to a senior U.S. defense official, "Not even the most alarmed people thought Iraq was as advanced as they in fact were, that they had weaponized systems which were ready for use immediately. What it all adds up to is a program that was . . . very successfully hidden from the world's intelligence community."¹⁵⁴ In contrast, prior to the 2003 invasion of Iraq, the U.S. intelligence community believed that Iraq had stocks of biological agents as well as an active weapons program that was even larger and more advanced than it was in 1991.¹⁵⁵ Two trailers found after the invasion that resembled the mobile biological warfare production plants described by the United States before the war were called "the strongest evidence to date that Iraq was hiding a biological warfare program."¹⁵⁶ The State Department's intelligence bureau, engineers from DIA, and British biological weapons experts, however, have disputed this finding.¹⁵⁷ The controversy sur-

151. Bill Gertz, "Defecting Russian Scientist Revealed Biological Arms Efforts," *Washington Times*, July 4, 1992, p. A4; and R. Jeffrey Smith, "Russia Fails to Detail Germ Arms," *Washington Post*, August 31, 1992, p. A1.

152. Department of Defense, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, D.C.: U.S. GPO, 1992), p. 640.

153. Albert J. Mauroni, *Chemical-Biological Defense: U.S. Military Policies and Decisions in the Gulf War* (Westport, Conn.: Praeger, 1998), pp. 27, 86.

154. Quoted in R. Jeffrey Smith, "Iraq's Drive for a Biological Arsenal," *Washington Post*, November 21, 1997, p. A1.

155. Central Intelligence Agency, *Iraq's Weapons of Mass Destruction Programs* (Langley, Va.: Central Intelligence Agency, October 2002), pp. 2, 13–17.

156. Central Intelligence Agency and Defense Intelligence Agency, *Iraqi Mobile Biological Warfare Agent Production Plants*, May 28, 2003, p. 1, http://cia.gov/cia/reports/iraqi_mobile_plants/index.html.

157. The leading alternative explanation is that the trailers were used to produce hydrogen for weather balloons employed by artillery units. Judith Miller and William J. Broad, "Some Analysts

rounding the trailers highlights the ambiguity inherent in dual-use technologies and the challenges that this poses for conducting accurate and convincing threat assessments.

The difficulty in conducting such assessments has several implications. First, without adequate intelligence, it is more difficult to develop and deploy effective defenses. The agent-specific nature of most medical countermeasures and diagnostic and detection systems requires advance knowledge of the agents that an adversary is developing. As a result, it is “an established principle that offensive developments will always lead and drive defensive developments.”¹⁵⁸ In addition, without reliable intelligence indicating that an adversary’s biological warfare program poses a significant threat, it may not be possible to mobilize the resources for researching and fielding defenses against the threat.

Second, without credible intelligence, it is much more difficult to rally domestic and international support for diplomatic efforts to bring states into compliance with their biological disarmament obligations.¹⁵⁹ As the investigations into the Soviet and Iraqi biological weapons programs demonstrated, accurate intelligence is also crucial for planning and conducting inspections, as well as analyzing their results.¹⁶⁰

Third, in the absence of reliable intelligence, governments may engage in worst-case planning and undertake an exaggerated reaction to perceived threats.¹⁶¹ In light of the similarities between offensive and defensive biological warfare activities, interpreting uncertain intelligence in this way could lead

of Iraqi Trailers Reject Germ Use,” *New York Times*, June 7, 2003, p. A1; Peter Beaumont, “Iraqi Mobile Labs Nothing to Do with Germ Warfare, Report Finds,” *Observer*, June 15, 2003, <http://observer.guardian.co.uk/international/story/0,6903,977853,00.html>; Douglas Jehl, “Agency Disputes C.I.A. View on Trailers as Weapons Labs,” *New York Times*, June 26, 2003, p. A1; and Douglas Jehl, “Iraqi Trailers Said to Make Hydrogen, Not Biological Arms,” *New York Times*, August 9, 2003, p. A1.

158. Thomas Dashiell, “The Need for a Defensive Biological Research Program,” *Politics and the Life Sciences*, Vol. 9, No. 1 (August 1990), p. 89

159. Paradoxically, the reluctance to share sensitive information may limit the utility of the most useful types of intelligence on foreign biological warfare programs, such as that provided by spies and defectors. According to a participant in the debate on how to confront the Soviet Union with the information provided by Pasechnik in 1989, “We were worried about not being able to convince people because our evidence was secret.” Mangold and Goldberg, *Plague Wars*, p. 103.

160. David C. Kelly, “The Trilateral Agreement: Lessons for Biological Weapons Verification,” in Trevor Findlay and Oliver Meier, eds., *Verification Yearbook, 2002* (London: VERTIC, 2002), p. 104; and Tim Trevan, “Exploiting Intelligence in International Organizations,” in Zilinskas, *Biological Warfare*, pp. 207–224.

161. Robert Jervis, *Perception and Misperception in International Politics* (Princeton, N.J.: Princeton University Press, 1976), pp. 64–66.

to a security dilemma where states take actions to improve their own defense that inadvertently threaten other states.¹⁶² As the number and size of national biological defense programs increases in response to the threat of biological terrorism, other states may perceive these activities as threatening, thereby providing a justification for initiating or continuing a biological weapons program. Timely and dependable intelligence will not negate the threat posed by biological weapons, but it will help to calibrate defensive and diplomatic responses to these threats and reduce the likelihood of counterproductive actions.

Rebuttals and Responses

There are three possible objections to the preceding analysis. The first objection is that terrorists, not states, pose the predominant biological threat.¹⁶³ This article's state-centric perspective may appear to be outmoded in the post-September 11 world, but it is both important and practical. National programs to develop biological weapons are both more numerous and more advanced than those of their terrorist counterparts. In addition, states that are hostile to the United States and its allies sponsor many of these programs. Further, as a result of declassification, defections, and investigations, there is much more information available regarding the history and conduct of national biological warfare programs.

The second potential rebuttal is that biological weapons will have their greatest impact on the relations and conflicts of smaller and nonnuclear states. This objection is based on the false premise that these are the only types of states interested in biological weapons and that the strategic consequences of these weapons can be contained to this group of states. Virtually all of the nuclear states, however, developed biological weapons at some point—for purposes ranging from counterinsurgency to operational military employment to strategic attack. Even nuclear states with weak conventional forces may be tempted to use these weapons as force multipliers. In addition, possession of

162. Jervis, "Cooperation under the Security Dilemma," pp. 169–170.

163. On the threat of biological terrorism, see Brad Roberts, ed., *Terrorism with Chemical and Biological Weapons: Calibrating Risks and Responses* (Alexandria, Va.: Chemical and Biological Arms Control Institute, 1997); Richard A. Falkenrath, Robert D. Newman, and Bradley A. Thayer, *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, Mass.: MIT Press, 1998); and Jessica Stern, *The Ultimate Terrorists* (Cambridge, Mass.: Harvard University Press, 1999).

nuclear weapons will not necessarily deter the use of biological weapons by actors that do not believe they will be identified or that are insensitive to retaliatory threats. Moreover, the use of biological weapons in a regional conflict is likely to involve the ally of a major power and lead to outside intervention or escalation. Like a contagious disease, the security implications of biological weapons will affect some states more than others, but they spread easily and no state is immune.

The third likely objection is that because biological weapons have been used so rarely, this restraint is likely to hold. Therefore, despite their potential military utility, biological weapons will remain marginal in most states' national security calculations. Although modern biological weapons based on aerosol dissemination technology have not been successfully employed by states or terrorists, cruder weapons have been used in modern times.¹⁶⁴ There are also disturbing signs that the normative, operational, and political restraints that have limited the use of these weapons are weaker now than they were thirty years ago. Most of the states currently suspected of developing biological weapons are parties to the 1972 BWC, which illustrates the permeability of the normative barrier to proliferation.¹⁶⁵ The 2001 anthrax letter attacks, the first overt use of biological weapons, weakened the taboo against using disease as a weapon. In addition, advanced biotechnologies that can ameliorate problems in safely producing, storing, and handling these weapons as well as effectively employing them in combat are becoming increasingly available.¹⁶⁶ Further-

164. Japan and South Africa employed biological agents for sabotage and counterinsurgency operations. The white-ruled government of Rhodesia, now Zimbabwe, has also been implicated in similar activities. On Japan, see Harris, *Factories of Death*. On Rhodesia and South Africa, see Gould and Folb, *Project Coast*, pp. 24–30, 159–167; and Burger and Gould, *Secrets and Lies*, pp. 15–16, 32–39. In addition, nonstate actors have used biological weapons at least twice in the past twenty years. In 1984 the Rajneeshee cult in Oregon sickened 750 with *Salmonella typhimurium*, and in 2001 an unidentified perpetrator caused twenty-two casualties and disrupted the operations of the U.S. Postal Service and U.S. Senate with five letters containing spores of *B. anthracis*. Ronald Atlas, "Bioterrorism before and after September 11," *Critical Reviews in Microbiology*, Vol. 27, No. 4 (January 2002), pp. 359–361.

165. The State Department lists eight states as not being in compliance with the BWC: China, Cuba, Iran, Iraq, Libya, North Korea, Russia, and Syria. Department of State, *Adherence to and Compliance with Arms Control and Nonproliferation Agreements and Commitments* (Washington, D.C.: Bureau of Verification and Compliance, 2002), <http://www.state.gov/documents/organization/22466.pdf>.

166. Department of Defense, *Biotechnology and Genetic Engineering: Implications for the Development of New Warfare Agents* (Washington, D.C.: U.S. GPO, 1996); Jonathan B. Tucker, "The Future of Biological Warfare," in W. Thomas Wander and Eric H. Arnett, eds., *The Proliferation of Advanced Weaponry* (Washington, D.C.: American Association for the Advancement of Science, 1992), pp. 61–71; Steven M. Block, "Living Nightmares: Biological Threats Enabled by Molecular Biology," in Sidney D. Drell, Abraham D. Sofaer, and George D. Wilson, eds., *The New Terror: Facing the Threat of Biolog-*

more, the overwhelming conventional superiority of Western states and their allies provides dissatisfied actors with strong incentives to employ biological weapons as part of an asymmetric strategy that may outweigh the political and strategic hazards of using these weapons.¹⁶⁷ Leaders may calculate that they can use their biological weapons as force multipliers to accomplish a *fait accompli*, tailor their use of these weapons to avoid provoking regime-threatening retaliation, or conduct anonymous attacks and avoid retaliation. Extremist religious terrorist groups such as al-Qaeda and its affiliates that have emerged as direct threats to the United States and its allies are among those most likely to resort to unconventional weapons in their drive to inflict as many casualties and as much terror as possible. As with nuclear weapons, the lack of large-scale use of biological weapons since 1945 is a cause for celebration, but not grounds for complacency.

Conclusion

The global diffusion of dual-use biotechnology, coupled with strong incentives for revisionist states and extremist terrorist groups to harness this technology for malevolent purposes, poses a severe challenge to international peace and stability in the twenty-first century. As biological weapons become more capable and more accessible to a wider range of players, the strategic consequences outlined in this article—proliferation to dissatisfied actors, undermining of deterrence, obstruction of civilian oversight, and flawed threat assessments—should become more evident. This analysis yields four policy prescriptions for countering the growing danger posed by biological weapons.

First, defenses against biological weapons should be strengthened to make these weapons less effective and less likely to be used in future conflicts. Robust defenses against the most threatening agents and further improvements in vaccines, detection, physical defense, diagnosis, surveillance, therapy, and forensics could create sufficient uncertainty in the minds of potential attackers about the likelihood of success to deter such attacks.¹⁶⁸ Besides the sub-

ical and Chemical Weapons (Stanford, Calif.: Hoover Institution Press, 1999), pp. 39–75; and Robert P. Kadlec and Alan P. Zelicoff, “Implications of the Biotechnology Revolution for Weapons Development and Arms Control,” in Zilinskas, *Biological Warfare*, pp. 11–26.

167. Brad Roberts, *Biological Weapons in Major Theater War* (Alexandria, Va.: Institute for Defense Analysis, November 1998); and United States Commission on National Security/21st Century [Hart-Rudman Commission], *New World Coming: American Security in the 21st Century, Supporting Research and Analysis* (Washington, D.C.: United States Commission on National Security/21st Century, September 1999), p. 50.

168. For a biodefense research agenda, see National Research Council, *Making the Nation Safer: The*

stantial investment that must be made in research and development, medical countermeasures need to be stockpiled, and local public health and medical communities and military units need to be prepared to detect and respond to a biological attack.¹⁶⁹ At the same time, these efforts should be accompanied by transparency measures to ensure that these defensive programs are not misinterpreted by other states as threatening.¹⁷⁰ The use of biological weapons anywhere would further erode the taboo against these weapons everywhere. Therefore, these defensive innovations should also be made available internationally to reduce the incentives for any actor to develop or use these weapons.¹⁷¹ To the extent that the tools and technologies developed to defend against biological weapons are also useful in combating naturally occurring infectious diseases, this initiative would have humanitarian as well as security benefits.

Second, the capability to detect clandestine offensive activities and distinguish them from defensive and civilian activities is needed for three reasons: (1) to establish a foundation for verification, (2) to provide policymakers with insights into the capabilities and intentions of other states, and (3) to improve the effectiveness of defenses. Accurate and timely intelligence is crucial to achieving these objectives. Therefore, the United States and its allies should enhance the collection and analysis of intelligence regarding biological warfare programs by aggressively seeking human sources, exploiting open sources, and recruiting more academic and industry biotechnology experts. In addition, a major research and evaluation program is required to develop techniques and technologies that could be employed to investigate allegations of noncompliance on an ad hoc basis or as part of a verification regime. The difficulty that the United States has had in confirming its prewar intelligence on Iraq's biological weapons program highlights the urgent need for improvements in this field.

Third, the barrier to the acquisition of biological weapons should be raised by limiting access to dangerous pathogens, techniques, and research results applicable to the development of biological weapons.¹⁷² In addition, given the

Role of Science and Technology in Countering Terrorism (Washington, D.C.: National Academy Press, 2002), pp. 65–106.

169. For an overview of U.S. bioterrorism preparedness efforts, see Koblenz, "Biological Terrorism," pp. 97–173.

170. Barbara Hatch Rosenberg, "Defending against Biodefence: The Need for Limits," *Disarmament Diplomacy*, No. 69 (February–March 2003), <http://www.acronym.org.uk/dd/dd69/69op03.htm>.

171. I thank Paul Schulte for this point.

172. See Barletta, Sands, and Tucker, "Keeping Track of Anthrax," pp. 57–62; Gerald L. Epstein,

sophistication of the former Soviet biological weapons program, preventing the proliferation of biological weapons-related resources from Russia is essential.¹⁷³ Similar projects could also be useful in South Africa, Iraq, and other states unable to fully dismantle their former biological weapons programs. Enhanced cooperative nonproliferation efforts would complement efforts to strengthen biological defenses by slowing the progress of offensive programs and employing former weapons scientists in civilian or defensive research. These measures would not be able to prevent proliferation, but they could complicate terrorist access to biological weapons based on traditional pathogens and hinder the development of more sophisticated weapons by states.

Fourth, the norm against the development and use of biological weapons should be strengthened to reduce the motivations of states and terrorists to acquire these weapons and gain operational experience with them. One valuable step in this direction would be an international agreement that the development, production, transfer, and use of biological weapons, including unethical human experimentation, represents a crime against humanity and that perpetrators would be subject to international arrest and prosecution.¹⁷⁴

“Controlling Biological Warfare Threats: Resolving Potential Tensions among the Research Community, Industry, and the National Security Community,” *Critical Reviews in Microbiology*, Vol. 27, No. 4 (January 2002), pp. 321–354; and National Research Council, *Biotechnology Research in an Age of Terrorism: Confronting the “Dual Use” Dilemma* (Washington, D.C.: National Academies Press, 2003). On the potential drawbacks of these types of proposals, see Stern, “Dreaded Risks and the Control of Biological Weapons,” pp. 89–123; and Kendall Hoyt and Stephen G. Brooks, “A Double-Edged Sword: Globalization and Biosecurity,” *International Security*, Vol. 28, No. 3 (Winter 2003/04), pp. 123–148.

173. See Amy E. Smithson, *Toxic Archipelago: Preventing Proliferation from the Former Soviet Chemical and Biological Weapons Complexes* (Washington, D.C.: Henry L. Stimson Center, December 1999).

174. For proposals along these lines, see Matthew Meselson and Julian Robinson, *A Draft Convention to Prohibit Biological and Chemical Weapons under International Criminal Law* (Cambridge, Mass.: Harvard Sussex Program on CBW Armament and Arms Limitation, March 2003), <http://www.sussex.ac.uk/spru/hsp/IntroConvRev1.pdf>; and Jonathan Moreno, *Undue Risk: Secret State Experiments on Humans* (New York: Routledge, 2000), pp. 294–297.