CHAPTER ONE

# Introduction

## *Identifying Biological Agents, Characterizing Events, and Attributing Blame*

ANNE L. CLUNAN

The use of biological warfare (BW) agents by states or terrorists is one of the world's most frightening security threats. Killers such as anthrax, smallpox, botulism, tularemia, viral hemorrhagic fevers, and plague, and incapacitating diseases such as brucella, salmonella, typhoid, and shigellosis—the diseases commonly listed as BW agents—are invisible. Their effects may take days to manifest. BW agents can vary widely in the effects they can produce on humans—from incapacitating a population to causing mass deaths—and on animals and agriculture. Those who use BW may have impact without detection, and this possibility makes it more difficult for states to deter other states and terrorists from using biological weapons.

The risk that BW attacks might never be traced back to a particular source is greater than for nuclear or even chemical attacks, in part because BW attacks may look like those of naturally occurring disease. Historically, attributing blame for BW use has been fraught with controversy and may take a very long time. Only in 2002, for example, did a court in Japan formally acknowledge the Imperial Japanese Army's deliberate infection of Chinese prisoners and citizens with bubonic plague in 1940–42. Controversy still exists about aspects of many other alleged cases of BW, including the "Yellow Rain" episode in Southeast Asia. Even for other incidents known to be biological warfare or terrorism, such as the 2001 anthrax letters in the United States, the perpetrator remains unknown (see Table 9.1 for a summary of twentieth-century BW incidents, claims, and attempts).

The difficulties involved in determining whether terrorism, warfare, or disease is the source of a biological event may give the initiators of a BW release confidence that they might get away with a BW attack without being blamed or even suspected. Improved capabilities for accurate and rapid attribution of BW use are therefore central to the two key strategies available to policymakers: deterring an attack through the threat of retaliatory punishment, and deterring through denial of impact, by mitigating the consequences of an attack on the state and society.

Deterrence may require government capabilities to determine, first, what the agent of disease might be; second, whether a biological outbreak is terrorism or warfare, or is instead a naturally occurring disease; and third, if so, who is to blame. These are the three elements of the process of attribution, which are spelled out later in this chapter. First, however, I spell out how BW deterrence works, before explaining how the process of attribution works and how it may contribute to deterrence. The chapter then concludes with an overview of the rest of the book.

## BW Mitigation and Deterrence

Enhanced mitigation of the effects of BW should have a deterrent effect on potential BW attackers: societies that are clearly capable of substantially limiting the consequences of a biological attack are much less likely to be targeted, since the desired outcome of the attack is less likely to be achieved. To succeed at such deterrence by denial, governments must be capable of determining, quickly and accurately, which biological agent has been used (this is step one of the three-step attribution process). Identification of the agent can increase the effectiveness of medical intervention, minimizing the public disruption and damage that are the aims of would-be attackers. Knowing whether the attack was deliberate and understanding the motives behind it (the second element of the attribution process) may also help emergency responders and public-health officials allocate appropriate resources and capabilities during the outbreak, and to prepare for further outbreaks. Capability of making such a determination may thus contribute to deterrence by denial, and is essential to deterrence by punishment.

Deterrence by punishment hinges on knowing whom to blame, the third element of the attribution process. Although nuclear weapons bear the unmistakable “signature” of the countries that manufactured their nuclear material, biological agents are unlikely to carry such signatures. Biological warfare agents could be found “in the wild,” and rapid advances in biotechnology mean that new biological agents are being created in the commercial and scientific spheres that could also be used as weapons.[1]

### *Knowledge Makes for Better Policy*

In the face of such challenges, the literature on biological warfare attribution is underdeveloped. Further, most of it predates the 2001 anthrax attacks in the United States and the Bush Administration’s decision to withdraw from negotiations on a verification protocol for the Biological and Toxin Weapons Convention (BWC). Some studies have examined the nature of the BW threat, offered histories of state and non-state actors’ BW programs, and explored the potential and the pitfalls of biological defensive efforts.[2] Some have focused on assessing the threat posed by biological weapons.[3] Notable is *Biological Weapons: Limiting the Threat* which, however, focuses on BW challenges primarily from a public-health perspective.[4] Other works examine how biological warfare might be carried out, and inter-state efforts at arms control and nonproliferation.[5] *Toxic Terror* concentrates on the types and nature of sub-state actors, such as terrorist groups, that have used biological or chemical weapons.[6] One recent work, *Scientific and Technical Means of Distinguishing Between Natural and Other Outbreaks of Disease*, focuses only on part of the BW attribution problem—distinguishing between natural and deliberate attacks—but does not examine the many sociopolitical factors that affect the attribution process.[7]

Much of this literature points out that the difficulty in identifying a biological warfare attack and accurately attributing its use hinders public-health responses, and also impedes deterrence of BW attacks, since deterrence requires knowing whom to blame. Little attention, however, has been devoted to understanding how to improve attribution of BW events, and much of that has focused on the scientific and technical difficulties and on biological, technical, legal, and criminological issues.[8] Yet, as this book shows, BW attribution is as much a political problem as it is a scientific one.[9]

This book seeks to fill the gap, addressing political, military, legal, and scientific challenges involved in determining when biological weapons have been used and who has used them. Internationally recognized experts offer detailed analyses of the most significant allegations of BW use from the Second World War to the present, assess past attempts at attribution of unusual biological events, and draw lessons from these cases for current attribution policy. They identify political, social, and economic as well as scientific factors that affect when, how, and with what success states may undertake attribution. A major contribution of this book, and the substance of this chapter, is to offer a definition of the multifaceted problem of tracking down the perpetrators of biological warfare, and analysis of the forces that shape each phase of the attribution process. This chapter next outlines the three steps that make up the process of attribution.

## The Three Steps of the Biological Weapons Attribution Process

The problem of identifying an intentional use of biological weapons and knowing whom to blame has three interrelated parts, each with its own particular requirements: identification of the biological agent(s) responsible for an event; characterization of the event as intentional or unintentional; and attribution of use to a specific perpetrator. These three parts—identification, characterization, and attribution—make up what is referred to in this volume as the BW attribution process.[10] For example, in the U.S. anthrax cases (see Chapter 2 by Leonard Cole), identification of the agent as anthrax was the first step, and the most important in terms of public-health response. It was relatively simple to identify the agent used in the attacks and to characterize the event as deliberate, since the envelopes containing the anthrax also contained letters announcing its presence. As in most cases, however, attribution to a specific perpetrator is more difficult. Questions still remain about the strain of anthrax used and the method by which it was processed. Answering those questions would significantly narrow the field of possible perpetrators, but the case remains unresolved as of this writing.

In the event of an overt attack with military-grade weapons, the three-part process of attribution might be relatively uncomplicated.[11] However, a covert attack or one using non-military-grade strains of a BW agent would make the attribution process much more difficult.[12] The nature of biological agents, as well as the politics that surround characterization and attribution of a biological event, contribute significantly to the attribution problem. The cases described in this volume suggest that any effort to attribute BW use must attempt to accomplish the three elements of the attribution process within some agreed range of how much of the inevitable uncertainty is acceptable, aiming to avoid bias and preserve public trust.

The question of the degree of acceptable uncertainty highlights the crucial issue of what standards of evidence are necessary for BW attribution. In all three parts of the attribution problem, both legal-scientific and political standards for information are important. Throughout the BW attribution process, actors must attempt to meet legal and scientific standards for the collection of evidence if any attribution of use is to be credible internationally or in a court of law. In the United States, for example, public-health agencies may conduct searches without judicial warrants, but resulting evidence might be excluded from criminal cases if deemed the fruit of warrantless or unconstitutional searches. Legal evidentiary standards may govern search and seizure, wiretapping, or other forms of information collection. Close cooperation between law-enforcement and public-health officials is therefore required in order to meet appropriate standards for the collection of evidence and the custody of evidence.[13] Scientific standards require, among other things, the replicability of tests by independent researchers and establishing a degree of confidence in the results of analysis linking agent with disease and disease with intentional attack.

Both legal and scientific standards require that the evidence is demonstrably not tampered with. However, ensuring a properly documented chain of custody of evidence can be extraordinarily difficult in BW cases. Samples, control samples, and physical evidence must be collected, preserved, and transferred in such a manner as to protect them from contamination, to document where they came from, and to make it clear that they have not been tampered with. Yet in many cases, the first responders to a biological event may not know that it may become the subject of a BW investigation. The first people to collect what may become evidence may be the victims, or humanitarian relief workers operating in refugee camps, or emergency room doctors and primary-care physicians. As Chapters 4 and 5 on Yellow Rain in this volume make clear, there is considerable potential for controversy regarding the scientific validity of data, for both scientific and political reasons.

Charges of BW use must also be politically persuasive. The standard of proof must be sufficiently high that it allows a decision maker to make a well-informed decision on whether or not to take steps to apprehend or retaliate against the perpetrator. As deterrence rests on credible threats to retaliate, attribution must achieve a degree of certainty that allows policymakers to respond, but such responses must be widely viewed as legitimate, not misplaced or politically motivated. Given the domestic and international need for any retaliation to be seen as legitimate, meeting very demanding legal-scientific standards should be the goal in all cases, even though it may not be reached. Particularly in cases where a state alleges that a foreign actor used BW, the state must, at a minimum, act on the basis of a scientifically valid preliminary attribution process and show its willingness to have its investigation and methods reviewed by outside experts, and even better, to accept a multilateral investigation of the alleged attack under international auspices such as those of the United Nations. Only under these conditions are allegations of a biological weapons attack likely to be credible. If the accusing state has conducted its own investigation according to rigorous scientific standards, then it will have little reason not to invite outside scrutiny of its charges. Such standards would also serve to discourage states from making false allegations, such as those highlighted in Chapters 6 and 7, in the hopes of politically shaming an opponent, as any allegation that is not accompanied by openness to independent and multilateral investigation would be suspect.

### *Identification of the Disease Agent*

The key biological agents most associated with warfare and terrorism, according to the World Health Organization (WHO), are *Bacillus anthracis* (anthrax), *Clostridium botulinum* (botulism toxin), *Yersinia pestis* (bubonic, septicemic, and pneumonic plague), *Francisella tularensis* (tularemia), and *Variola major* virus (smallpox). The U.S. Centers for Disease Control and Prevention (CDC) lists these and viral hemorrhagic fevers (filoviruses such as Ebola and Marburg, and arenaviruses such as Lassa and Machupol) as the disease agents of most concern because of their ease of human-to-human transmission (contagiousness), high mortality rates, potential for public panic and social disruption, and specialized public-health requirements. Less dangerous agents that are also listed by the CDC as potential BW agents include *Brucella* (brucellosis or undulant fever), *Clostridium perfringens* (epsilon toxin), *Salmonella typhimurium* and *Salmonella entriditis* (salmonella), *Escherichia coli* O157:H7, *Shigella sonnei*, *flexneri,* and *dysenteriae* (shigellosis), *Salmonella typhi* (typhoid fever), *Vibrio cholerae* (cholera), and emerging infectious diseases such as Nipah virus and hantavirus.[14]

The central issue in identifying a BW agent is distinguishing signals—pertinent information—from background noise, such as poor public-health and poor environmental conditions, the presence of diseases with symptoms similar to potential BW outbreaks, and the normal disease patterns of the locale.[15] As Leonard Cole notes in Chapter 2, in the U.S. anthrax case, the flu-like symptoms associated with inhalation anthrax led to many misdiagnoses of infected postal workers, despite widely broadcast signals that anthrax had been found in letters. In this case, first responders did not separate signals from noise, the disease was misidentified, and deaths resulted. Many of the diseases listed as BW agents have symptoms that may be confused with other common or endemic diseases, making it difficult to identify the disease agent correctly, especially as diagnosticians are trained to focus on the most likely hypotheses for the appearance of symptoms, rather than on rare or exotic causes.

Identification of the agent causing a disease is largely a medical and scientific issue. The primary actors are likely to be emergency room doctors, poison control centers, primary care physicians, veterinarians, humanitarian aid workers, epidemiologists, disease specialists, and biologists. Scientific knowledge, and especially technological advances in DNA sequencing, now allow pathogen identification at the strain level, which should generally meet law-enforcement standards of evidence. However, developments in genetic engineering mean that new agents, or agents that do not conform to known epidemiological patterns, may be created that would make characterization and attribution much more difficult. In such cases, information from public-health officials, academic experts, and the biotechnology community may be necessary to identify where a particular strain originated. However, as Chapters 4 and 5 on Yellow Rain suggest, it may be neither easy nor simple to reach agreement on what biological or toxic agent may be involved, even within the medical and scientific community let alone the political community.

A biological agent, once introduced, generally first manifests as a health problem, and is only detected if victims seek medical care. Healthcare professionals are therefore the frontline forces in biological terrorism and thus in BW attribution, particularly at the identification stage.[16] These would include veterinarians or, in the case of plant pathogens, plant biologists. Such first responders will probably be the ones to notice that an unhealthy patient, animal, or crop presents particular symptoms, and to identify and report disease outbreaks.[17] Domestic detection of a disease outbreak requires pooling information gathered by healthcare providers or other first responders, infection control practitioners, and health departments. Internationally, this list includes disease surveillance systems, national health ministries, international agencies such as the WHO and the Animal Health Organization (OIE, Office des Epizooties), and non-governmental organizations (NGOs), particularly humanitarian aid organizations, as well as environmental monitors (who may be the first to note the appearance of endemic, novel, or genetically modified organisms).[18]

The effectiveness of national or international surveillance systems rests primarily on the type and nature of pathogen involved. Agents that are not transmitted directly from human to human (non-contagious agents), such as anthrax, are often detected only after everyone has already been exposed. For contagious agents such as smallpox, early detection could limit the spread of infection. However, speed of detection also varies with whether the infectious pathogen spreads fast (like cholera, whose incubation period is under 1–5 days), or slowly (symptoms of inhalation anthrax, for example, may appear 8 days to 2 months later, while smallpox has an incubation period of 10 days, and symptoms of HIV/AIDs may take years to manifest).[19]

From the perspective of attribution, deterrence, and international law or treaty enforcement, early detection of BW is vital for both infectious and non-infectious pathogens, as it increases the likelihood of collecting evidence from living victims and identifying how the pathogen was introduced or delivered. Identification is much more difficult when the investigation occurs in environments where access is limited or impossible. The Yellow Rain case illustrates the difficulty of collecting and analyzing uncontaminated samples from a conflict zone or other non-permissive environments. Lack of early access to the site of alleged attacks hampered the interviewing of eyewitnesses and victims as well as the collection of physical evidence.

### *Characterization of Outbreak as Intentionally Caused or Not*

The second analytic step in the process of BW attribution is characterization of the outbreak of a disease as deliberate, accidental, or naturally occurring.

Epidemiologists, public-health officials, and law-enforcement officials must determine whether reported patterns of disease outbreak are suspicious. Yet the majority of such reports are likely to represent unintentional biological events, or "noise," from a BW attribution perspective, especially if the biological pathogen occurs naturally or is endemic to an area. Over an eleven-year period in the United States, the CDC suspected only six of 1,099 reported outbreaks affecting human health to be potentially intentional.[20] Even in some cases involving a listed biological agent, healthcare professionals might not even report the event if the disease occurs naturally in their locale.[21] Characterizing outbreaks as intentional attacks or endemic diseases requires baseline data on the population in question. Domestic and international disease surveillance systems provide vital information for such a determination.

Characterization is primarily a medical, scientific, and investigative process, but it can be affected, usually adversely, by politics. As shown by the 1994 outbreak of plague in India (described by Barrett in Chapter 3), rumors about the source of an outbreak and lack of public trust in political officials can hamper efforts to characterize the outbreak. Cases involving charges against or by the United States (discussed in Chapters 4 by Meselson and Robinson, 5 by Katz, 6 by Leitenberg, 7 by Zilinskas, and 10 by Harris) illustrate how geopolitics frequently cloud characterization.

Even when politics and rumor are not involved, and even under permissive conditions, the characterization element of the attribution process can be quite lengthy. The CDC has found that it took as long as 26 days for suspicious events to be reported to the CDC, even in cases where the agents involved—brucella and shigellosis—were listed by the CDC as potential biological warfare agents.[22] Only in the case of suspected anthrax use was reporting time less than one day. If a disease occurs naturally in a region, reporting may be delayed as long as a year, or not reported at all, even for a disease listed as a potential BW agent.[23] This suggests that disease outbreaks that are not associated with specifically identified biological warfare agents are even less likely to be reported rapidly.[24] Because BW attacks are rare, the possibility that a BW agent is involved may not even occur to first responders and so they might not report it until much later, if at all.

However, if a large number of people suddenly contract a disease for which there is no obvious natural source, then alarm bells may ring. For example, when at least 750 people were afflicted with salmonella poisoning in 1984 in The Dalles, Oregon, the agent was traced to as many as ten restaurant salad bars. However, even though foul play was immediately suspected, no one could imagine a motive for such an attack. The case was not amenable to available technical solutions, as the disease strain found was also used in many commercial clinical laboratories. No common supplier, food item, water supply, or distribution could be identified. The investigation therefore stalled.[25] Only a year later, when the leader of the cult publicly accused one of its members of poisoning the local population, did blame focus on the Rajneeshee cult, resulting in further investigation and the conviction of three cult members.[26]

Epidemiology alone, therefore, is insufficient to determine whether an outbreak of disease is intentional or not; traditional forensic analysis must also be incorporated.[27] This requires that analysts have sufficient knowledge of the conditions on the ground to assess factors beyond clinical science, such as local political conditions, migration patterns, social contacts, and other factors such as those described by Barrett in Chapter 3. The problem of characterizing and attributing use of biological agents has spurred interest in forensic microbial epidemiology, which "combines principles of public-health epidemiology and law enforcement to identify patterns in a disease outbreak, determine the pathogen involved, control its spread, and trace the microorganism to its source—the perpetrator."[28] In the United States, this new discipline (variously referred to as forensic microbial epidemiology and microbial forensics, or more broadly as forensic epidemiology) has led to a rapidly evolving and deepening relationship between public-health experts and law-enforcement officials, fostered through training programs sponsored by the CDC.[29]

Characterizing a biological event as intentional or unintentional may require matching public-health data with information collected through local, national, and international law-enforcement and intelligence communities, such as surveillance of criminal and terrorist organizations and state-sponsored biological programs.[30]

However, even forensic investigation may be unable to characterize a biological event accurately. Socioeconomic, demographic, and political trends may affect the process of determining whether an event was intentional or unintentional. As Ronald Barrett's analysis of the human ecology of plague in India indicates, knowledge of local conditions may have to be very broad, detailed, and diverse. Correctly characterizing the plague outbreak in that case required knowledge of the socioeconomic conditions that gave rise to a migrant labor force by which the disease spread. Detailed analysis of historical and current social, economic, and political data was essential to determining that the plague was an unintentional outbreak resulting from labor migration and demographic trends, rather than, as widely believed for a time, a terrorist attack by one ethnic community against another.

### *Attribution to a Perpetrator: Knowing Whom to Blame*

The third part of the problem of BW attribution is fingering the person, organization, or government that perpetrated an attack. This involves the law-enforcement, intelligence, and policy communities. The process may be conducted by domestic law-enforcement officials, foreign intelligence and foreign-policy agencies, or by all three.

With heightened concerns over the possible use of biological weapons by terrorists and "rogue states," deterring the use of biological weapons use has increased the importance policymakers attach to the attribution process.[31] Policymakers recognize that attribution, if done accurately and quickly, significantly increases the chances of holding states and non-state actors accountable for the use or supply of BW. This supports the classic aims of deterrence by punishment, which require that states fear retaliation for the use or supply of BW and that non-state actors, too, face credible threats of detection and punishment.

In practice, the three parts of the attribution process outlined here may not be distinctly separate: as the case studies in this volume show, outbreaks are rarely investigated in the analytic sequence of identification, characterization, and attribution. Rumors, panic, and politics often delay and complicate the process, and as a result, critical samples and other evidence may be mishandled, altered, or otherwise compromised.

## How This Book Is Organized

Part I of this book features empirical case studies from the Second World War to the present, while Part II draws lessons and generates policy recommendations.

*Case Studies: Part I*

The case studies include actual uses of BW agents, alleged uses, fabricated reports of BW use connected with real disease outbreaks and staged "evidence," and natural, non-deliberate occurrences of disease that implicate agents that could have been used intentionally.[32] Two chapters address confirmed cases of BW use: the 2001 dissemination of anthrax through the U.S. postal system, and the use of BW agents by the Japanese Imperial Army in China in the 1930s and 1940s. The contentious "Yellow Rain" case of the late 1970s and early 1980s—in which the U.S. government alleged that Vietnamese forces and the Soviet military used trichothecene mycotoxin as a weapon—is the subject of two chapters. Another chapter addresses an unintentional outbreak of plague in India that was initially suspected to be a bioterrorist attack. Two chapters discuss false allegations accusing the United States of BW use; one case covers events during the Korean War, and the other Cuban allegations starting in the 1960s.

In Chapter 2, Leonard Cole discusses a confirmed case of BW agent use, the U.S. anthrax letters of 2001. This case overturned many assumptions about the use of a biological agent for hostile purposes, surprising U.S. authorities on a number of fronts, from the method of delivery and breadth of contamination to the health effects on infected survivors. Who committed these attacks, and why, remain unknown; where the spores originated and how they were processed are still a matter of controversy. Given that the attacks were openly carried out in a permissive environment and in a country with significant scientific and technological capacity, the surprises and failures experienced in the U.S. anthrax case bear careful study, as it represents perhaps the best case scenario for BW attribution.

Chapter 3 by Ronald Barrett examines the 1994 plague outbreak in Surat, India, in which 1,000 people or more may have had pneumonic plague, and more than three dozen died of it. Evidence strongly indicates that the plague occurred through natural and non-deliberate factors. Initially, however, rumors of chemical and biological terrorism impeded early detection and treatment programs. They also delayed follow-up efforts to prevent future outbreaks. The 1994 plague and its aftermath hold important lessons for the attribution and control of infectious diseases, whether or not they are deliberately initiated.

Chapter 4, by Matthew Meselson and Julian Perry Robinson, and Chapter 5, by Rebecca Katz, both examine reports of the late 1970s and early 1980s of "Yellow Rain," alleged to be trichothecene mycotoxin weapons attacks, in Southeast Asia and Afghanistan. These allegations sparked the first large-scale investigation conducted by the United States into allegations of chemical or biological weapons use. Although the United States officially found that toxin weapons had been used in Southeast Asia and Afghanistan, a number of scientists and experts, including Meselson and Robinson and some British government experts, concluded that trichothecene mycotoxin was not present. Katz argues on the basis of newly declassified documents, however, that while trichothecene mycotoxin may not have been the weapon used, some form of toxin weapon was likely used. Both chapters discuss the lessons of the Yellow Rain case for improving capabilities for accurate and timely BW attribution, with attention to difficulties that can arise during an investigation, especially in a conflict zone. These include problems in obtaining good data, the challenges in confirming use and in reaching an attribution determination in the absence of good data, and the consequences that flow from these difficulties.

The most prominent accusation of biological weapons use in the twentieth century was made during the Korean War against the United States, as Milton Leitenberg recounts in Chapter 6. China, North Korea, and the USSR charged that the United States had used a wide range of biological warfare agents in China and North Korea. Based on documents from the former Soviet archives and other evidence earlier unavailable, Leitenberg concludes that the charges were contrived and fraudulent. The chapter shows how false allegations and attributions of BW use can be manufactured, and draws lessons for the means by which false allegations might be refuted.

Since the 1960s, Cuban politicians, led by Castro, have repeatedly alleged that the United States or its proxies deliberately carried out biological warfare attacks against Cuba's human, animal, and plant populations. However, as Raymond Zilinskas shows in Chapter 7, the Cuban government has never backed up its charges with any scientific evidence. Zilinskas analyzes the Cuban allegations, and suggests that they were lodged largely for domestic and international political reasons. The chapter discusses the implications of the Cuban actions for international biological arms control and emphasizes the role of the UN Secretary-General in future BW investigations.

In Chapter 8, Jeanne Guillemin examines China's 1942 allegations of Japanese biological warfare. The accusation that the Japanese army had attacked Chinese civilians with germ weapons represents the first modern historical dispute that turned on the question of natural versus deliberate epidemics. Instead of investigating China's claim that thousands of civilians had been infected and many killed by Japan's deliberate use of plague-infected fleas, the United States chose to offer immunity to Japan's BW scientists in exchange for information on its biological warfare program. The suppression of this information from war-crimes proceedings represents a missed opportunity to establish criminal liability under international law for individuals who commit war crimes involving BW; the gap remains unfilled to this day.

Gary Ackerman and Victor Asal provide a quantitative and comparative overview of confirmed or suspected cases of BW agent use. Chapter 9 discusses the available data sources, their comprehensiveness, and the credibility of the information they provide. It provides a compilation of data on all 31 confirmed and alleged BW uses of the twentieth century. They find that the number of confirmed BW cases produced far fewer casualties than naturally occurring disease outbreaks, though they warn that advances in biotechnology may make biological warfare more effective in the future. Their chapter concludes that, in the absence of consistent and reliable data on BW use, efforts to understand and improve BW attribution must rely on qualitative analyses, such as those carried out in the case studies elsewhere in this volume.

All of the case studies in the first part of the book describe what mechanisms were available and what steps were taken by government officials, quasi-governmental bodies, and non-governmental experts to identify the actors responsible for the events. They also suggest steps that might have facilitated more rapid and definitive identification and attribution of BW use. They highlight how political context and overarching strategic goals often hinder BW attribution efforts.

### *Lessons and Recommendations: Part II*

Part II of the volume draws lessons from the cases and generates policy recommendations. It also looks to the future in its assessment of how states in the post–9/11 world are organizing to meet this challenge. Two chapters assess U.S. and British policies regarding BW attribution. Another evaluates the available multilateral tools for BW attribution and the reforms required to make them more effective. The penultimate chapter outlines methodologies and requirements for information-sharing and alerts within and across national agencies, the private sector, foreign governments, and international organizations such as the WHO, OIE, and the UN Food and Agriculture Organization (FAO).

Chapter 10 by Elisa Harris examines U.S. efforts to investigate the use of biological weapons in the Yellow Rain and the more recent anthrax letters cases, as well as the U.S. approach to attribution in cases where the United States has been accused of BW use, during the Korean War and by Cuba. She draws lessons from these and other cases to offer recommendations for future U.S. policy toward investigating and attributing the use of biological weapons, in particular the need for independent and multilateral investigations that would give attributions of BW use political legitimacy.

Graham Pearson assesses United Kingdom policies regarding biological weapons in Chapter 11. He notes that the UK has long focused on dissuading would-be state possessors of biological weapons, rather than on evaluating or determining whether an outbreak of disease has been intentional or natural, both because there have been few attempted uses, and because responses after use would not be as effective. Since the attacks of September 11, 2001, however, the UK has increased its attention to non-state possession and use, increasing the importance of evaluation and determination of an outbreak. Pearson concludes that more effort should focus on deterring states and non-state actors from acquiring BW.

In Chapter 12, Jonathan Tucker examines multilateral approaches to the investigation and attribution of biological weapons use, including a mechanism under the United Nations secretary-general. At the request of a member state, he or she may dispatch a group of experts to investigate an alleged chemical or biological attack. This procedure was established in 1980 in response to charges that the Soviet Union and its allies were using a toxic agent ("Yellow Rain") in Southeast Asia and Afghanistan; subsequent UN investigations of alleged chemical warfare took place during the Iran-Iraq War of the 1980s and in Mozambique and Azerbaijan in 1992. Tucker examines the successes and failures of these investigations, as well as other procedures under the BWC and the Chemical Weapons Convention, and suggests how they might be strengthened.

In Chapter 13, Anne Clunan explores how national, subnational, and transnational information networks may offer a crucial capacity for timely and accurate attribution of BW use. She assesses policy and trust issues involved in moving from a "need-to-know" limitation to a "need-to-share" presumption to facilitate quick and accurate determination of whether BW has been used and by whom. It surveys the perspectives of critical stakeholders in the attribution process, including policymakers, the intelligence community, business sectors, non-governmental organizations, and first responders and other public-health agents—who usually have first-hand knowledge of the event and the victims—as well as intergovernmental organizations.

Chapter 14 by Susan Martin and Anne Clunan concludes the book by drawing lessons from the preceding chapters regarding the identification, characterization, and attribution of biological weapons use. It finds that, for attributions of BW use to be politically credible, they must be based on investigations that are scientifically sound and which establish with a high degree of confidence that a particular culprit perpetrated a biological weapons attack. The development of capabilities for conducting all three phases of a BW investigation enhance both a state's ability to deter by the threat of punishment and its capacity to deter by denial (reducing the consequences of attack). Enhanced identification, characterization, and attribution capabilities increase the likelihood that a perpetrator will be identified and can therefore be punished, while improvements in the public-health system that facilitate accurate and timely BW attribution, such as epidemiological surveillance, sanitation, vaccination, and information-sharing programs, serve to reduce the loss of life and societal disruption that BW attackers seek.

## Notes

The views expressed in this chapter do not represent the official position of the Department of Defense or the U.S. government, but are the sole responsibility of the author.

1. Rocco Casagrande, "Biological Terrorism Targeted at Agriculture: The Threat to U.S. National Security," *Nonproliferation Review* 7, 73 (Fall–Winter 2000): 92–105; René Gottschalk and Wolfgang Preiser, "Bioterrorism: Is It a Real Threat?" *Medical Microbiology and Immunology* 194, 3 (May 2005): 109–14; James B. Petro, Theodore R. Plasse, and Jack A. McNulty, "Biotechnology: Impact on Biological Warfare and Biodefense," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 1, 3 (September 2003): 161–68.

2. Recent histories of biological warfare are Jeanne Guillemin, *Biological Weapons: From the Invention of State-sponsored Programs to Contemporary Bioterrorism* (New

York: Columbia University Press, 2006); and Mark Wheelis, Lajos Rozsa, and Malcolm Dando, eds., *Deadly Cultures: Biological Weapons since 1945* (Cambridge, MA: Harvard University Press, 2006).

3. Richard A. Falkenrath, Robert D. Newman, and Bradley A. Thayer, *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, MA: BCSIA/MIT Press, 1998); Milton Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat* (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2005); Anthony Cordesman, *The Challenge of Biological Terrorism* (Washington, DC: Center for Strategic and International Studies, 2005); and Sidney D. Drell, Abraham D. Sofaer, and George D. Wilson, eds., *The New Terror: Facing the Threat of Biological and Chemical Weapons* (Palo Alto, CA: Hoover Institution Press, 1999).

4. Joshua Lederberg, ed., *Biological Weapons: Limiting the Threat* (Cambridge, MA: BCSIA/MIT Press, 1999).

5. Raymond Zilinskas, ed., *Biological Warfare: Modern Offense and Defense* (Boulder, CO: Lynne Rienner, 1999).

6. Jonathan Tucker, ed., *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, MA: BCSIA/MIT Press, 2000).

7. Malcolm Dando, Graham S. Pearson, and Bohumir Kriz, eds., *Scientific and Technical Means of Distinguishing Between Natural and Other Outbreaks of Disease* (Norwell, MA: Kluwer Academic Publishers, 2001).

8. Alexander Kelle, Malcolm R. Dando, and Kathryn Nixdorff, eds., *The Role of Biotechnology in Countering BTW Agents* (Norwell, MA: Kluwer Academic Publishers, 2001); and Luther E. Lindler, Frank J. Lebeda, and George Korch, eds., *Biological Weapons Defense: Infectious Disease and Counterbioterrorism* (Totowa, NJ: Humana Press, 2005).

9. For an introduction to the many epidemiological and political issues hindering BW attribution inspired by the project that produced this volume, but which focuses on anthrax, see Elizabeth Stone Bahr, "Biological Weapons Attribution: A Primer," Master's Thesis, Naval Postgraduate School, June 2007.

10. This understanding of "attribution" as identification of a perpetrator and "attribution process" as encompassing the three elements of identification of a BW agent, characterization as intentional or unintentional, and attribution to a perpetrator is distinct from, and broader than, the forensic-science definition of attribution, which limits attribution to mean that a piece of evidence did in fact originate from a source of known origin to a high degree of scientific certainty to the exclusion of all other sources. I thank Randall S. Murch for bringing this distinction to my attention.

11. Even investigations of suspected overt use are not simple. Concerns over the possible use of biological weapons against U.S. and coalition forces during the 1990 Gulf War led to detailed investigations that ultimately found no evidence that any biological weapon was used, but sampling problems, particularly issues about the chain of cus-

tody of the samples, plagued the operation. See U.S. Department of Defense, "Close-Out Report: Biological Warfare Investigation," February 13, 2001, 20001011-0000001 Ver. 1.1, <http://www.gulflink.osd.mil/bw_ii/>; and U.S. Department of Defense, "Information Paper: Medical Surveillance During Operations Desert Shield/Desert Storm," November 6, 1997, 1997197-0000-052, <http://www.gulflink.osd.mil/nfl/>, both accessed June 21, 2006.

12. On the covert aspect, see Falkenrath, Newman and Thayer, *America's Achilles' Heel.*

13. Goodman et al., "Forensic Epidemiology," 684–700.

14. Centers for Disease Control and Prevention, "Bioterrorism Agents/Diseases," *Bioterrorism*, <http://www.bt.cdc.gov/agent/agentlist-category.asp>, accessed March 22, 2007.

15. World Health Organization, "Specific Diseases Associated with Biological Weapons," *Epidemic and Pandemic Alert and Response (EPR)*, <http://www.who.int/csr/delibepidemics/disease/en/>, accessed March 22, 2007.

16. David A. Ashford, Robyn Kaiser, Michael E. Bales et al., "Planning against Biological Terrorism: Lessons from Outbreak Investigations," *Emerging Infectious Diseases* 9, no. 5 (May 2003), <http://www.cdc.gov/ncidod/EID/vol9no5/02-0388.htm>, accessed June 21, 2006.

17. Ashford et al., "Planning."

18. Barry Kellman, "The International Matrix for Biosecurity," paper presented at the Los Angeles Terrorism Early Warning Group Conference on Terrorism, Global Security, and the Law, Santa Monica, CA, June 1–2, 2005.

19. Michael A. Stoto, "Syndromic Surveillance," *Issues in Science and Technology* Spring 2005, <http://www.issues.org/21.3/stoto.html>, accessed June 21, 2006.

20. Ashford et al., "Planning."

21. Anne Clunan, personal communication with State Department official responsible for biological weapons verification and attribution, September 6, 2006.

22. Ashford et al., "Planning." For the particulars of this case, see J. Greenblatt, "Suspected Brucellosis Case Prompts Investigation of Possible Bioterrorism-Related Activity—New Hampshire and Massachusetts, 1999," *Morbidity and Mortality Weekly Report* (MMWR) 49, no. 23 (June 16 2000): 509–12, <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4923a1.htm>, accessed June 21, 2006.

23. Anne Clunan, personal communication with State Department official responsible for biological weapons verification and attribution, September 6, 2006.

24. Ashford et al., "Planning."

25. Seth W. Carus, "The Rajneeshees (1984)," in Jonathan B. Tucker, ed., *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, MA: MIT Press, 2000), 115–37; and T. J. Torok et al., "A Large Community Outbreak of Salmonellosis

caused by Intentional Contamination of Restaurant Salad Bars," *Journal of the American Medical Association* 278 (1997): 389–95.

26. Carus, "The Rajneeshees (1984)," 136; and Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon and Schuster, 2001): 32. For an excellent analysis of the Rajneeshee case from the perspective of BW attribution, see Brian C. Bernett, "U.S. Biodefense and Homeland Security: Toward Detection and Attribution," Master's Thesis, Naval Postgraduate School (December 2006), 13–35.

27. Randall S. Murch, "Microbial Forensics: Building a National Capacity to Investigate Bioterrorism," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 1, 2 (2003): 117–22.

28. American Academy of Microbiology, quoted in Richard A. Goodman, Judith W. Munson, Kim Danners, Zita Lazzarini, and John P. Barkely, "Forensic Epidemiology: Law at the Intersection of Public Health and Criminal Investigations," *Journal of Law, Medicine and Ethics*, 31 (2003): 685.

29. For the development of microbial forensics and its standards, see Bruce Budowle, Randall Murch, and Ranajit Chakraborty, "Microbial Forensics: The Next Forensic Challenge," *International Journal of Legal Medicine* 119, 6 (November 2005): 317–30, available at <http://www.springerlink.com/content/1437-1596/>; Bruce Budowle, Steven E. Schutzer, Michael S. Ascher, Ronald M. Atlas, James P. Burans, Ranajit Chakraborty, John J. Dunn, Claire M. Fraser, David R. Franz, Terrance J. Leighton, Stephen A. Morse, Randall S. Murch, Jacques Ravel, Daniel L. Rock, Thomas R. Slezak, Stephan P. Velsko, Anne C. Walsh, and Ronald A. Walters, "Toward a System of Microbial Forensics: From Sample Collection to Interpretation of Evidence," *Applied and Environmental Microbiology*, May 2005: 2209–13; Bruce Budowle, Martin D. Johnson, Claire M. Fraser, Terrance J. Leighton, Randall S. Murch, and Ranajit Chakraborty, "Genetic Analysis and Attribution of Microbial Forensics Evidence," *Critical Reviews in Microbiology* 31: 233–54; and J. Fletcher, C. Bender, B. Budowle, W. T. Cobb, S. E. Gold, C. A. Ishimaru, D. Luster, U. Melcher, R. Murch, H. Scherm, R. C. Seem, J. L. Sherwood, B. W. Sobral, and S. A. Tolin, "Plant Pathogen Forensics: Capabilities, Needs and Recommendations," *Microbiology and Molecular Biology Reviews*, June 2006: 450–71.

30. Such surveillance systems may be insufficient to provide the necessary baseline data. Massive data-mining programs could gather global public-health data and also data on ongoing research and development in the biotech industry and academia, and could even monitor biodiversity. Developing such a system would require use of existing international organizations and databases in the area of public health, the environment, and microorganisms and bio-science to create a complete picture of the background data of biological agents in order to better pick out an anomalous event. Kellman, "International Matrix." Yet many of the organizations collecting such information may be

quite reluctant to share data with law-enforcement, military, intelligence, or other government agencies.

31. See, for example, President of the United States, *National Strategy for Combating Terrorism*, September 2006, 14–15, http://www.whitehouse.gov/nsc/nsct/2006/nsct2006.pdf, accessed September 7, 2006; and Assistant Secretary of State Paula DeSutter, "Identification, Characterization, and Attribution of Biological Weapons Use," remarks at a Conference on Identification, Characterization, and Attribution of Biological Weapons Use, organized by the Naval Postgraduate School's Center for Contemporary Conflict and the Kings College London Centre for Science and Security Studies, London, United Kingdom, July 12, 2006. Available at http://www.state.gov/t/vci/rls/rm/69313.htm, accessed August 22, 2006.

32. Another category is accidental biological outbreaks, such as the unintentional release of aerosolized anthrax in Sverdlovsk in 1979 and the 1971 smallpox epidemic in Aralsk, Kazakhstan. In order to limit the size of this study, however, there is no specific discussion of accidental outbreaks. The attribution requirements for accidental outbreaks are no different from those needed to distinguish between unintentional events and intentional release of BW. For the purposes of this volume, an accidental release of a biological warfare agent would fall into the category of intentional release, as the agent was not introduced as a result of natural patterns of interactions with the environment by humans, animals, plants or insects, as was the case in the 1994 Indian plague outbreak. At the characterization phase, the only distinction would be to determine whether the release was accidental or deliberate, which is merely a question of expanding hypotheses for why the agent appeared.