A Brief History of Biowarfare

In the spring of 1811, two Indians, a man and a woman, appeared at the Pacific Fur Company's post at the mouth of the Columbia River. While the man, a Crow Indian named Qànqon, provided the inhabitants of the post with "much information respecting the interior of the country," he quickly became an object of fear.[1] Qànqon, as the Post inhabitants discovered, was not all that he appeared to be. To begin with, Qànqon was actually a woman who had adopted male dress and taken a wife. But for the inhabitants at the Pacific Fur Company, this was a minor concern—the real problem with Qànqon was that he claimed to be able to infect others with smallpox.

Nearly two hundred years after Qànqon's appearance at the Pacific Fur Company, the fear which he evoked is still very much with us. Despite the tremendous progress which science and medicine have made in the last two centuries, disease and the ability to inflict disease remain among the most powerful threats which confront us both as a society and as individuals. In fact, it is our knowledge of science—our understanding of the genetic code, our knowledge of genetic engineering and so on—which provides us with the ability to inflict biological havoc on our enemies and ourselves. The more science we know, the better the biological weapons we can develop.

Even before the biological revolution of the nineteenth century, governments and individuals used biological weapons. However, exact dates as to the first use of these weapons are difficult to determine. Because war causes both disruptions in food supplies and the spread of disease along military and refugee routes, differentiating between naturally occurring diseases and those which are intentionally released upon a population has often been difficult, if not impossible.[2]

But while the origins of biological warfare are in dispute, its nature is not. At the most basic level, biological weapons seek "to overcome [an] enemy's effort to...defend against sickness by deliberately disseminating infectious biological material."[3] Typically, these weapons rely on multiple approaches to achieve this goal—users of biological weapons employ biological agents to cause death or illness or to damage the food supply, causing starvation and economic disruption. Before the antibiotic revolution of the 1940s and 1950s, creators and users of these weapons were broad-minded in their tastes, employing any and all diseases. Widespread use of antibiotics—which began in the late 1940s—dimmed the lure of bacterial diseases and many scientists, especially in America and the Soviet Union, shifted their emphasis to viruses.[4] Viruses presented two important advantages over bacteria. First, viruses are often invulnerable to antibiotics. Second, while bacteria such as anthrax require large doses before they can infect the human body, viruses are generally more compact and more deadly—less does more, in other words.

For most of its history, however, biological warfare has not had to take these niceties into account. Early examples of biowarfare indicate that biowarriors were highly opportunistic in their use of biological agents. A typical story of this sort is that of the siege of Caffa (what is now Fedosia, Ukraine). In 1346, or so the story goes, Muslims laid siege to the city which was held by

Christian defenders. Midway through the siege, bubonic plague broke out. Although the plague was a completely new and unknown disease, the invaders seized the opportunity presented by the disease and began to catapult their dead over the city walls into Caffa, hoping to infect its inhabitants. The disease spread quickly and forced the fall of the city.

As a story, the siege of Caffa presents all of the elements of biological warfare which would characterize the use of these weapons until the twentieth century. Warriors use an existing epidemic to launch their attack; their use of this weapon is perceived as being slightly underhand (you'll notice that those who employ these weapons are Muslim); the use of this type of warfare results in havoc among not just the military but also the civilian population and finally, this warfare requires no real investment in terms of either manpower or military weapons. The siege of Caffa is a perfect example of the power and the limitations of pre-nineteenth century biological warfare—a perfect example because the story was probably manufactured by Christian chroniclers.[5] But while the story of Caffa is not true, its repeated telling (even in today's press) tells us a great deal about the ways in which we view biowarfare.[6] At the most basic level, this seven hundred year old story reminds us of the power of the microbe---cheap, easy to employ and guaranteed to break both military and civilian opposition, biological weapons have and always will have a strong lure. For scientists and laypeople alike, these weapons are the monster in the closet—a threat which may or may not exist and a threat, which if it does exist, is often hidden in the dark. Separating the truth from the myths and determining the extent of this threat is not always possible.

More often than not stories such as that told about Caffa tell us what we want to believe about bioweapons—namely that when these weapons are used it is readily apparent even to the most ignorant observer. But this is the real myth. Rarely do biowarriors openly catapult bacteria or viruses into their enemies' midst and even more rarely do they discuss their actions in detail. Throughout history, the creators and users of these weapons---from eighteenth-century military officers to twentieth-century Soviet and American scientists---have preferred to work in secrecy.

This secrecy often makes it difficult to uncover the history of biowarfare. As a result, the history and historiography are constantly shifting. Some of these shifts are obvious. Take, for example, discussions of biological warfare directed against the Native Americans. In the early twentieth century, few historians discussed the role which biological weapons—or even disease—played in the decimation of the Indians. In the late twentieth century, historians openly acknowledge the use of biological warfare directed against the Native Americans.[7] But pre-twentieth century biological warfare is, as one historian put it, "a slippery topic of inquiry."[8] The extent to which biological weapons were used against and even by the Native Americans is, and always will be, hotly disputed, with many maintaining that bioweapons were used only sporadically.[9]

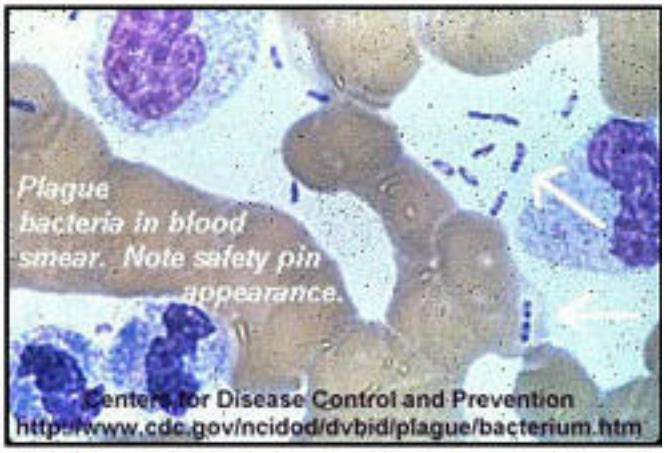
In the pre-modern period, biological warfare's dependence on an existing epidemic meant that these weapons were difficult to use and control. The advent of germ theory in the mid-nineteenth century changed all that. By providing scientists with a better ability to control and prevent epidemics, germ theory also gave biowarriors the ability to initiate and spread disease in a fashion which was unimaginable to their predecessors.

Although the first global war of the twentieth century is usually linked with chemical weapons, biological weapons *were* used in World War I. In 1915, the Germans launched a small and very rudimentary biowarfare program. Under this program, German agents infected animal shipments being sent to the Allies from five neutral countries: Romania, Spain, Norway, the United States and Argentina. The

goal was to disrupt both food supplies as well as transportation networks which relied on animals. Targeted livestock included sheep, cattle, horses, mules, and in Norway, reindeer. Animals were infected by having anthrax injected directly into their blood or by being fed sugar laced with anthrax.[10] Obviously, the program was only marginally effective—in a war which killed millions, the deaths of a few thousand animals meant little. Looking back at the war from the hindsight of the 1920s, the lesson must have seemed clear: bioweapons were not a significant threat. Ironically, it was this belief that biological warfare posed no real threat which set the stage for the rise of this type of warfare. Because most nations felt that these weapons were ineffective (especially when compared with chemical weapons which had left millions dead or maimed) there was little concern regarding biological warfare.[11] The Geneva Protocol of 1925 *did* prohibit the development and use of biological weapons—but no concentrated attempt to enforce or expand the treaty followed its ratification. As a result, nations continued to push the boundaries of biology.

While politicians dismissed the threat of bioweapons, scientists came to view this issue quite differently–as Shiro Ishii, the head of Japan's program, put it, those engaged in bioweapons research had the opportunity not only to search "for the truth in natural science" but also "to successfully build a powerful military weapon against" their nation's enemies.[12] Not surprisingly, this dual appeal—both to patriotism and the scientist's desire to understand and control nature—meant that governments in the United Kingdom, Canada, France, Germany, the Soviet Union, Japan and the United States were able to recruit top-notch biologists for their bioweapons programs.

Among the most successful in creating and *using* bioweapons were the Japanese. Throughout the 1920s and 30s, Japan's program grew in both the number of its employees and the scope of its mission—while their success in weaponizing disease remained limited, the program's *potential* was unlimited. Few industrialized superpowers, however, saw the Japanese program as a threat–a response which enabled the Japanese to be surprisingly indiscreet. As late as 1939, the Japanese government openly attempted to buy yellow fever from the American government. The Americans refused the request. But even without yellow fever,[13] scholars suspect that the Japanese killed thousands of Chinese using bioweapons; direct evidence indicates that hundreds of Chinese prisoners of war were killed in secret germ warfare tests. [14] Although the United States did indict and convict Japanese doctors and nurses who performed medical experiments on American flyers, there was no attempt to try or even indict the scientists who lead Japan's biowarfare program.[15]



This reluctance to prosecute the creators of the Japanese biowarfare program stemmed from two contradictory factors. First, although France, Canada, Great Britain and Japan had what one journalist calls

"substantial [bioweapons] programs during World War II," the United States was not very enamored of bioweapons.[16] True, an American biological weapons program had been launched in 1943 and American scientists had created and stockpiled thousands of anthrax bombs but success in weaponizing biological agents had been limited. Consequently, most American politicians and military personnel continued to regard biological weapons as highly impractical. Second, the few officials and scientists who believed that these weapons could pose a threat were reluctant to pursue Japanese scientists—because they themselves were actively and secretly engaged in expanding America's biological weapons program.

This expansion was linked to the emergence of the Cold War. The Soviet's detonation of a nuclear bomb in 1949 had heated tensions between the East and West and leveled the playing field between the USSR and America. As a result, American officials turned to even less conventional weapons—defense experts, scientists and top government officials now came to believe that biowarfare was, if not crucial to America's survival, central to its defense. And there was some rationale for these fears. Although few Americans knew it at the time the Russians had launched a bioweapons program in 1928 and the program had grown substantially during World War II.

The Soviet program had benefitted tremendously from the capture of a Japanese germ unit during the war. When grafted onto the Soviet program, Japanese technology significantly advanced the Russians' understanding of biowarfare. In 1946, at Sverdlovsk, the first factory specializing in anthrax was built; a year later, a factory specializing in smallpox was also built. By 1956, biological warfare was seen as not only a necessity for the defense of the USSR but also an inevitable price for progress; that same year, Georgi Zhukov told a Communist Party Congress that future wars would undoubtedly include the use of biological weapons.[17]

Zhukov's views were shared by defense officials in America. In 1956, American spy planes took a series of revealing photographs. Deciphering and interpreting these photos proved to be extraordinarily simple. The "dense clusters of buildings and odd geometric grids" which CIA analysts saw on photos taken of a Russian island were eerily similar to aerial photographs of the Utah desert—where America had set up its own biowarfare unit.[18]

Like the Soviets, the Americans had launched their program in the wake of World War II and like the Soviets, the Americans had myriad reasons for embracing biowarfare. As viewed from the perspective of 1945, biological warfare, had several benefits. To begin with, it was incredibly cheap. Unlike the Manhattan Project, biowarfare programs required little or no investment in exotic or expensive equipment or ingredients.[19] Additionally, biowarfare programs could be easily created and maintained in secrecy (buying pathogens on the open market has always been very easy to do). And finally, for most defense experts reviewing the history of the twentieth century, biological warfare may have seemed to be the wave of the future. Certainly, if one was to judge by the past and to think in the context of what was rapidly coming to be characterized as the ABCs of war (atomic, biological and chemical), then it was clear that World War III would be a biological war (World War I was a chemical war and World War II an atomic war). Indeed, many scientists and defense analysts argued, the threat posed by biological warfare was such that America should begin to prepare itself—both by creating a system of defense against these weapons as well as by building a program which could compete with America's enemies.

America's biowarfare program emerged, then, as a reaction to the excesses of World War II and the implicit threat posed by the Cold War. In 1944, an extensive base was built at Fort Detrick,

Maryland—although testing and experiments would always be done at a variety of different locations. Fort Detrick boasted the program's "Special Projects School" which sought to provide students with "an understanding of the known technical facts and potentialities of germ warfare."[20] Under the direction of Ira Baldwin, Fort Detrick grew rapidly between 1943 and 1945. The end of the war caused only a slight hiccup in this expansion, with programs and funding being temporarily cut. By 1946, American officials were prepared not only to continue the nation's biowarfare program but also to increase its budget and expand its range.

The start of the Korean War in 1950 further hastened this expansion with several buildings being constructed at Fort Detrick. The first of these—a massive metal sphere four stories high—was "a captive atmosphere" which could be adjusted to replicate anything from a tropical region to a desert. The "8 Ball" as it was called allowed scientists to test biological agents on animal subjects while minimizing the scientist's exposure to the agent.[21] While the "8-Ball" was central to the program, the construction of an anthrax factory at Fort Detrick was also regarded as crucial. Along with this building program, scientists also assessed the nation's vulnerability to biowarfare attacks—they sprayed germs in San Francisco, shattered lightbulbs filled with biological agents in the New York City subway and even sprayed bacteria into the vents of the Pentagon air-conditioning system. Although Fort Detrick's experts believed that the germs which they used were harmless, later critics claimed that their actions released hidden epidemics and resulted in at least one death.[22]

Not all was doom and gloom for the biowarriors, however. A new agency, the CDC (or Communicable Diseases Center as it was called then) became a prime beneficiary of the biological warfare program. In 1950, Alexander Langmuir, a member of the United States Public Health Service who had been assigned to the CDC, "developed a three point-plan for guarding [the nation's] health during the Cold War: research on airborne infections, development of an epidemic intelligence service and training in biological-warfare defense."[23] The primary task of the Epidemic Intelligence Service was the "detect[ion] of masked biological-warfare attacks;"[24] and under Langmuir's guidance, the CDC aggressively moved to create "more effective sampling methods to detect biological warfare agents...[to] employ faster reporting of disease incidence, upgrade laboratory facilities, and [provide] more extensive immunization programs and better investigations of all outbreaks of disease."[25] In short, Langmuir's blueprint for biodefense became the blueprint for the CDC itself. But the CDC's emphasis on biopreparedness was, some historians have argued, short-sighted—"at the same time that funding for [and concern about] biological warfare research was increasing...funds for local health departments were cut sharply."[26] In other words, the nation's emphasis on "induced" epidemics may have lead epidemiologists and scientists to ignore "natural" epidemics and existing public health problems.

For American biowarriors, the Korean War provided a payoff. Accusations that America used bioweapons during the Korean War were made in 1952 and although the United States successfully refuted these accusations, "a cloud of suspicion" lingered. There is still some question today as to whether the United States did or did not use bioweapons during the war.[27] During the 1960s, however, the CIA and the US military *did* attempt to use bioweapons against specific dictators; the most well-known of these attempts were staged against Fidel Castro but attempts were also made against Patrice Lumumba, the

Congo's first prime minister after independence. Tests were also run in Utah, Alaska, and the South Pacific—some of these tests used human subjects but most did not. By the end of the decade, bioweapons had become an established aspect of the American defense program and scientists at Fort Detrick had stockpiled an astonishing array of biological agents.

In 1969, as the nation's stockpile continued to rise and as scientists pushed the boundaries of biology even further, then-president Richard Nixon suddenly announced that he had "ordered the Defense Department to make recommendations about the disposal...of bacteriological weapons." Arguing that "mankind already carries in its hands too many of the seeds of its own destruction," Nixon called for an end to research on biological weapons.[28] It is unclear why Nixon decided to end the nation's bioweapons program but end the program did—over a period of three years, "death came to the nation's supplies of offensive weapons."[29]

As the American bioweapons program was dismantled, the Soviet Union, Britain, Canada and the United States signed a new biological weapons treaty. The BWC (Biological Weapons Convention) of 1972 was ultimately signed by seventy-nine nations—the treaty called for the destruction of existing stocks of bioweapons as well as an end to biological weapons research. On paper, it looked as though the world would now be safe from biological weapons.

But this was true only on paper. Despite signing the treaty, the Russians continued their program. In fact, some scientists and historians have alleged that the USSR saw the BWC treaty as an opportunity to advance their program secretly—as the United States pulled out of the bioweapons game.[30] And there would seem to be evidence to support this claim. In 1973, only a year after signing the BWC, the Soviets created a massive bioweapons program controlled by two entities, the Ministry of Defense and an agency called "Biopreparat" which was in the Ministry of Medical and Microbiological Industry. Officially, Biopreparat was a state-owned pharmaceutical company but "in reality it was an elaborate front for a military-funded program...which aimed to develop a new generation of super lethal biological weapons."[31] Throughout the 1970s and 1980s, Biopreparat was one of the USSR's most closely guarded secrets—only a handful of top Soviet officials knew of its existence and it would not be until the break-up of the Soviet Union that American defense experts would discover the program.

At its peak, the Soviet bioweapons program employed 60,000 people at more than a hundred facilities in eight different Soviet cities; it stockpiled thousands of anthrax, plague and smallpox bombs, and it had an annual budget of close to a billion dollars.[32] The most chilling aspect of this massive program was not its reliance on traditional bioweapons—but rather its development of "improved" biological agents. Using gene manipulation, the Soviets created both a highly lethal form of anthrax (against which vaccines were ineffective) as well as "improvements" on smallpox.

The latter "supergerm" was—and still is—an issue of great concern. Smallpox is a viral infection with no known treatment or cure.

There are two forms of the disease–*variola major* and *variola minor*. Both forms can be fatal and throughout history, smallpox has been one of the greatest killers. The disease is highly infectious, with most of its victims becoming infected by inhaling the virus when in close contact with an infected person. The disease can also be acquired through contact with the corpse of a smallpox victim or even articles belonging to a smallpox patient. In the seventeenth century, smallpox was endemic in Asia, Africa and Europe—in other words, smallpox was omnipresent in these regions, passing from one person to another and erupting into a full-blown epidemic every ten or so years. To become an epidemic, smallpox needed a large population which was susceptible. However, once a person contracted smallpox, he or she became immune to the disease. So in Europe, Africa and Asia, significant proportions of the population were exposed to the disease as children; if they survived (which was more likely than not), they were then immune. The greater the immune population, the more difficult it was for the disease to spread.

Before 1750, medical practitioners had two methods for dealing with smallpox. The first of these was quarantining—this was fairly effective as a method of containment but obviously it was not perfect. The second of these techniques was variolation—here a healthy person was deliberately infected with smallpox—the case which developed was usually mild and the person generally recovered and was then immune. Variolation occasionally resulted in the death of the patient and, for this reason, it was regarded as problematic. In 1796, an English physician, Edward Jenner, discovered that sufferers of cowpox became immune to smallpox. Vaccination—or the deliberate infection of a patient with cowpox—then replaced variolation---the deliberate infection of an individual with smallpox—as the preferred method of dealing with smallpox. Throughout the nineteenth century, growing numbers of people were vaccinated against smallpox and the disease become less common. By the 1950s, smallpox was to be found in only a few regions of the world. The growth of airline travel as well as other global networks meant, however, that smallpox could easily spread from Africa to New York—as a result, public health officials saw smallpox as an issue of concern, regardless of where they lived. In 1958, a Soviet Minister of Health, Viktor Zhdanov began to advocate a world-wide campaign to eradicate smallpox through a massive vaccination campaign. In 1967, the campaign was officially launched; ten years later the last case of naturally occurring smallpox was recorded in Somalia. Officially, smallpox had been eradicated.

But the eradication of smallpox has raised new problems. If we build on the supposition that "the more diseased a community the less destructive its epidemics become"[33] then the opposite is true—the less diseased a community is the more dangerous its epidemics become. And this is true with smallpox. Lacking the immunity of our ancestors and the immunity conferred by vaccination, we are now highly susceptible. But smallpox has been eradicated so we are all safe. Or are we? In 1980, the World Health Organization ordered "all institutions maintaining stocks of variola virus [to] to destroy or transfer these stocks to WHO...centers."[34] Officially, there were to be only two repositories for smallpox: the CDC in Atlanta and Russian State Research Center of Virology and Biotechnology in Koltsovo. In 1992, however, a high-ranking Soviet biologist, Kanatjan Alibekov defected to the United States. Over the course of a year-long debriefing, Alibekov informed horrified CIA officers that the USSR had grown and stored twenty tons of variola virus. It has been suggested that this stockpile was destroyed in the

late 1980s but as a former Russian scientist told an American weapons inspector, "there were plenty of opportunities for staff members to walk away with an ampule [of virus and] although we think we know where our formerly employed scientists are we can't account for all of them."[35] Although the Soviet Union and its bioweapons program no longer exist, their legacy in the form of smallpox bioweapons may have been sold to another nation or terrorist organization.

But this is not the only legacy of the Soviet bioweapons program. Although smallpox is the ideal biological weapon, the Soviets also developed anthrax. This work with anthrax became evident early on when an anthrax outbreak occurred in Sverdlovsk in 1979. Soviet officials at first denied the outbreak and, then, when forced to concede its existence, maintained that the outbreak had been caused by tainted meat and that the death toll was limited to 100. Soviet dissidents claimed otherwise, insisting that the outbreak resulted in about a thousand deaths and that the source of the infection was the release of agent from a secret military complex.[36] American intelligence analysts agreed. The number of dead as well as the exact cause of the outbreak continue to be disputed (all records relating to this incident were destroyed in 1990). However, there is clear evidence that the Soviets were working with anthrax and that they stockpiled the anthrax bacillus. Again, the exact amounts of bacillus which were stockpiled is unknown as is the exact whereabouts of this agent.

The break-up of the Soviet Union has meant the break-up of the Soviet bioweapons program. Today, the Soviet's elaborate program and the buildings which harbored it are in decay. Soviet biowarriors, the former elite of Russian society are unemployed and stocks of bioweapons are poorly guarded and poorly stored. In the late 1990s as the Clinton Administration became aware of these problems, the United States moved to secure the program by providing money to salvage and convert its facilities as well as discourage the sale of bioweapons knowledge to rogue states. However, this program has received only sporadic funding and the fate of the Russian program is still uncertain.

There are a number of potential buyers for bioweapons—with Iraq topping the list. Even before the break-up of the USSR, Iraq had acquired and developed biological weapons—often with the complicity of American, Japanese and European commercial suppliers (during the 1980s, Iraq bought anthrax from the American Type Culture Collection, a non-profit company in Maryland, a purchase cleared by the Reagan Administration). During the 1990s, Iraq produced at least 8,000 liters of anthrax. In the summer of 1999, Congress released a report which claimed that Iraq possessed smallpox. Although there have been several inspections of Iraqi weapons sites by the United Nations and although Iraq has occasionally confessed to stockpiling bioweapons—and although these weapons have been destroyed—UN inspectors suspect that the Iraqis have managed to successfully hide most of their bioweapons. Recently, an Iraqi defector told a *New York Times* reporter that "money was no object in Iraq's quest for weapons of mass destruction"[37]—and clearly, the Iraqis possess both the money and the desire to expand their bioweapons program. But the Iraqis are not the only nation interested in biological warfare. The US State Department lists six "rogue" nations which possess bioweapons, including Iran and North Korea.[38]

The events of September 11th remind us that terrorist organizations are also in the market for bioweapons. Because they are both inexpensive and compact, these weapons are a perfect choice for terrorists. During the last twenty years, terrorist organizations, both in the US and abroad, have used or attempted to use bioweapons. In the US, the most famous bioattack—before 2001---occurred in Wasco County, Oregon in 1984. There, members of the Rajneeshees religious cult sprinkled salmonella on salad

bars at several restaurants with the intention of sickening local residents (the goal was to prevent local residents from voting, thereby enabling cult members to take over the local government). The perpetrators were eventually uncovered but it took a year as well as information from an inside source before the FBI ascertained the cause of the outbreak. Outside the US, the Aum Shinrikyo sect in Japan attempted several times to release biological agents during the 1990s. These attacks failed—probably because of the organization's inability to recruit skilled biologists or build high-quality laboratories.[39]

Looking back over the long history of biowarfare, several things seem clear. First, biological warfare is and has been a component of many twentieth-century nations' arsenals. Second, although bioethicists and politicians have routinely condemned the use of bioweapons, moral condemnations of biological warfare—whether in the form of treaties or ostracism---have not prevented the development or use of bioweapons. And third, bioweapons programs do not die even when a nation abandons them—we have only to remember that Japan's program was picked up and expanded upon by the US and USSR in the 1940s to recognize this. But in assessing biowarfare, we need to be careful and avoid overstating the possible risks. Biowarfare is truly a monster in the closet—we do not know if it exists and the shape which it possesses if it does exist. As historians, scientists and politicians have pointed out, the best preparation for biowarfare may well be one which will benefit us in the event or absence of a biological attack and that is investment in our public health system.

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Endnotes:

1.Alexander Ross quoted in Elizabeth Fenn, *Pox Americana: The Great Smallpox Epidemic of 1775-1782* (Farrar, Straus and Giroux, 2001), p. 224.

2.Interactions between different communities—whether hostile or not–can also cause epidemics which work to one group's advantage. For example, when a smallpox epidemic killed almost nine-tenths of the Massachusetts Indian population in 1620, John Winthrop remarked with some pleasure that the epidemic meant that "the Lord hath cleared our title" to the land. John Winthrop quoted in Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox*, (New York, Atlantic Monthly Press, 2001) p. 11.

3.Aileen M. Marty, "History of the Development and Use of Biological Weapons," *Clinics in Laboratory Medicine*, Vol. 21, No. 3, September, 2001, p. 424.

4.Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War*, (New York: Simon and Schuster, 2001), p. 43.

5.Robert S. Gottfried, *The Black Death: Natural and Human Disaster in Medieval Europe*, (New York: The Free Press, 1983), p. 37.

6.The story appears in medical journals, newspapers and books on biological warfare programs. See for example, Steven M. Gordon, "The Threat of Bioterrorism: A Reason to Learn More about Anthrax and Smallpox," *Cleveland Journal of Medicine*, Vol. 66, No. 10, November-December, 1999, p. 593; Vincent J. Derbres, "De Mussis and the Great Plague of 1348: A Forgotten Episode of Bacteriological Warfare," *JAMA*, April 4, 1966, Vol. 196, No. 1, p. 59-62; Guy Gugliotta, "Anthrax Has Inspired Dread and Breakthroughs," *The Washington Post*, November 5, 2001, p. A9; Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 37-38.

7.A few historians have speculated that some Native American tribes may actually have used biological warfare first. See Elizabeth Fenn, "Biological Warfare in Eighteenth-Century North America: Beyond Jeffrey Amherst," *The Journal of American History*, (March 2000), p. 1565.

8.Elizabeth Fenn, "Biological Warfare in Eighteenth-Century North America: Beyond Jeffrey Amherst," *The Journal of American History*, (March 2000), p. 1552.

9.In 1763, for example, Henry Bouquet sought to infect the Ottawa Indians with smallpox, noting with some anxiety that he would "take...care however not to get the disease myself." Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox*, p. 20.

10.Mark Wheelis, "First Shots Fired in Biological Warfare," *Nature*, Vol. 395, September 17, 1998, p. 213; "Deadly Relic of the Great War," *Nature*, Vol. 393, June 25, 1998, p. 747.

11.In 1932, Leon Fox, a medical officer in the US Army, wrote "bacterial warfare is one of the recent scare-heads that we are being served by the pseudo-scientists who contribute to the flaming pages of the...nation's press...it is highly questionable if biologic agents are suited for warfare." Leon Fox quoted in Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, (New York: Henry Holt, 1999), p. 9.

12.Shiro Ishii quoted in *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 40.

13.Yellow fever is a viral infection—at the time there was no treatment for the disease and fatality rates

were about five percent.

14.Laurie Garrett, *Betrayal of Trust: The Collapse of Global Health* (New York: Hyperion, 2000), p. 494. See also Daniel I. Barenblatt, "Anthrax Victims of the Axis," *The Washington Post*, December 31, 2001, p. A17.

15.Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 40. Miller et al note that the US gave Japanese biowarriors immunity in exchange for "the voluminous records of Japan's germ program and their help in deciphering them." There is, however, currently a push to provide restitution for victims of Japanese biowarfare. See Daniel I. Barenblatt, "Anthrax Victims of the Axis," p. A17.

16.Laurie Garrett, *Betrayal of Trust: The Collapse of Global Health*, p. 494.

17.Zhukov paraphrased in Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 48.

18. Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 48.

19.In fact, "the entire wartime budget for the Army's biological warfare program would have carried the Manhattan Project all of a day or so." Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 114.

20.Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 66.

21.Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 133.

22.Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 42.

23.Elizabeth Etheridge, *Sentinel for Health: A History of the Centers for Disease Control* (Berkeley: University of California, 1992), p. 43.

24.Elizabeth Etheridge, *Sentinel for Health: A History of the Centers for Disease Control*, p. 38.

25.Elizabeth Fee and Theodore M. Brown, "Preemptive Biopreparedness: Can We Learn Anything from History?" *American Journal of Public Health*, May 2001, Vol. 91, No. 5, p. 722-723.

26.Elizabeth Fee and Theodore M. Brown, "Preemptive Biopreparedness: Can We Learn Anything from History?" p. 725.

27.Regis implies that the United States did not use bioweapons and that the charges were fabricated by

China and supported by the Soviet Union. Fee and Brown see the issue as being more ambiguous and point out that "much of the evidence...which could be relevant for settling these questions definitively is still classified." Fee and Brown, "Preemptive Biopreparedness: Can We Learn Anything from History?" p. 724. For Regis' discussion of this, see Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 161.

28.Richard Nixon quoted in Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 206-207.

29.Ed Regis, *The Biology of Doom: The History of America's Secret Germ Warfare Project*, p. 212.

30.D.A. Henderson, "The Looming Threat of Bioterrorism," *Science*, Vol. 283, February 26, 199, p. 1280.

31.Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox*, p. 145.

32.Judith Miller et al, *Germs: Biological Weapons and America's Secret War*, p. 167; D.A. Henderson, "The Looming Threat of Bioterrorism," p. 1280.

33.William H. McNeill, *Plagues and Peoples*, (New York: Anchor, 1975), p. 197.

34.Final Report of the Global Commission for the Certification of Smallpox Eradication, Geneva, December 1979, quoted in J.G. Bremen and D.A. Henderson, "Poxvirus Dilemmas—Monkeypox, Smallpox and Biological Terrorism," *The New England Journal of Medicine*, August 20, 1998, Vol. 339, No. 8, p. 557.

35.Richard Preston, "The Demon in the Freezer," *The New Yorker*, July 12, 1999, p. 59.

36.Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak*, (Berkeley: University of California Press, 1999), p. 8.

37.Judith Miller, "An Iraqi Defector Tells of Work on at Least Twenty Hidden Weapons Sites," *The New York Times*, December 20, 2001.

38.D.A. Henderson, "Bioterrorism as a Public Health Threat," *Emerging Infectious Diseases*, Vol. 4, No. 3, July-September, 1998, p. 489. The six nations characterized as rogue states which may have bioweapons includes Iraq, Iran, Libya, North Korea, the Sudan and Syria.

39.Kyle B. Olson, "Aum Shinrikyo: Once and Future Threat?" *Emerging Infectious Diseases*, Vol. 5, No. 4, July-August, 1999, p. 514.