Chapter 1

Editor's Introduction: The Politics, People, Science and Historical Roots

Filippa Lentzos

Biological weapons

This volume explores biological threats in the 21st century through the lens of biological weapons. It tells the story of how we have come to view contemporary biological threats through the politics, people, science and historical roots of biological warfare (BW).

It is a story suffused by secrecy. Most of us are familiar with chemical and nuclear weapons in the sense that they conjure images in our mind's eye: gas clouds wafting over WWI trenches, nuclear missiles displayed in military parades and the mushroom cloud. But it is hard to imagine what biological weapons look like. This is partly because we know so little about them. Biological weapons were researched and developed in the utmost secrecy. The programs were concealed in labs at military sites not listed on ordinary maps; special code names and exceptionally high classification categories were assigned to biological agents and the projects devised to weaponize them; and bioweaponeers were sworn to secrecy and under constant surveillance. Mistakes were costly — one bioweaponeer caught peddling bioweapons-related information to the Soviets was secretly trialled under a news blackout and spent a decade of his 20-year sentence in solitary confinement in an Israeli high security prison under a fake name and a fabricated

profession. Much of the documentation and other evidence of past programs has been destroyed. Where there were concerted efforts to bring war crimes and human rights abuses to public light, information about BW programs was suppressed. In the post-WWII Tokyo war crimes trials, similar to the Nuremberg trials in Germany, immunity was traded for lab notebooks and the results of experiments, and the trials concluded without revelations about the atrocities committed by Japan's medical and biological scientists. When the Truth and Reconciliation Commission hearings in South Africa began to uncover details of the BW program "Project Coast" they were faced with delays and legal challenges, and eventually shut down before the investigators could complete their work; the head of the program was never brought to justice and remains a practising medical doctor to this day. What has not been destroyed, concealed or silenced from these programs, often remains highly classified.

The secrecy surrounding past programs have made them difficult to research. Yet, a small group of leading academics has carefully collated documents, interviewed the scientists and others involved in the programs, and visited the labs, facilities and testing grounds in an effort to analyze and piece-together the open-source material available. The efforts to suppress information about biological weapons have also meant that they have rarely been discussed in public forums; BW programs have to a large extent been insulated from outside criticism and open debate about their ethical, social and political aspects. Biological weapons have never aroused the international outcries and protests we are so familiar with from the nuclear field. Yet, in spite of this, the international community has laid down very clear red lines about BW. The preamble to the Biological Weapons Convention (BWC), the treaty banning biological weapons and now signed by over 170 countries, sets out an exceptionally strong normative frame, stating that states party are:

> "Determined for the sake of all mankind, to exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons, Convinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize this risk"

The efforts and narratives of the people involved in advocating, negotiating and sustaining biological disarmament, and of those who analyze, manage and limit contemporary biological proliferation risks also, therefore, form a crucial element of the story of biological weapons. *Biological Threats in the 21st Century* brings together the accounts of academics and policymakers, diplomats and biosecurity experts, bioweaponeers and activist scientists, in a unique, rigorous and authoritative volume.

Early history

Biological weapons are complex systems that disseminate disease-causing organisms or toxins to harm or kill humans, animals or plants. They can take many different forms, but generally consist of two parts: a weaponized biological agent and a delivery mechanism. For most of human history, attempts to transmit infections were rare and clumsy; they probably seldom worked out and, when they did, they were in all likelihood redundant with natural routes of transmission (Wheelis 1999). Among the older military techniques that can be considered BW is the use of corpses of humans or animals to contaminate wells and other sources of drinking water. While the principal objective was thought to be the denial of clean water to the enemy, a secondary effect was to spread disease among people and animals that consumed the contaminated water.

The earliest recorded account of armies using infectious disease as a weapon is the 1346 siege of the heavily fortified Crimean city of Kaffa, an important trading hub on the Black Sea between Europe and the Far East controlled by the Maritime Republic of Genoa (Wheelis 2002). The Mongol forces besieging Kaffa suffered a severe natural outbreak of bubonic plague that was killing "thousands upon thousands every day" (Horrox 1994: 17). A contemporary Arabic source estimates 85,000 plague fatalities among the Mongol forces in the Kaffa region during this epidemic (Wheelis 1999). But the Mongols turned this to their advantage and catapulted the plague-infected corpses of their dead comrades over the city walls to spread the disease to the European traders taking refuge

in Kaffa. The Mongols were skilled siege warriors, and their artillery at Kaffa was likely numerous and sophisticated. The numbers of cadavers hurled into the city could well have been in the thousands. The Mongol's tactic finally broke the 3-year stalemate; the Genoese were crippled by the plague and fled Kaffa by sea back to Europe.

A second well-documented account comes from North America and the wars against the Native Americans. Of the many new diseases that the Europeans brought with them to the New World in the 1700s and 1800s, smallpox was the most feared. Among Europeans, smallpox epidemics typically had a case fatality rate of 20–40 percent; but among Native Americans, who had not previously been exposed to smallpox and who had not built up immunity towards the disease, fatality rates of 90 percent or higher were common (Wheelis 1999). In the late 1700s, at Fort Pitt on the Ohio River — in present day Pittsburg — conditions were extremely crowded. Traders and settlers had been driven in by the hostilities, and smallpox had just broken out. Journal entries, ledgers and other documents from the time indicate that the ranking British officers at the fort met with a delegation from the native Delaware tribe, and handed over smallpox-contaminated sheets and linens from the Fort's hospital under the false pretence of a gift (Wheelis 1999). A smallpox epidemic is reported to have broken out in the Delaware tribe at this time. Of course, the extent to which the spreading epidemic can be attributed to the blankets is impossible to determine, but the incident is indicative of what appears to be a history of sporadic British and American efforts to infect North American tribes with smallpox (Wheelis 1999).

Rational design and industrial scale

Lack of knowledge about infectious disease and how they are transmitted prevented rational design of methods of biological attack. This changed in the 20th century. The revolution in microbiology transformed ignorance about infection into sophisticated understanding. Over the period 1880–1900, the microbial basis of infectious disease was proven, the pathogens causing virtually every common bacterial disease of importance were identified and studied, and their

mechanisms of transmission worked out. Coupled with new organizational links between the military and sciences, this paved the way for manipulating infection and for the systematic design and improvement of biological weapons.

Advances in science were applied to unconventional weapons at an industrial scale for the first time in World War I, and the horrors of gas warfare led to several arms limitation treaties. A key treaty was the League of Nations' 1925 Geneva Protocol prohibiting the use of chemical weapons in international armed conflicts. Unlike chemistry, there were no indications at the time that biology was being militarized, but a prohibition on the use of "bacteriological methods of warfare" was added to the treaty late in the negotiations. Yet shortly after the treaty was signed, the Japanese did exactly that. They developed a biological weapons program on a significant scale that included the most atrocious human-subjects experiments on thousands of Chinese prisoners of war and attacks on civilians with biological agents. These actions, unique in military history, crossed a normative and legal barrier that other military powers avoided breaching, and are detailed by anthropologist and sociologist Jeanne Guillemin in Chapter 2.

Most major World War II combatants conducted research on biological weapons, but none of these programs were on the scale of the Japanese program. The post-war nuclear age set a high standard for the next 20 years of biological weapons development; they made it imperative for bioweaponeers to show how pathogens could devastate populations at the same enormous scale as the bombs dropped on Hiroshima and Nagasaki (Guillemin 2005). The post-war Allied efforts of the United Kingdom (U.K.), United States (U.S.) and Canada to show that BW could rival nuclear warfare were extensive, and, as described by historians Brian Balmer and John Moon in Chapter 3, involved laboratory and human subjects research into potential pathogens, the industrial production and stockpiling of agents, the manufacture of bombs and spray generators, fitting of airplanes and ships for dispersal, the indoctrination of troops, and large-scale field trials. Yet, despite the intensive development and testing of these programs, elaborated by political scientist Lenny Cole in

his Point of View contribution, and which eventually demonstrated that biological weapons could be as great a threat to large populations as nuclear weapons, biological weapons were not assimilated into the thinking and planning of the regular military. In a political move that caught the bioweaponeers off-guard, the newly-elected President Richard Nixon unilaterally renounced biological weapons in 1969, paving the way for the multilateral BWC. The U.S. bioweapon program was dismantled in the early 1970s, the considerable stockpiles destroyed and the facilities converted.

Ironically, it was only after signing the BWC that the Soviet program began its incredible expansion. The expansion and redirection of the program was proposed by a small but very influential group of scientists arguing for exploiting the new field of genetic engineering that was just beginning to emerge in the West. As virologist Jens Kuhn and arms control expert Milton Leitenberg describe in Chapter 4, new pathogen properties, such as increased virulence, antibiotic resistance and enhanced stability, were to be engineered directly into pathogens, including agents not on classical bioweapons agent lists. These altered pathogens formed a novel arsenal of weapons that could not be predicted by western intelligence. The tightly controlled program was even more secret than the USSR's efforts in the realm of nuclear weapons. Rather than expanding the Soviet military biological institutions, the new offensive program was established in the civilian sphere. Western intelligence services most likely knew about the military biological institutions and kept them under observation, so the better option was to "hide" the new institutions in plain sight. An entirely new, ostensibly commercial, network of institutes, production plants and storage facilities was constructed. Collectively known as Biopreparat, it worked both sides of the street: it cured diseases and invented new ones. In the years following the USSR's collapse, the Cooperative Threat Reduction (CTR) program decommissioned the main production plant and testing site, and transformed the majority of the Biopreparat facilities into more open research facilities some of which began international collaborations on peaceful microbial research, including international scientist exchanges. The three key military institutes involved in the BW program remain

closed to outsiders, and it is not possible to ascertain whether the biological weapons program has been terminated in its entirety. Russia's current official position is that no offensive BW program ever existed in the Soviet Union.

In her Point of View contribution, Sonia Ben Ouagrham-Gormley presents a 4-year oral history project on the former Soviet and American bioweapons programs. She introduces two scientists from the former Soviet program — one defector living in the U.S. and one practising scientist still working in Russia — and provides a snapshot of what it was like inside the highly secretive program, what motivated their work, how they felt about it and how they grappled with the ethical dilemmas raised by their research.

There were also other 20th century efforts by nations to add biological weapons to their arsenals. In Chapter 5, political advisor and former diplomat Tim Trevan describes the origins, expansion and eventual demise of the Iraqi program through United Nations (UN) intervention following the first Gulf war "Desert Storm". UN bioweapons inspector Gabriele Kraatz-Wadsack details the Iraqi leadership's tactics to undermine the UN inspectors, with her Point of View contribution describing her experiences of cutting through the Iraqi lies, half truths, intimidation and deceptions. In Chapter 6, toxicologist and activist scientist Alastair Hay describes another of the smaller BW programs, that of Apartheid-era South Africa, which came to light during the public hearings of the Truth and Reconciliation Commission held as the 20th century was drawing to a close. His research gives insight into the motivations of the scientists behind the program, and is complemented by Truth and Reconciliation Commission investigator Chandré Gould's Point of View examining transitional justice institutions as a means of revealing otherwise hidden weapons programs.

What stands out in the accounts of historical BW programs is the different ways in which they conceived of biological weapons — another factor complicating what biological weapons look like in our mind's eye. The major Allied powers predominantly saw biological weapons as strategic weapons comparable to the atomic bomb. Biological agents were researched for militarily useful criteria — dispersible as an aerosol,

economically scalable, stable in the air, high virulence and so on — and their delivery systems took the form of missiles, cluster bombs and drones, or sprayers and spray tanks fitted to aircraft, cars, trucks and boats. The later, smaller programs viewed biological weapons differently. The South African program focused on assassinations, sabotage operations and the development of a "vaccine" to limit the fertility of black women, and on developing injection systems and concealed delivery devices like sugar cubes, chocolates and cigarettes, seeing biological weapons more as tactical weapons. The Iraqis conceived of biological weapons in yet another way. They focused on their psychological impact, viewing biological weapons more as weapons of terror, where it did not matter if the weapons were poorly designed and ineffective as long as they instilled exceptionally high levels of fear and dread in their enemies.

Bioterrorism

The fear biological weapons can elicit has also appealed to non-state actors. In Chapter 7, political scientist Seth Carus, from the U.S. National Defense University, describes four historical cases where individuals or small groups have attempted to use biological agents as weapons of terror, and he draws out suggestive features that can enrich assessments of the current and future threat. Former British security services analyst Toby Ewin further elaborates what makes terrorists choose, or avoid, biological weapons in his Point of View, reminding us that the terrorism threat is not "a static subject to be 'uncovered' like an archaeological find" but constantly evolving.

Bioterrorism first emerged as a political concept during the early 1990s in the United States. As the Cold War faded, the threat of terrorists armed with biological weapons and other "weapons of mass destruction" (WMD) began to replace the Soviet threat. Different assessments of the importance, urgency and scale of the newly perceived threat were present in the early political debates on bioterrorism (Wright 2007). "Alarmists," who included prominent scientific and technical advisers, tended to emphasize the possibility of "apocalyptic" attacks with natural pathogens and genetically engineered

hybrids, and the vulnerability of the civilian population. They were less focused on the identities of "bioterrorists," and in their interests in pursuing such attacks or in their capacities to do so. "Sceptics," on the other hand, tended to have backgrounds and training in the history, politics and culture of terrorism, and for them, question of identity, interests and details of past attackers were the primary questions to ask. Although little credible evidence existed at the time that terrorists would, or even could, resort to biological weapons, alarmism ultimately trumped scepticism and federal funds poured into new U.S. preparedness and civilian biodefense programs of considerable institutional proportions (Guillemin 2005; Wright 2007).

The "Amerithrax" attacks — as the FBI code-named the series of anonymous letters containing anthrax sent to media outlets and the U.S. Senate within weeks of the "9/11" terrorist attacks on New York and Washington on September 11, 2001 — revealed serious shortcomings in U.S. biosecurity. They also raised fears about the growing potential for bioterrorism on American soil. The threat of bioterrorism became one of the Bush administration's key security concerns during its two terms in office, and, as described by science and technology studies scholar Kathleen Vogel in Chapter 8, initiated a series of new regulations, policies and programs to further strengthen U.S. preparedness and defense against a bioweapon attack.

Concern about the threat of international terrorism coupled with WMD proliferation was also exported from the United States to international security forums and back to capitals around the world. "Bioterrorism" became an international problem requiring a policy response, and counteroffensives materialized in international risk and security strategies. In Europe, the European Commission launched a program to respond to the consequences of WMD attacks, and particularly bioterrorism attacks, already within a few weeks of 9/11 and Amerithrax. The European security strategy, drawn up for the first time in 2003, focused heavily on the new threat from WMD and "terrorists committed to maximum violence."[1] In parallel, the European Union also adopted a strategy against proliferation of WMD.[2]

Dual use research of concern

The global political focus on the bioterrorism threat has been sustained since 2001 by the perception that biological weapons are increasingly becoming accessible through scientific advances.

The BWC prohibits the development, production and stockpiling of biological weapons, but it does not prevent states conducting research activities for peaceful and defensive purposes. However, distinguishing between permitted and prohibited activities is difficult at the level of basic biological research where the same techniques used to gain insight and understanding about fundamental life processes for the benefit of human health and welfare may also be used for the development of BW agents, as biosecurity expert Gigi Kwik Gronvall elaborates in her Point of View contribution.

A set of high profile scientific experiments in the early 2000s added to the growing political concerns about bioterrorism. These aimed to make mousepox more deadly, synthesize poliovirus from scratch, and reconstruct the extinct 1918 flu virus. Experiments aiming to make flu viruses more easily able to spread first attracted attention in 2011. Many scientists and others worried that if the potent new lab strain was accidentally or deliberately released, it could result in a deadly pandemic. By 2012, leading influenza virologists agreed to a voluntary moratorium on these so-called gain-of-function studies, but the work resumed in 2013. New experiments on dangerous flu strains like H5N1, H1N1, H7N9 and H7N1 rekindled concerns — in part because a series of lab accidents and breaches at the Centers for Disease Control and Prevention and the National Institutes of Health had heightened concerns about safety at high-containment labs. In October 2014, the U.S. government stepped in, imposing a federal funding pause on the most dangerous gain-of-function experiments and announcing an extended deliberative process, analyzed by microbiologist Nancy Connell and sociologist Brian Rappert in Chapter 9.

The seminal report framing current discussions about dual use research of concern is the U.S. National Academies of Sciences report *Biotechnology Research in an Age of Terrorism*. In his Point of View,

Dave Franz, a member of the committee behind the report and previous Commander of the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) at Fort Detrick, reflects on how thinking about dangerous life sciences research has developed over the last 15 years.

Global health security

The World Health Organization (WHO), which has traditionally been reluctant to address security-related issues for fear that its public health mission would be compromised, has increasingly been gaining a profile as a key actor in the security world, and it has exerted significant influence on how the perception of biological threats has evolved. From the outset, its overriding message has been that, whatever the cause of epidemics or emerging infectious diseases, the response to them will initially be the same: "In most situations, the public health system will be the first to detect cases and raise the alarm."[3] In other words, the threat of deliberate use of biological weapons should be thought of as part of a wider spectrum of threats that also includes the threat of disease from natural outbreaks and accidental releases, and the most effective response to these threats is to bolster public health measures.

Following this lead, the Obama administration ushered in an evolution in U.S. thinking about its response to bioterrorism. The administration's first major policy initiative on biosecurity was the *National Strategy for Countering Biological Threats*. While the Bush Administration's efforts had been focused on biodefense, this strategy was focused on prevention. It emphasized linking deliberate disease outbreaks from bioterrorism attacks with naturally occurring disease outbreaks, to create a more "seamless" and "integrated" link across all types of biological threats — echoing what the WHO had been pushing multilaterally for years. In his 2011 speech to the UN General Assembly, President Obama called upon all countries to "come together to prevent, and detect, and fight every kind of biological danger — whether it's a pandemic like H1N1, or a terrorist threat, or a treatable disease."[4] In February 2014, the U.S. spearheaded the Global Health Security

Agenda to establish global capacity to prevent, detect and rapidly respond to biological threats. A test case was brewing even as the initiative was getting off the ground. By August 2014, the WHO declared the Ebola epidemic in Western Africa a "Public Health Emergency of International Concern." But as Margaret Chan, the Director-General of the WHO, explained to the international community's premier security forum, the Security Council of the UN, this Ebola epidemic was very different to the many big infectious disease outbreaks managed by the WHO in recent years: "This is likely the greatest peacetime challenge that the UN and its agencies have ever faced. None of us experienced in containing outbreaks has ever seen, in our lifetimes, an emergency on this scale, with this degree of suffering, and with this magnitude of cascading consequences."[5] The Ebola outbreak was characterized not merely as a public health crisis, but as "a threat to national security well beyond the outbreak zones." In Chapter 10, bioethicist Nick Evans considers the international response to the Ebola outbreak and some of the larger implications of securitizing public health.

The lack of vaccines and treatments for Ebola was one of the overriding challenges of the outbreak, and the key lesson coming out was the need to pool risks and share responsibilities in private–public partnerships for medical countermeasure development. The emerging biodefense industry, which often has an unusual disease focus and where there is little to no commercial market, has had years of experience with this. One company, Bavarian Nordic, has demonstrated how private–public partnerships can be successful in the biodefense area. It developed a novel smallpox vaccine and secured a series of contracts to supply the vaccine to the U.S. government stockpile, all the while reinvesting the profits into its cancer and infectious disease research. In his Point of View contribution, Jacob Cohn, Vice President of governmental affairs at Bavarian Nordic, reflects on the company's experiences, and outlines how to nurture the emerging biodefense industry to become not only a vital part of national security but also an asset to global health in the battle against emerging diseases. In Chapter 11, political scientist Greg Koblentz continues the focus on biodefense, and explores how governments can develop defenses against biological threats securely, responsibly, safely, legally,

transparently and in alignment with public health priorities — bringing together some of the key themes raised in earlier chapters of the "Biological weapons in today's context" section.

Governance and responsible research

The normative and legal framework against the use of disease as a weapon is exceptionally strong; yet, as political scientist Marie Chevrier and historian Alex Spelling detail in Chapter 12, the enforcement mechanism remains weak. Unusually for an arms control treaty, the BWC was agreed without routine on-site verification mechanisms to enhance assurance of compliance. Some states argued that the nature of biological weapons is such that they are inherently impossible to verify: not only can significant quantities of biological agents be produced in small and readily concealable facilities, but most of the equipment required — the fermenters, centrifuges and freeze-dryers — is ubiquitous in public, private and commercial laboratories. Other states argued that, while the same level of accuracy and reliability as the verification of, for example, nuclear arms control treaties is unattainable, it is possible to build a satisfactory level of confidence that biology is only used for peaceful purposes.

In the Witness Seminar, Jeanne Guillemin, Matt Meselson, Julian Robinson and Nicholas Sims provide first-hand insights into the delicate treaty negotiation process in the late 1960s, early 1970s. Their narratives highlight the significant role played by life scientists, as political advisors, technical experts and advocates, in getting biological weapons on the international disarmament agenda, in building support for a treaty and pushing it through to agreement. The Interview with biologist and activist scientist Steven Rose focuses on the political role of scientists in the 1960s and 1970s, the revulsion they felt about the military misuse of their science, and their efforts to sound the alarm. The life science community continues to play a crucial role in sustaining biological disarmament and non-proliferation, and political scientist Jo Husbands' Point of View makes the case for framing scientist engagement in terms of professional ethics and the responsible conduct of science, rather than in terms of legal obligations.

The responsible conduct of science is also one of the core ambitions of the biological CTR initiative of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. Originally focused on former Soviet Union states, and on destroying stockpiles of biological weapons, dismantling production facilities, redirecting research to peaceful purposes, and reemploying former weapons scientists, the initiative now emphasizes biosafety and biosecurity, disease detection and control, and scientist engagement — in line with changing political conceptions of the biological threat and the Global Health Security Agenda, as described in the Interview with Trevor Smith from Canada's Global Partnership Program. In their Point of View contribution, Melissa Finley and Jen Gaudioso, from Sandia National Laboratories, provide examples of the frontline work of biological CTR demonstrating the diversity and complexity of their programs, which have expanded beyond former Soviet Union states into Africa, the Middle East and Asia.

The final contribution of the volume is a Roundtable with five of today's foremost experts on biological disarmament and non-proliferation: Iris Hunger, Jez Littlewood, Caitríona McLeish, Piers Millett and Ralf Trapp. They discuss and reflect on contemporary biological weapons threats, the management of misuse risks and the shifting nature of biological threats.

Editor's note: All contributions to this volume are in a personal capacity; the views expressed are those of the authors and do not necessarily represent the views of the organizations where they are or were employed. The witness seminar, interviews and roundtable are all edited versions, where the contributors were provided with the opportunity to comment on and amend the text.

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Notes

[1] European Council (2003) *European Security Strategy: A Secure Europe in a Better world*, adopted December 12, 2003, Brussels.

[2] European Council (2003) EU Strategy Against the Proliferation of Weapons of Mass Destruction, adopted December 12, 2003, Brussels.

[3] World Health Organization (2002) 'Preparedness for the deliberate use of biological agents: A rational approach to the unthinkable' WHO/CDS/CSR/EPH/2002.16.

[4] https://www.whitehouse.gov/the-press-office/2011/09/21/remarks-president-obama-address-united-nations-general-assembly (accessed March 17, 2016).

[5] http://www.who.int/dg/speeches/2014/security-council-ebola/en/ (accessed March 17, 2016).