Why the United States Rejected the Protocol to the Biological and Toxin Weapons Convention

Kathleen C. Bailey

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Executive Summary

In November 2001, the United States formally rejected the draft Protocol to the Biological and Toxin Weapons Convention, which had been under negotiation since 1995. The purpose of the Protocol was to increase confidence that nations are in compliance with the Convention, which outlaws development, production, and stockpiling of pathogens and toxins for nonpeaceful purposes. The rejected Protocol was a product of the negotiations chairman and was not a consensus document as required by the Protocol negotiating mandate. US or other nations' adherence or commitment to the Biological and Toxin Weapons Convention is unaffected by rejection of the Protocol.

In rejecting the draft Protocol, US officials stated that it would add nothing to US or international verification capabilities. The United States has held consistently, since the entry into force of the Biological and Toxin Weapons Convention, that the treaty is not verifiable. The materiel, equipment, and technology for making weapons is the same as that used for legitimate scientific and industrial endeavors; the difference between a biological or toxin weapons (BTW) program and peaceful biotechnology pursuits is solely one of intent.

Furthermore, the Protocol would have substantial downsides, namely: US defenses against biological and toxin warfare would be revealed to potential aggressors, proprietary intellectual property from the US pharmaceutical and biotechnology industries would be at great risk of loss, and the efficacy of multilateral export control regimes would be endangered.

The United States has advocated, along with some other like-minded nations, a number of initiatives, examples of which include enhanced disease surveillance, worldwide criminalization of biological and toxin terrorism, and preparations for defense against potential attacks using such weapons. Organizations such as NATO, the World Health Organization, and the G-7 are more appropriate contexts for pursuing these initiatives.

Given that the Protocol is unacceptable and cannot be fixed, and that the initiatives most likely to be successful in dealing with the threat of biological and toxin weapons can best be undertaken outside of any arms control treaty, what should happen in November 2002, when the Convention's Review Conference is set to reconvene? At that time, a decision must be made on what to do with the multilateral Ad Hoc Group that negotiated on the Protocol unsuccessfully. The three basic options are to redirect the multilateral process within the context of the Convention, end the process, or postpone decision.

Redirecting the multilateral process is fraught with difficulty. The Non-Governmental Groups and arms control activists that formulated the Protocol are almost certain to remain engaged in any continued process. They are committed to declarations and inspections as a "solution" and are very likely to continue to push for adoption of such measures. This, coupled with the fact that needed initiatives can be undertaken better in other contexts, indicates that the most constructive course of action would be to disband the multilateral process.

The focus of our energies, monies, and expertise should be on preparing to respond effectively to BTW use. This requires improving our human-source intelligence and analysis, our technical capabilities to detect and identify agents, and medical countermeasures. We must also continually reassess and enhance education and training of medical and response personnel, as well as public health infrastructure, particularly at the local level. And, we should not assume that deterrence won't work. We should define and clearly communicate a doctrine that BTW use will be met with swift, proportional, decisive response.

Introduction

Biological weapons and toxin weapons have the capacity to kill and/or harm literally millions of people.[1] They may also devastate food animals and crops, causing severe economic disruption[2] and, perhaps, widespread starvation. The fact that Iraq, North Korea, and several other nations have such weaponry—in defiance of the Biological and Toxin Weapons Convention of 1972—makes the prospect of use of these weapons more likely. And, as the terrorist use of anthrax in the United States proved, any number of terrorists or subnational groups may acquire and use BTW.

Defenses against BTW are seriously inadequate. The problem is, to some extent, due to the multiplicity of pathogens and toxins. There are approximately 30 diseases that may be used effectively as biological weapons. Table 1 lists the categories of BTW that have been identified by US national public health officials as those against which it is most critical to prepare. Even when means are devised to counter a disease or toxin used as a weapon (e.g., drugs to treat diseases or vaccines), those defenses may be defeated. For example, the Soviet Union cultivated bacteria in media containing Western antibiotics to make the bacteria resistant to drug treatments.[3]

The challenge of finding a prophylactic or treatment for diseases that can be used as weapons is made more difficult by the advent of genetic engineering, which allows pathogens to be changed. Benign organisms can be engineered to become harmful; pathogens can be made more deadly; or, diseases can be made to foil countermeasures such as vaccines or post-infection drugs, or to evade detection methods. Genetic engineering can also be used to increase toxin production or to make an otherwise non-toxic agent harmful.

Defenses against BTW are also complicated by the variety of delivery means available to the aggressor. Aerosol generators are one often-mentioned method. Vectors, such as mosquitoes or fleas, are another means. Supplies of food and water may be surreptitiously contaminated. And, of course, delivery vehicles such as artillery shells, missiles, and aircraft may carry BTW.

The difficulty of defending against BTW may be best exemplified by the threat of technically unsophisticated cruise missiles. Small, unmanned aerial vehicles—or even model airplanes—could be outfitted to deliver biological agents. Such a missile could easily be constructed within the United States, smuggled in, or launched from just offshore. Current air defenses are unable to detect the flight of such missiles and there is no broad-based capacity to destroy them even if they were detected.

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[1] For example, more than 500,000 deaths resulted from the influenza pandemic of 1918-19. See K.F. Gensheimer, et al, "Preparing for Pandemic Influenza: the Need for Enhanced Surveillance," *Emerging Infectious Diseases*, Vol. 5, No. 2, March-April, 1999, p. 297.

[2] It is difficult to estimate the extent of economic damage caused by a biological weapons attack, in part, because the effect of an attack varies with the type of pathogen used. One model shows that the economic damage from an attack can range from about $477.7 million per 100,000 persons exposed to brucellosis, to an estimated $26.2 billion per 100,000 persons exposed to anthrax. See Arnold F. Kaufmann, Martin I. Meltzer, and George P. Schmid, "The Economic Impact of a Bioterrorist Attack: Are Prevention and Postattack Intervention Programs Justifiable?" in *Emerging Infectious Diseases*, Vol. 3, No. 2, April-June 1997.

[3] This was publicly revealed in 1993 by Vladimir Pasechnik, a senior biologist who defected to Britain in 1989, during an appearance on BBC's 'Newsnight' program. See Bill Gertz, "Russia Has Biological Weapons, Defector Says," *The Washington Times*, 22 January 1993, p. A9.

Table 1. Critical biological Agent Categories for Public Health Preparedness

Biological Agent(s)	Disease
Category A	
Variola major	Smallpox
Bacillus anthracis	Anthrax
Yersinia pestis	Plague
Clostridium botulinum (botulinum toxins)	Botulism
Francisella tularensis	Tularemia
Filoviruses and Arenaviruses (e.g., *Ebola virus, Lassa virus*)	Viral Hemorrhagic fevers
Category B	
Coxiella burnetii	Q Fever
Brucella spp.	Brucellosis
Burkholderia mallei	Glanders
Burkholderia pseudomallei	Melioidosis
Alphaviruses (encephalomyelitis viruses)	Encephalitis
Rickettsia prowazekii	Typhus Fever
Toxins (e.g., Ricin, Staphylococcal enterotoxin B)	Toxic syndromes
Chlamydia psittaci	Psittacosis
Food safety threats (e.g., *Salmonella spp, Escherichia coli* O157:H7)	
Water safety threats (e.g., *Vibrio cholerae, Cryptosporidium parvum*)	
Category C	
Emerging threat agents (e.g. *Nipah virus*, hantavirus)	

Source: "Public Health Assessment of Potential Biological Terrorism Agents," *Emerging Infectious Diseases*, Vol. 8, No. 2, February 2002, p. 226.

The threat posed by BTW is so severe, and the means to combat such weaponry are so limited, that the impulse of many representatives of governments around the world has been to try "fix" the problem with arms control. In the past few years, the focal point of that effort has been to draft a Protocol to the Biological and Toxin Weapons Convention (BTWC).[4] Arms control advocates have sought to supplement the treaty with a legally binding agreement comprised of regulations, reporting requirements, on-site activities, an international organization or bureaucracy with oversight functions, and a continuing process such as review conferences and working groups. The United States has participated in the Protocol negotiations since their onset in 1995.

At the Fifth Review Conference of the BTWC in November, 2001, the United States formally rejected the draft Protocol, after having indicated prior to the meeting that it would do so. Simply stated, the US Government concluded that the Protocol may cause significant harm while not achieving the Protocol's objective of strengthening confidence in compliance with the Convention.

The US position caused significant international consternation, particularly among ardent arms control advocates who had put much effort into drafting the Protocol. Some Conference attendees believed that more time might lead to settling of differences regarding the Protocol and the Ad Hoc Group that negotiated it. Many wanted to see the Ad Hoc Group continued and opposed the US demand that the Group and its mandate be terminated formally. For this reason, the meeting was adjourned rather than

[4] In the United States, the treaty is most often referred to with the acronym BWC. This author prefers BTWC to emphasize the role of toxins, which pose an increasing threat in the context of bio-terrorism and biological warfare.

ended. The Conference is scheduled to reconvene for two weeks starting 11 November 2002. Given that there will still be substantial support for enacting the Protocol, it is important to reexamine the reasons for rejecting the Protocol and to explore potential alternatives, if any.

This monograph explains the reasons behind the US Government's decision not to support the Protocol and discusses potential options for what might be done now. It should be kept in mind that rejection of the Protocol does not, in any way, affect US support of the BTWC. The US Government has made clear its determination to support the treaty and to continue to work to strengthen it. As Ambassador Donald Mahley has stated:

> The mandate for the protocol negotiations specifically prohibits any result from modifying, reducing, or altering the basic obligations of the convention itself. Thus, the commitment of the states parties to the (BTWC), including the United States, should not be altered by the outcome of the protocol negotiations.[5]

Background on the BTWC and the Protocol

The threat of BTW exists despite the international ban on such weapons codified by the 1972 BTWC, a treaty that entered into force in 1975 and now has 144 nations as States Parties. The BTWC prohibits the development, production, stockpiling, acquisition, and transfer of biological agents and toxins for hostile purposes. The treaty does not, however, prohibit these same activities if they are done for peaceful purposes. The difference between the two is solely a matter of intent.

At the time the treaty was drafted, it was widely recognized that there were no technical means to verify that nations were not engaged in BTW research, production, or stockpiling of weapons. Additionally, it was considered politically impossible to gain support for intrusive inspections, the technique then widely believed to hold the most promise for verification.

Following an outbreak of anthrax in the Soviet Union in 1979, the deficiencies of the BTWC in the face of violations became more apparent. The Soviets claimed that the outbreak, which caused some 70 fatalities, was caused by people eating tainted meat. US Government officials were highly suspicious that it was due to a release of anthrax spores from a biological weapons facility. (Russian leaders later admitted publicly that the outbreak was due to their BW program.) US officials knew that sampling the type of anthrax involved in the outbreak would provide important evidence that could help determine the truth. However, there were no established measures for inspections or sampling that could be utilized to gain access to the victims or to the suspected weapons facility. The United States could have taken the compliance dispute to the UN Security Council, but did not do so because any Council action would probably have been vetoed by the Soviet Union.

The anthrax outbreak in the Soviet Union marked a turnaround in the thinking of many policy-makers in Washington DC. Although there was still a realization that the BTWC could not be verified, per se, there was increased support for establishing some means by which sites of suspected biological weapons production or locations of outbreaks could be visited to gather information. Thus, there was renewed interest in Washington in exploring ways to enhance compliance with the BTWC. The emphasis remained on seeking transparency regarding biological-related activities rather than the types of verification procedures that typified other arms control treaties.

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[5] Ambassador Donald A. Mahley, Special Negotiator for Chemical and Biological Arms Control, US Department of State, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs and International Relations, 10 July 2001, available at http://reform.house.gov/ns/107th_testimony/testimony_donald_a_mahley_july_10.htm (access date 23 September 2002).

In the early 1980's, parties to the BTWC developed a set of confidence-building measures. A plan was formulated whereby parties to the BTWC would regularly and voluntarily provide data on their permitted activities and facilities that might potentially relate to biological or toxin warfare, with the intent of increasing transparency. These so-called confidence-building measures were adopted at the Second Review Conference in 1986. (The BTWC provides for review conferences to be held at five-year intervals to assess whether the treaty's objectives are being achieved.) Additionally, the Final Declaration of the 1986 Review Conference called for establishment of an Ad Hoc Group of scientific and technical experts to develop procedures for implementing the annual data exchanges. In 1991, additional non-binding measures were adopted with the same goal of building confidence in BTWC compliance.

In the years following adoption of the transparency measures, less than half of the Parties participated in the data exchanges. Many of those that did participate responded in a minimal manner. The requirements were viewed by nations (and by research and commercial entities) as burdensome. Additionally, some nations felt that monitoring legitimate biological-related activities would have little impact on the potential for biological and toxin weapons proliferation. Any nation seriously attempting to develop BTW would be highly unlikely to declare and disclose information on its program and weapons facilities.

Faced with the failure of the transparency measures, arms control advocates began to press for a more rigorous verification regime, including inspections, to be embodied in a Protocol to the BTWC. Progress toward completion of the Chemical Weapons Convention, which contained verification measures, added impetus for similar action on the BTWC. Although the Protocol idea was strongly supported by delegations of some States Parties, great pressure for a Protocol also came from Non-Governmental Organizations (NGOs) and arms control interest groups, many of which had a strong presence in Geneva. These groups regularly produced papers, gave briefings, and lobbied States Parties to draft a Protocol.[6]

At the Third Review Conference of the BTWC, in 1991, international events again set the stage for pressures to devise verification provisions. Additional intelligence information acquired by the United Kingdom and the United States bolstered the case that the Soviet Union had been pursuing a very large-scale biological weapons program in violation of the BTWC. Also, awareness of the Iraqi biological weapons activities had increased as a result of Desert Storm and the initiation of inspections by the UN Special Commission on Iraq (UNSCOM).

Although the United States supported continued search for ways to strengthen confidence that parties were in compliance with the BTWC, it continued to maintain that there were no cost-effective, meaningful steps that could be taken to verify the BTWC. In 1991, Ambassador Ronald F. Lehman made a strong statement to the Third Review Conference opposing negotiation of a formal verification protocol on three grounds:

- The BTWC can not be verified effectively[7] because biological production facilities are dual-use and lack distinctive "signatures."

[6] For example, the Federation of American Scientists, among others, produced many papers and briefings that ultimately became part of the draft Protocol.

[7] The verification standard commonly accepted in the US policy community was that a measure should make it more likely than not that noncompliant activity could be identified before that activity resulted in a significant security risk to the US and to US allies.

- A negotiated regime can not be sufficiently intrusive to detect clandestine facilities. Yet, the regime can generate false confidence that a country is in compliance with the treaty when in fact it was not.

- Highly intrusive inspections by multinational teams can expose both government and commercial facilities to foreign espionage. In particular, the loss of valuable trade secrets can weaken the competitive edge of the US biotechnology and pharmaceutical industries.[8]

Some other nations, particularly European and Western Group nations, argued that even less-than-effective measures could strengthen the treaty. These nations did not share the US view that inspections and other verification-related activities could cause greater harm than good.

The 1991 Review Conference resulted in a compromise. Although the United States successfully resisted efforts to begin negotiation of a legally binding Protocol for BTWC verification, it did agreed to continue to research measures for the future. The decision was to create an Ad Hoc Group of governmental experts, called VEREX. The charter of VEREX was to investigate potential verification measures solely from a scientific and technical viewpoint. It had no negotiating mandate. VEREX met for a total of four times in 1992 and 1993 and drew up a consensus report. The report found that some measures, either singly or in combination, have the potential to strengthen the BTWC by helping to differentiate between prohibited and permitted activities.

A Special Conference of BTWC parties was called in September 1994 to review the VEREX report. This Special Conference concluded that an Ad Hoc Group would be convened to develop a legally binding Protocol to the BTWC. The United States, which had just undergone a change of administration with the election of Bill Clinton, supported the Ad Hoc Group formation. The United States expressed hope that the draft protocol could be completed in time for consideration and adoption at the Fourth Review Conference scheduled for 1996.[9]

When negotiations on the protocol began in 1995, the US Government reaffirmed its consistently held position that the BTWC is not verifiable. "[T]he goal established by the [Clinton] administration was to promote measures that would provide some degree of increased *transparency* of potential biological weapons-related activities and facilities."[10]

The Ad Hoc Group met regularly in Geneva under the Chairman, Ambassador Tibor Tóth of Hungary. In 1997, a draft text was produced with brackets around the many provisions not yet agreed upon. From 1997 onward to 2001, the Ad Hoc Group struggled without reaching consensus. This was a crucial issue because the charter of the Ad Hoc Group requires that the draft Protocol be a consensus document.

Ambassador Tóth formally issued his own version of a Protocol, removing all brackets regarding issues that were still in dispute, at the Ad Hoc Group's 23rd session on April 23, 2001. The 210 page document

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[8] Statement before the Third Review Conference, September 10, 1991, cited in United States Congress, Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction* (Washington, DC: US Government Printing Office, 1993), p. 74.

[9] US Arms Control and Disarmament Agency Factsheet, "The Biological Weapons Convention: The Special Conference and Beyond," 9 August 1994, available at http://dosfan.lib.uic.edu/acda/factshee/wmd/bw/bcc-spec.htm (access date 16 June 2002).

[10] Dr. Edward J. Lacey, Principal Deputy Assistant Secretary of State for Verification and Compliance, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, 10 July 2001, available at http://reform.house.gov/ns/107th_testimony/testimony_of_dr_lacey.htm (access date 23 September 2002).

totaled 30 articles, 3 annexes, and 9 appendices. The essential elements of the Protocol drafted by Ambassador Tóth are the requirements for declarations, investigations, confidence-building visits, and technology transfer.

The draft Protocol is modeled on past arms control treaties' verification procedures and implementation measures. In particular, it closely resembles the Chemical Weapons Convention (CWC). Features of the Protocol that are very similar to provisions of the CWC are:

- Declarations of all past offensive and defensive BTW activities, as well as annual declarations of biological activities in biodefense, maximum and high containment laboratories, work with listed agents and toxins, and microbiological production facilities. As a practical matter, it would not require declaration of brewers, yogurt makers, and other types of laboratories.

- Transparency visits to assess accuracy and completeness of the declarations.

- Investigations (e.g., inspections) to examine potential non-compliance with the treaty. "Facility investigations" are to address concerns that a particular site is engaged in activities prohibited by the BTWC. "Field investigations" are to examine charges that there may have been an accidental release of biological agents or toxins or an actual use of BTW.

- Managed access as a means to try to protect proprietary and classified information.

- An international bureaucracy to oversee implementation of the Protocol.

The Protocol drafted by Ambassador Tóth did not incorporate a number of substantive points long insisted upon by the United States. Additionally, the text contained many elements strongly opposed by the United States. As a result, the United States swiftly rejected the Protocol.

On July 25 2001, Ambassador Donald Mahley, US Special Negotiator for chemical and biological arms control issues, announced in Geneva that the United States would formally oppose the Protocol. An unidentified US official elaborated, saying that the Protocol added nothing to our verification capabilities and that "…looking at this treaty in purely cost-benefit terms, it has zero benefits. And it has three categories of substantial downsides." US officials listed the downsides:

> First, it would have caused risks in US biological warfare defensive preparations. Second, there was a risk of the loss of highly sensitive and highly valuable intellectual property from the US pharmaceutical and biotechnology industries, and finally the risk of the loss of integrity and utility in the multilateral export control regimes the US participates in.[11]

The following sections will examine each of these arguments—nonverifiability, risks to biodefense, risks to the US pharmaceutical and biotechnology industries, and potential damage to multilateral export control regimes—in more detail. It should be noted, however, that there are a host of other problems with the Protocol that will not be discussed here. They range from the ease with which an investigation could be blocked under the Protocol, to the historical evidence that nations found to be in noncompliance with arms control agreement(s) suffer no serious consequences.[12]

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[11] Merle D. Kellerhals, Jr., US Department of State, "Proposed Biological Weapons Protocol Unfixable, US Official Says," 25 July 2001, available at http://usinfo.state.gov/topical/pol/arms/stories/01072503.htm (access date 8 June 2002).

[12] For a thorough critique of these and other problems with the Protocol, see Michael Moodie, "The BWC Protocol: A Critique," *Chemical and Biological Arms Control Institute Special Report*, June 2001.

Principal Reasons for US Rejection of the Draft Protocol

Non-verifiability of the BTWC

An arms control treaty is effectively verifiable if it is more likely than not that cheating will be detected in a timely manner. In the case of the BTWC, the United States has always held that the treaty is not effectively verifiable. This is due to the fact that any nations (or some groups or individuals) that want to secretly make biological or toxin weapons can do so with little or no risk of discovery. Thus, addition of a protocol "…would not improve our ability to effectively verify compliance with the [BTWC] either in terms of certifying that country is in compliance with, or in violation of, its obligations."[13]

Why is it so much more difficult to verify compliance with the BTWC, as compared with other arms control agreements? The answer lies in the facts that biological and toxin agents are easy to make and that the technologies, materiel, and equipment are dual-use—that is, they can be used both for peaceful and nonpeaceful purposes. The science of making weapons and making treatments for diseases are one in the same; only a matter of intent separates the two.

The Ease of Making BTW Agents

In the 1960's and early 1970's, when the BTWC was being formulated, negotiators realized that there were no technologies available then that would determine whether a nation, group, or individual clandestinely has produced or stockpiled BTW. This fact remains true today and it is important at the outset to understand the reasons why.

Biological and toxin agents that can be used against man, other animals, and plants can be produced with readily available equipment and materiel that have many common uses in legitimate research and industry. This point is extremely important and must be emphasized: none of the items required for making BTW—beakers, fermenters, growth media, etc.—need be specialized. Thus, it would be possible for an individual, group, or government to buy all the necessary manufacturing equipment openly, without arousing suspicion. These could be bought from laboratory supply houses or catalogs. A small-scale, rudimentary production capability—one that is fully functional—could be built using items purchased in hardware and cookware stores. As a result, export controls, which have proved useful in combating nuclear and chemical weapons proliferation, simply will not work vis-à-vis BTW proliferation.

Many of the pathogens usable as weapons are found naturally occurring in nature.[14] For example, anthrax is endemic in many regions of the world. Although gathering samples and separating the organism of interest requires some expertise, many, many people worldwide have the ability to undertake this type of basic biological endeavor.

While many pathogens are readily available in the environment, samples also are stockpiled by some 472 organizations in 61 countries that supply them to health researchers throughout the world.[15] The American Type Culture Collection in the United States, for example, has a vast number of strains of

[13] Lacey, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, 10 July 2001.

[14] Genetically engineered pathogens, or those that are not ubiquitous, are obviously less available and would require greater resources to acquire or develop.

[15] William Broad, "World's Largest Germ-Bank Union Acts to Keep Terrorists from Stealing Deadly Stocks," *The New York Times*, 10 October 2001, p. B9.

diseases. While individuals previously could obtain pathogens from such organizations quite easily, in the United States the procedures have been tightened in response to the growing threat of BTW proliferation and terrorism.[16]

Samples of some pathogens are also kept in hospital and veterinary laboratories. They could be stolen. It is also possible that deadly agents could be stolen from the archives of existing or former BTW programs.

Toxins may be acquired by cultivating the organism that produces them. Alternatively, some small toxin genes may be synthesized by using openly available databases.

In the case of many toxins and pathogens, there are legitimate reasons for having small stocks on-hand. They may be used to research and produce medications and vaccines, for example. Several potent toxins—saxitoxin, botulinum toxin, ricin, tetrodotoxin, and others—can be used to treat diseases.[17]

It is important to note the wide range of types and sizes of facilities in which BTW can be produced and stored. Because the number of facilities in which BTW activities could take place is so large, the focus of the draft Protocol was necessarily limited to inspections of certain types of declared facilities. It is probable that a nation would either not declare the facility where BTW activities are or have been, or it would make sure that the risk of discovery in a declared facility is little or nil.

BTW agent-manufacturing sites can be as simple and small as a room in a house because the required equipment and materiel are not large. A small ten-liter fermenter would suffice for a terrorist's purposes. Large-scale production of BW agents can occur in small-scale buildings with no remarkable features to distinguish them.[18] It is also possible to locate a BTW-production facility in a mobile vehicle or underground.

BW agents also could be produced easily in a host of different types of commercial or research facilities, such as a hospital laboratory, a pharmaceutical plant, a yogurt factory, or a beer brewery. It is even possible that a portion of a legitimate facility could be used briefly for illicit purposes without the knowledge or approval of the owners or managers of the facility. Production can occur for a short time (e.g., hours or days) and then be shut down. (For example, a single 100-liter fermenter could produce ten thousand million infectious doses of anthrax bacteria in a single week.[19]) Evidence of production can be cleaned up quickly and easily, leaving no telltale signs that would be observable to inspectors. It is also conceivable that illicit production of BTW agents could take place, without detection, even when inspectors are on-site looking for such activity.[20]

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[16] In 1997, the US Centers for Disease Control & Prevention began regulating interstate transfers of particularly dangerous pathogens and toxins. The US Department of Agriculture similarly acted to control transfers of plant and animal pathogens.

[17] Alan Zelicoff, "The Dual-use Nature of Biotechnology: Some Examples from Medical Therapeutics," Lawrence Livermore National Laboratory, *The Director's Series on Proliferation* (UCRLR-114070-4), 23 May 1994, pp. 79-84.

[18] The equipment for larger scale production is not large. For example, A fermenter capable of producing many kilograms of botulinum toxin can measure only 10 feet high and 5 feet wide.

[19] United Kingdom Secretary of State for Foreign and Commonwealth Affairs, "Strengthening the Biological and Toxin Weapons Convention: Countering the Threat from Biological Weapons," April 2002, p. 4, available at http://files.fco.gov.uk/npd/ btwc290402.pdf (access date 19 September 2002).

[20] For a description of different types of scenarios by which a nation, group or individual could clandestinely make BTW, see Kathleen C. Bailey, "Responding to the Threat of Biological Weapons, *Security Dialogue*, Vol. 26, No. 4, December 1995, pp. 387-8.

Given the large number of potential production sites and the lack of telltale attributes that would draw attention to a BW agent-production site, discovery would almost certainly depend upon obtaining accurate, timely human-source information about the location and activity. Inspections would not be likely to discover the activity.

Some experts disagree with the conclusion that inspections are highly unlikely to reveal illegal activity. They have concluded that "if multidisciplinary inspection teams are allowed sufficient time on site and empowered to use pre-inspection research and analysis, site tours, document reviews, interviews, and sampling, they can discern legitimate from cheating facilities."[21] The point being made—that if very intrusive methods were allowed, then verification might be possible—is faulty.

Intrusive inspections have not been very successful in uncovering the nature or the extent of BTW programs, as will be outlined below in the sections on trial inspections and Iraq. Moreover, we cannot conclude that illegal BTW activities will take place in declared facilities or at a time when inspectors are present. More likely is the case that BTW production and storage will take place in secret, undeclared facilities or in declared facilities at a time when inspectors are not present.

Because the raw materials and equipment necessary for BW production are widely available and multi-use, and the facilities can be small and without remarkable features, there is nothing unique that would signal noncompliance with the BTWC.

In summary:

- The technology for BTW production is relatively simple and cannot be controlled.
- The equipment and materiel to produce biological and toxin weapons are the same as those necessary for pharmaceutical research and manufacture, as well as a host of other legitimate commercial and research activities. They are readily available.
- Many pathogens and toxins are readily available.
- The facilities required can be very small. Alternatively, a legitimate facility can be used clandestinely for illicit BTW purposes. Clean-up of the production site can be fast and easy.
- There is no technology or procedure, at present, that can detect BTW production or storage.

Proving the Point: US Trial Inspections

Although the United States took the position that the BTWC was unverifiable from the outset, it agreed to explore any technology or procedure that might serve to bolster compliance with the BTWC. For this reason, the United States actively participated in the VEREX and Ad Hoc Group efforts to develop confidence-building measures for the treaty.

As part of its contribution to these efforts, the United States undertook a series of inspections exercises to determine whether a set of arms control measures—managed access, compliance checking, and declaration validation—would enhance the prospects of BTWC compliance. During the period 1994 to

[21] Henry L. Stimson Center, *Compliance Through Science: US Pharmaceutical Industry Experts on a Strengthened Bioweapon Nonproliferation Regime*, Stimson Center Report No. 48, p. 25, available at http://www.stimson.org/pubs.cfm?ID=66 (access date 28 September 2002).

1996, the US Departments of Energy and Defense undertook an extensive set of mock inspections carefully designed to determine whether such exercises could contribute to confidence-building or, more importantly, help determine compliance with the BTWC.

These exercises were conducted in a highly rigorous manner using scientific methods and controls.[22] Participants in the process were unbiased with regard to the Protocol; they had no hidden agenda to find in favor or against the proposed measures. The mock inspections were conducted at a vaccine manufacturing facility, a Department of Defense biological weapons defense laboratory, a university medical school, the most advanced aerosol-biology facility in the United States, and at an explosives testing facility. The trial inspections demonstrated that the proposed measures contained in the BTWC Protocol would be of little or no use in detecting BTW agent development or production.

A principal outcome of the mock inspections was that a protocol for checking national declarations would not build confidence. Indeed, such checks almost certainly would result in more ambiguous data that might generate more suspicion. A key for this is that the activities normally carried out in pharmaceutical and bio-defense facilities are indistinguishable from those that would be used to develop and produce BTW agents. The difference is merely one of intent. Also, efforts by the visited site to protect data often raised more questions as well as more suspicions. This situation can result in an innocent firm or laboratory being falsely accused and having no way to "prove" its innocence.

Other US experts have reached the same conclusions. A group of representatives of the biotechnology and pharmaceutical industries were assembled by the Henry L. Stimson Center to examine the draft Protocol's monitoring techniques. The Stimson report stated:

> "When they reviewed the investigatory and non-challenge procedures in the draft BWC monitoring protocol, the industry group concluded that what the Ad Hoc Group had crafted would not allow the inspectors to determine what was happening at facilities. Instead of clarifying compliance matters, the inspectors would end up adding to uncertainties by leaving a question mark hanging over legitimate facilities and covert weapons sites alike. The industry experts were so unimpressed with the draft BWC protocol that they gave it a grade of "D."[23]

The mock inspections did reveal that challenge inspections, in some situations, could be useful to some degree. If a very specific allegation were to be made about BTW use in a given location, and if prompt access to that place were granted, it is possible that any illegal activity there would be discovered. In such a situation, however, it may not be possible to determine what government, group, or individual use the BTW, a point demonstrated by the difficulty in finding the person(s) who mailed anthrax in the United States. In many cases, however, a challenge inspection will be of no use. A challenge inspection to a pharmaceutical facility, for example, would be unlikely to uncover illicit activity even if they existed, due to the size and multiplicity of the processes taking place there.[24]

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[22] There were some trial inspections conducted by other countries that yielded results at variance with those conducted by the United States. Many in the US technical and political community viewed the non-US trial inspections as being seriously flawed in terms of scientific procedure, incompleteness, and political motives.

[23] Stimson Center, *Compliance Through Science*, p. 16.

[24] Alan P. Zelicoff, Senior Scientist, Nonproliferation Initiatives, Sandia National Laboratories, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, 5 June 2001, p. 3, available at http://reform.house.gov/ns/107th_testimony/testimony_of_al_zelicoff.htm (access date 23 September 2002).

Proving the Point: The "Real-Life" Case of Iraq

There is no more instructive a case on why the BTWC is unverifiable—and why inspections are insufficient to ensure compliance—than Iraq. Prior to Iraq's defeat in Desert Storm, the United States had suspicions that Saddam Hussein's government was engaged in biological weapons work. These suspicions were based largely on human-source intelligence, as well as on information regarding Iraqi imports of equipment that could be used for agent production and, particularly, weaponization. However, the types of agents produced, quantities, and extent of weaponization were not known.

After the war, inspectors for UNSCOM began in 1991 to search for Iraqi biological and toxin weapons capabilities and stockpiles. During initial interviews with UNSCOM inspectors, Iraqi officials admitted that Iraq did indeed have an biological weapons research program and had produced limited quantities of a few agents. Iraq claimed that the small program had ended in 1990 and that all agents were destroyed. UNSCOM began a series of inspections of dozens of Iraqi facilities—a process that spanned four years—to try to uncover the extent and nature the BTW program. Inspectors used the 21 measures developed by the VEREX, (the group formed by States Party to the BTWC to develop verification for the Convention) to enhance BTWC compliance.

Despite comprehensive mandatory declarations and inspections far more intrusive and frequent than provided for in the draft BTWC Protocol, Iraq was able to obscure its BW program. Inspectors were deeply suspicious, but could find no clear evidence either of research and production of agents or of stockpiles.

It was not until the defection in 1995 of the late Hussein Kamel that the extent of the Iraqi BTW program became clear. Kamel, the son-in-law of Saddam Hussein, gave information that led to the discovery of a vast BTW program. The inspectors, tipped by Kamel's information, found many documents that informed them, for the first time, of the extent of Iraq's BTW research and production.[25] Faced with the evidence, Iraq finally admitted that it had produced a half million liters of BW agents.

Although the quantities of agents produced remain in question, it is undisputed that Iraq manufactured multiple BW agents, including: thousands of liters of *Bacillus anthracis* (anthrax) in concentrated form, aflatoxin, many thousands of liters of *Clostridium botulinum* (spores and toxin), wheat smut, *Clostridium perfringens*, and a plant-derived toxin, ricin. Iraq also produced *Bacillus subtilis* and *Bacillus thuringiensis*, which are *Bacillus anthracis* simulants). It is also possible that Iraq has types of biological and toxin agents that it did not declare.

Without the information provided by a defector, the extent and depth of the Iraqi BTW program may never have been known. Although the existence of the program was not in doubt, inspectors were unable to find clear evidence of the kinds of agents produced or of their quantities. In short, "...UNSCOM's experience in Iraq challenges the conventional wisdom that intrusive inspections can provide convincing proof of violations and resolve suspicions."[26]

Iraq probably has kept up its BW research, development, and production despite efforts by the UN to destroy the program. Even if inspections, halted in 1998, were resumed, it is unlikely that all BTW stockpiles, facilities, and capabilities would be uncovered. Iraq has learned well how the inspections

[25] For a description of what was known in 1995 about the Iraqi BTW program prior to the defection of Hussein Kamel, see Kathleen C. Bailey, *The UN Inspections in Iraq: Lessons for On-Site Verification* (Boulder, CO: Westview Press, 1995), pp. 37-45.

[26] Robert P. Kadlec, Allan P. Zellicoff, Ann M. Vrtis, "Biological Weapons Control: Prospects and Implications for the Future," *Journal of the American Medical Association*, Vol. 278, No. 5, 6 August 1997, p. 352.

process works and has undoubtedly become even more adept at hiding its BTW program. Given the fact that there are no technologies that can detect hidden BTW activities and stockpiles, we will be unable to determine what and how much remains hidden.

Sensitive Information Could Be Compromised

The second principal reason given by the US Government for rejecting the draft Protocol was that it could result in compromising sensitive or classified information. The risks are posed both to US biodefense efforts and to US pharmaceutical and biotechnology industries.

Risks to US Biodefense

The United States has the largest biodefense program in the world. Researchers are exploring a host of technologies, including detectors to determine whether BTW weapons have been used, decontamination equipment, and treatments or preventatives to counter the effects of BTW agents.

Under the draft Protocol, the United States would be obligated to provide information on its extensive biodefense programs in complying with requirements for declarations and inspections. "Providing extensive information about these efforts in an unclassified format to an international organization under the guise of 'transparency' runs the risk of providing a proliferators or terrorist with a roadmap to exploit our vulnerabilities."[27] Terrorists and adversaries would learn not only of promising defensive capabilities we are exploring, but also about areas of vulnerability where we have not yet been able to find appropriate biodefenses.

Risks to US Industry

The $120-billion-per-year US pharmaceutical industry leads the world in both research and development and production of new drugs. Approximately 80 % of the new products introduced each year in the pharmaceutical and biotechnology sector is from US firms. The investment in each new product is very high. It takes an average of 10-12 years from the time laboratory studies are conducted until a drug is successfully marketed. The cost of bringing a new drug to market is approximately $800,000,000.[28]

The Threat of Industrial Espionage. Organisms, which are the key to many production processes, as well as most protocols (scientific procedures) and equipment, are not patented, primarily as a measure to keep them secret. It is possible that industrial spies, posing as an arms control inspectors, could learn invaluable process information by looking at fermenters and other equipment; an illicit air or swipe sample could reveal such data as which organism is being used or what unique nutrients are in the growth media. Industrial espionage is a constant threat and companies exercise great control over who is allowed to enter production areas.

Some US biotechnology and pharmaceutical company representatives have expressed concern that proprietary data could be lost by giving declarations and submitting to inspections under the BTWC

[27] Mahley, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs and International Relations, 10 July 2001.

[28] In 1994, the cost for research and development, and not including facilities and equipment, was estimated to be $350,000,000. See Al Holmberg, "Industry Concerns Regarding Disclosure of Proprietary Information," Lawrence Livermore National Laboratory, *The Director's Series on Proliferation* (UCRLR-114070-4), May 1994, p. 93. Inflation and added costs required by regulation have greatly increased that figure.

Protocol. Managed access, the procedure used under the CWC to try to protect information, might not protect, for example, formulae for newly developed drugs, or data on processes, methodologies, and materiel that give a company a competitive edge.[29] Foreign inspectors could use the requirements of the Protocol as a means of industrial espionage, enabling their own nations' firms to avoid the costs of early research and development or to gain unfair advantage in production.

As a result of these concerns, the US Pharmaceutical Research and Manufacturers Association (PhRMA) has urged that there be no "non-challenge" (i.e., routine) on-site visits to gather data and check declarations. PhRMA has stated that it is, "…skeptical that any site inspection can detect a violation of the BWC. The nature of microbiology is such that it is easy to quickly obliterate traces of any development, manufacture, or storage of a biological-warfare agent."[30] PhRMA is not alone in its assessment. A Joint Position Paper by European, US, and Japanese industries argued against routine inspections saying, "Since the nature of microbiology is such that it is often easy to remove traces of any development, manufacture or storage of a biological-warfare agent, any routine on-site activity is not a useful concept under the Protocol."[31]

The Danger of False Findings. Another danger to industry is the possibility of ambiguous or purposefully erroneous findings by inspectors. Such an event could damage the ethical reputation of the company, causing loss of consumer confidence and, potentially, severe financial damage. The possibility—perhaps even the likelihood—that this could happen was underscored by results from the US trial inspections described above.

The trial inspections demonstrated that transparency visits might have unintended consequences, creating ambiguities and generating suspicions rather than allaying them. "Indeed, the inspecting teams in these mock exercises left with less confidence that a perfectly legal facility was in compliance with the convention than they had before the visit took place."[32] It appeared to the inspection teams that legitimate activities were actually covers for biological weapons activities.

According to Dr. Alan Zelicoff of Sandia National Laboratories, the key reasons that inspections give rise to less rather than more confidence are:

- Legitimate activities use the same equipment, materiel, procedures, and processes as do weapons development and production;

- Even in small laboratories, records of organisms and toxins are rarely, if ever, centrally stored, which means that declaration forms are likely to have errors that smack of illicit activity; and,

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[29] This point was proven at a December 1993 trial inspection at a US company's pharmaceutical facility. Company officials, in cooperating with inspectors (whose roles were played by US and UK officials), found that they revealed too much information piecemeal. At the end of the exercise, they felt they had, in aggregate, revealed both process and throughput proprietary information. Were such information to be acquired by a competitor, the company almost certainly would have suffered severe losses.

[30] "Summary of PhRMA's Position on a Compliance Protocol to the Biological Weapons Convention," summarizing three PhRMA Board positions taken in May 1996, January 1997, and May 1998, available at http://srpub.phrma.org/phrma/Jul.98.PhRMA.bwc.html (access date 14 August 2002).

[31] "Compliance Protocol to the Biological Weapons Convention" A Joint Position of the Forum for European Bioindustry Coordination, Animal Health Institute, Association of Veterinary Biologics Companies, Biotechnology Industry Organization, Pharmaceutical Research and Manufacturers of America, and Japan Bioindustry Association. Available from PhRMA.

[32] Alan P. Zelicoff, "An Impractical Protocol," *Arms Control Today*, May 2001, available at http:///www.armscontrol.org/act/ 2001_05/zelicoff (access date 8 June 2002).

- Practices in the use, handling, storing, and disposition of micro-organisms and toxins varies widely from site to site.[33]

If a foreign inspector were to arrive with suspicion already aroused, it would be extremely hard to allay his or her fears. "[T]he very acts of genetic engineering, large-scale fermentation, and the array of standard operating procedures will meet any expectations pre-formed in the eye of the beholder."[34] Thus, there is substantial risk that the reputation of a US commercial entity could be severely damaged by a visit or inspection that reached ambiguous or false conclusions.

Why the Biotechnology Sector Isn't Like the Chemical Industry. Some proponents of a Protocol for the BTWC have argued that declarations by and inspections of biotechnology firms would be as acceptable to those firms as similar measures were to chemical companies under the CWC. On the contrary, the CWC model does not work for the BTWC because of fundamental differences between chemical and biological research and production. Some examples of the essential differences between the two industries are:

- Some of the most sensitive proprietary information in the chemical industry are temperature, pressure, duration, and type of catalyst. These data can be obscured from inspection by covering monitors and key equipment. By contrast, much of the sensitive data in the biotechnology arena relates to materiel used and protocols followed, which cannot be readily masked.

- In the chemical industry, mass-balancing equations can demonstrate what reactions are being undertaken. In biology, one cannot examine the input and output to determine what transpired.

- A sample of a chemical product will confirm only what the product is. In biology, a sample of the product can reveal additional sensitive information, including what the proprietary production process is.[35]

The Protocol Would Undermine Export Controls

The third major reason that the United States rejected the draft Protocol is that it might endanger export controls, which are useful in controlling nuclear and chemical weapons-related technologies and materials. Currently, the United States works with other like-minded states to interrupt the flow of some toxins as well as biological weapons-related equipment, technology, and materiel to countries of concern. While it is true that such countries could undertake BTW research, development, and production with off-the-shelf items, attempts to restrict their access to sophisticated equipment and strains of pathogens perhaps may impede their programs to some degree. The means by which biological export controls are exercised is through the so-called Australia Group, an organization that was originally designed to place controls on items that could be used to produce chemical weapons.

[33] Ibid, p. 1.

[34] Zelicoff, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, 5 June 2001, p. 3.

[35] Ambassador Donald Mahley, Special Negotiator for Chemical and Biological Arms Control, Department of State, testimony before the US House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, 13 September 2000, available at http://www.house.gov/reform/ns/floor/testimony_of_ambassador_donald_a.htm (access date 20 September 2002).

Nonaligned countries have argued that export controls are unfair because they limit the economic and technological growth of non-industrial countries. They reason that if they undertake arms control commitments to use technologies for peaceful purposes only, they should no longer be subject to controls.

During the negotiations for the BTWC Protocol, there was a clash between those nations that support application of export controls (including the United States and other members of the Australia Group) and nations that demand technology transfer and free trade. As a result, provisions to provide assistance and cooperation for peaceful purposes were included in the Protocol. In addition, several developing countries argued that dismantlement of the Australia Group should be the quid pro quo for their participation in the BTWC.

The Protocol text submitted by Ambassador Tóth would actually promote the trade and supply of equipment and materiel to nations, regardless of their status as "countries of concern" to the United States. Article 14 of the Protocol says each State Party "…shall not establish, maintain or take either individually or collectively any discriminatory measures…which would hamper the economic and technological development of States Parties to the Convention…"

Some countries of concern, notably Iran, have made it clear during the negotiating sessions that they interpret this provision to mean that there must be no export control of any kind exercised against a nation that is a Party to the BTWC. This interpretation would mean that current controls on biological-related equipment and materiel would be removed. Additionally, it could be interpreted by some nations to mean that US and Australia Group export controls on chemicals and key equipment that could be used for chemical weapons production would also be disallowed under the Protocol.

The Constitutional Problem

Although the question of Constitutionality was not at the forefront of US objections to the Protocol, it is an important concern.[36] The Fourth Amendment to the Constitution protects citizens against unreasonable search and seizure and specifies that any search warrant issued shall be based on probable cause. Probable cause is, for example, strong evidence that a crime has been committed. Because the Constitution takes precedence over international treaty obligations, it is conceivable that a request for an inspection could be significantly delayed or rejected if a biotechnology or pharmaceutical firm were to object, on Constitutional grounds, to request for an inspection.

The Fifth Amendment protects against self-incrimination and, most importantly in this context, provides that there shall be just compensation for losses "taken for public use." This could have enormous cost implications for US taxpayers if a company were to have financial losses stemming from a declaration or inspection. For example, if an inspector engaged in industrial espionage and stole a pharmaceutical company's secret production process, that company would be entitled to sue the US Government for losses incurred.

The Constitutional issue arose during the debate over whether to ratify the Chemical Weapons Convention, which contains provisions for routine and challenge inspections. As a result, the US Senate included in its Resolution of Ratification the requirement that the President certify to Congress that a criminal search warrant will be obtained for any US facility subject to challenge inspection, if consent of

[36] These arguments are discussed in greater detail in Kathleen C. Bailey, "Problems with Verifying a Ban on Biological Weapons," Lawrence Livermore National Laboratory, *Director's Series on Proliferation* (UCRL-LR-114070-3), 5 January 1994, pp. 62-63.

the owner or operator has been withheld. For routine inspections of declared facilities where consent has been withheld, an administrative search warrant from a US magistrate judge is required.

CWC advocates were deeply worried that the Resolution of Ratification provisions would adversely affect the treaty. If a US company were to successfully resist an inspection on Constitutional grounds, that would give other countries a basis for rejecting inspections, regardless of whether they have a similar constitutional provision.

There have been no serious difficulties with inspections of US companies under the CWC. This is because the risks of losing proprietary information are not as great for chemical companies as they are for biotechnology firms. Thus, it can be argued that there would be greater likelihood of corporate resistance to inspections in the context of the BTWC than there is under the CWC. Therefore, the Constitutional issue would be more problematical under the BTWC than under the CWC.

How Did We Get This Far?

If the Protocol is so inherently weak and harmful, why was the Protocol not stopped during the negotiations phase? How did such an unacceptable agreement come before an international body, requiring US rejection at the last moment to stop it? There is no single answer to these questions, but a number of contributing factors can be identified.

It is important to keep in mind that the original charter given to the Ad Hoc Group by States Party to the BTWC required that any Protocol negotiated would have to be a consensus document. Had this requirement been obeyed, the unfortunate event of having the Protocol presented and then rejected at the international Review Conference in 2001 would never have occurred. This would have saved the United States from the onus of having to reject the Protocol and, however unfairly, be accused of not going along with the decisions of the international community. Thus, the primary blame for the events as they unfolded lies with the abandonment of the consensus process and the presentation of a Chairman's Protocol text.

To understand why so many nations supported the Protocol despite its weaknesses, we must consider the setting. With the end of the Cold War, there was a sense that a roadblock to progress had been removed; without the US-Russian rivalry, new multilateral arms control measures could be undertaken. Entry into force of the CWC stood as a testament to that notion and became a model for the Protocol.

Another element of the setting was the backdrop of other arms control agreements. Other major international arms control treaties have international bureaucracies, inspections, and declarations. (The Nuclear Nonproliferation Treaty has the International Atomic Energy Agency, the CWC has the Organization for Prohibition of Chemical Weapons, and the Comprehensive Test Ban Treaty has the Comprehensive Test Ban Organization.) Arms control advocates and interest groups pressured States Parties to the BTWC to make this treaty like others with respect to verification measures and creation of an international oversight bureaucracy.

The influence of the arms control advocates—Non-Governmental Groups as well as individual ideologues personally and professionally committed to arms control—played a tremendously important role in pushing the Protocol. It can be argued that much of the Protocol language was drafted not by governmental representatives of States Parties, but by these advocates. Their arguments were based on at least three basic themes: what was good arms control vis-à-vis chemical weapons must also be good to combat biological and toxin weapons; doing something is better than doing nothing; and, it is possible

to create obstacles that will deter nations from producing BTW.[37] The United States failed to make the case strongly enough against all three arguments.

Although the United States has steadfastly and consistently contended that the BTWC cannot be verified, it must take much of the blame for allowing the Protocol to get as far as it did. The first important error was to allow the VEREX group (which had been formed to examine verification measures, but not to negotiate any agreement) to be replaced in 1994 by the Ad Hoc Group, which was given a mandate to negotiate a legally binding Protocol. Prior to newly elected President Clinton's announcement that the United States would support negotiation of a Protocol, the United States had opposed it. The reasons that the United States had given for not wanting a negotiated Protocol are the same as the reasons it gave when rejecting the Protocol in 2001.

The second major error of the United States was in not presenting a unified, clear message of its policy throughout the Protocol negotiations. Representatives from all involved US governmental agencies other than the National Security Council (NSC) were at one: they opposed any CWC-like Protocol for the BTWC. The NSC representative, however, was strongly committed to modeling the Protocol on the CWC. Thus, the policy conveyed abroad was mixed and unclear. Other nations would hear of US positions through formal channels and then hear something quite different from the NSC representative, leaving them to choose what to believe. Inattention to the US interagency conflict by high-level US officials left the problem unresolved.

Many arms control advocates and some foreign representatives believe that the Protocol is merely a victim of US politics and that, if the administration changes, a successor president may support it. There is historical justification for such a view because there have been times when the United States has opposed international treaties or activities, only to join them at a later time. However, the US position on the Protocol is very unlikely to change ever. Democrats and Republicans alike agree on the limitations of verification provisions as applied to BTW and, especially, that the downsides for US industry and biodefense are too great. It should not be forgotten that the Clinton Administration, notwithstanding the NSC representative noted above, was at one with previous administrations on the issues of BTW verification and dangers to US biotechnology industries. And, unlike the chemical industry's support of the CWC, the biotechnology sector does not support the Protocol. This would be a very influential point for the US Senate, two-thirds of which would have to vote affirmatively to give consent to ratification of any BTWC Protocol.

The Current US Approach

Because of the US rejection of the Protocol, some people criticized the United States, saying that it is unsupportive of efforts to combat BTW proliferation and terrorism. From the US perspective, the Protocol issue is wasting valuable resources—time, money, and diplomatic effort—in pursuit of something that won't work. The US approach is to undertake other efforts instead. This section will summarize some of the current US activities and initiatives to combat the BTW threat.

US Domestic Initiatives

The United States has invested significant resources—money, energy, and policy—in efforts to counter BTW. In fiscal year 200 alone, more than $1.5 billion was dedicated to military biodefense and another

[37] This is the so-called "web of constraints" idea that holds that no measure by itself will deter, but many measures taken together will. This notion gained currency during the Protocol negotiations despite the evidence from the Iraqi inspections showing that the VEREX measures were ineffective.

$1 billion to domestic preparedness for biological attack. Additionally, the United States has been very pro-active in passing legislation. In support of Article IV (National Implementation) of the BTWC, the US Congress passed the Patriot Act of October 2001. This law enhanced information-gathering and sharing, reformed criminal law to prevent and punish terrorism, and enabled immigration officials to exclude or deport aliens engaged in terrorism.

In support of Article VII (Assistance to Victims) and Article X (Technical and Scientific Cooperation), the US Congress passed the Public Health, Security, and Bioterrorism Preparedness and Response Act of June 2002. It focuses on prevention of bioterrorist attacks (e.g., imported-food inspection; tracking of bio-materials in the US), strengthening communications between public health authorities and health care workers, and expediting treatments of disease (e.g., vaccine production and stockpiling).

The US Centers for Disease Control strengthened its efforts to assist the World Health Organization (WHO) in monitoring global infectious disease outbreaks. It is also designing programs to assist developing countries to formulate public health response strategies.

International US Initiatives

The international community, supported by the United States, is undertaking initiatives in a number of fora. NATO has begun programs to improve troops abilities to respond effectively to an attack involving BTW, including enhanced training and education. At its May 2002 meeting, NATO's Defense Group on Proliferation developed a plan to stockpile medical and protective equipment, as well as to participate in medical surveillance.

The World Health Organization, with US encouragement, undertook several efforts at its May 2002 Assembly. Member States were urged to assure that their national disease surveillance plans complement regional and global programs. Members also have been asked to treat a BTW attack as a global health threat and to respond by sharing resources, expertise, and supplies.

At the 2002 Plenary of the Australia Group, members adopted tougher controls, lowering the threshold for controlling fermenters from 100 liters to 20 liters. Eight new toxins were added to the Groups biological control list, bringing the total to 19. Controls were also extended to the intangible transfer of information and knowledge that can be used for BTW purposes.

The G-7 (plus Mexico) Health Ministers adopted an "Ottawa Plan for Improving Health Security" in November 2001. Under this umbrella, the G-7 have increased cooperation on acquiring vaccines and antibiotics, improved support for WHO's disease surveillance network, and have shared emergency preparedness and response plans. Projects are also underway to share information on food and water supply contamination as well as on risk mitigation strategies to ensure food supply safety.

In addition to the large-scale projects noted above, the United States is also involved in a number of unilateral programs internationally to help other nations prepare for the possible use of BTW. For example, the US Defense Threat Reduction Agency has held provided training and equipment to Moldova and other nations of the former Soviet Union. The objective is to enable them to identify and counter terrorist weapons of mass destruction.[38]

[38] US Defense Threat Reduction Agency, "*Connection*," Vol. 4, No. 3, March 2002, p. 4.

President Bush's Proposals

In addition to the measures outlined above, the United States proposed that BTWC members respond to suspected use of BTW by asking the State Party under suspicion to provide explanatory information.[39] Under this proposal, each State Party would agree to allow an international inspection, commissioned by the UN Secretary General, to allay concerns.

There are difficulties with the proposal. The first is that this idea already exists, in a slightly different form, and has been ineffective. Currently, any State Party to the BTWC that believes that another State Party is in violation of the Convention may lodge a complaint with the Security Council. And, each State Party is obliged to cooperate with any investigation initiated by the Security Council. These treaty provisions are bolstered by the fact that the General Assembly and Security Council have allowed the Secretary General to deploy inspection teams without obtaining approval from a majority of member states. Nevertheless, nations can, and have, rejected cooperation with UN investigators.[40] It is also noteworthy that investigations that were undertaken were inconclusive, despite their being to determine whether there was chemical weapons use—a task that is arguably easier technically than determining biological weapons use.

A second problem is that nations often object to identifying nations by name that might be in noncompliance. European nations, for example, have faulted the United States for naming some nations that it suspects of BTW activities, This unwillingness to confront violators makes it unlikely that international support for an inspection can be mustered. The current quandary in the United Nations over how to respond to the US call for action against Iraq's weapons of mass destruction programs is a case in point.

A third difficulty is that even if there were an inspection and evidence of use were found, there is no agreed international response. Unless action is to be taken against the user, what is the point of determining that there was use?

In addition to the proposal to resolve suspicions regarding BTW use, the Bush Administration outlined 7 steps that could be undertaken by all BTWC parties. These steps were suggested by President Bush just prior to US rejection of the Protocol:

1) Enact strict national criminal legislation against prohibited BW activities with strong extradition requirements;

2) Establish an effective United Nations procedure for investigating suspicious outbreaks or allegations of biological weapons use;

3) Establish procedures for addressing [BTWC] compliance concerns;

4) Commit to improving international disease control and to enhance mechanisms for sending expert response teams to cope with outbreaks;

[39] US Department of State, "New Ways to Strengthen the International Regime Against Biological Weapons," Fact Sheet, 19 October 2001, available at http://www.state.gov/t/ac/bw/fs/2001/7909.htm (access date 21 September 2002).

[40] Jonathan B. Tucker and Raymond A. Zilinskas, "Assessing US Proposals to Strengthen the Biological Weapons convention," *Arms Control Today*, April 2002, available at http://www.armscontrol.org/act/2002_04/tuczilapril02 (access date 8 June 2002)

5) Establish sound national oversight mechanisms for the security and genetic engineering of pathogenic organisms;

6) Devise a solid framework for bioscientists in the form of a code of ethical conduct that would have universal recognition; and

7) Promote responsible conduct in the study, use, modification, and shipment of pathogenic organisms.[41]

As noted above, efforts on some of these suggestions (e.g., 1, 2, and 4) are already being pursued outside the context of the BTWC.

Items 5, 6, and 7 are related in that they concern some form of regulation over biotechnology research and development, as well as industry. Ideas on how to do this vary. The United Kingdom suggested a new Convention on Physical Protection of Dangerous Pathogens, which would codify standards for physical protection, containment measures, and operating procedures for dangerous pathogens held or worked upon in any laboratory.[42] Some arms control advocates have expanded upon the idea, calling for a Convention that would establish a host of controls over pathogens and toxins, and the laboratories and workers that handle them.[43]

Extreme care should be exercised in any attempts to create a new convention, or any similar initiative, to address these three issues. There is danger that oversight and regulation will stifle legitimate science and manufacture, while contributing little or nothing to preventing BTW activities. Any measure proposed should be subjected to two tests: Will the measure have a worthwhile impact on reducing the likelihood of BTW activities? Will it allow biotechnology and pharmaceutical endeavors to flourish without undue burden or risk?

Regarding the first question, it is unlikely that aggressive, comprehensive oversight and regulation measures will have much effect on the risks of biological or toxin weapons development, production, storage, or use. The reason goes back to the very problems with the Protocol: BTW are easy to make and easy to hide. Anyone with the knowledge to make BTW can do so with equipment and materiel readily available. No standard of ethical conduct or oversight of genetic engineering is going to affect the dedicated terrorist, subnational group, or government that is bent on obtaining BTW.

Regarding the second question, some of the same issues that plagued the Protocol are involved. To help develop the metrics by which this question can be adjudged, it is imperative that any measures to regulate or oversee be developed and undertaken with full participation from the outset by the biotechnology laboratories and firms.

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[41] President George W. Bush, "President's Statement on Biological Weapons," 1 November 2001, available at http://www.whitehouse.gov/news/relaeases/2001/11/20011101.html (access date 21 September 2002). Some of these steps are the same as or similar to those proposed by the United Kingdom.

[42] United Kingdom Secretary of State for Foreign and Commonwealth Affairs, "Strengthening the Biological and Toxin Weapons Convention," p. 15.

[43] For example, see Michael Barletta, Amy Sands, and Jonathan Tucker, "Keeping Track of Anthrax: The Case for A Biosecurity Convention," *Bulletin of the Atomic Scientists*, May-June 2002, pp. 57-62, and Jonathan B. Tucker, "Regulating Scientific Research of Potential Relevance to biological Warfare," in Michaael Barletta (ed.), "After 9/11: Preventing Mass-Destruction Terrorism and Weapons Proliferation," Monterey Institute of International Studies, Center for Nonproliferation Studies, Occasional Paper No. 8, pp. 24-25.

Item 3 in President Bush's list is the most problematical. The history of inspections in Iraq, the US-UK tours of biological weapons facilities in Russia, and the mock-inspections research conducted by the United States—all teach us that declarations and inspections do not resolve compliance concerns. The Ad Hoc Group has spent enormous effort trying to develop additional procedures that would be effective. The product, the Protocol, was not a viable solution. It is therefore hard to imagine what procedures could be developed—other than those already identified by the Protocol and subsequently rejected— that would enable nations to address compliance concerns.

One suggestion often discussed is to have the United Nations take on the task of dealing with allegations or evidence of noncompliance. The assumption is that, with the end of the Cold War, there would be no knee-jerk vetoes by Security Council members of actions against suspected or confirmed violators. This idea ignores the fact that the problem is not just one of taking action against a nation—something the United Nations is usually loathe to do. The problem is that research, development, production, weaponization, and stockpiling would be enormously difficult to ascertain without exceptionally good human-source intelligence. Even then, alternative explanations for the activities would make it very difficult to reach a conclusion. A somewhat easier task would be determining the use of BTW, particularly if access to victims were possible. However, as was demonstrated in the case of Iraqi and Iranian chemical weapons use, as well as in other historical cases, there is little that the international community has been willing to do in response to violations of international arms control agreements.

Alternatives for November 2002

The BTWC Review Conference is set to reconvene November 11, 2002 and there is a quandary. On one hand, the United States is firm in its rejection of the BTWC Protocol and committed to undertaking anti-BTW initiatives in other contexts. On the other hand, there are many States Party to the BTWC that continue to believe that there should be confidence-building measures much like those contained in the Protocol, and would like to continue some form of multilateral process under the auspices of the BTWC. The options before the United States and other States Party appear to be either to redirect the multilateral process or end it.

There are multiple reasons why some arms controllers may want to continue the BTWC multilateral process in some form. Certainly, there will be those who hope that the Protocol, or pieces of it, can be revived. Others may support continuation simply as an appeasement to those upset by the rejection of the Protocol. Some in the US Government may want to continue it to avoid accusations that the United States is uninterested in the BTWC or in multilateral processes. Whatever their motives, some supporters of continuing a BTWC multilateral process have suggested that a new group could be formed with a different focus or task.

There are at least two downsides associated with continuing a BTWC multilateral process. The first is that it will be extraordinarily difficult to redirect the "old" process that failed. The individuals who helped create the Protocol—representing governments as well as NGOs—would very likely continue to be engaged. It would be naïve to assume that these arms controllers would take a substantially different tack than they have in the past.

A second downside is that many of the tasks that need to be undertaken are likely to be more successfully undertaken outside of the context of arms control. For example, one of the most constructive provisions considered for the Protocol was to conduct investigations in event of a naturally occurring disease outbreak to determine whether the origin is natural or is the result of weapons-related activity. However, a country suffering from a disease outbreak would be inevitably sensitive to outside interference in its problems and, in particular, wary of accusations that the disease is caused by BTW activity. Cooperation is more likely to be forthcoming if there is no seeming assumption that foul play is involved.

It therefore makes more sense for the invaluable epidemiological investigations to take place under the mantle of the WHO, or some institution that is unassociated with the BTWC.

If one examines the 7 steps suggested by President Bush (above), the one that stands out as being most appropriate for development under the BTWC is establishing procedures for addressing BTWC compliance concerns. Giving such a task to a BTWC multilateral group would take us full circle. If one suspects noncompliance, it must be verified that the suspect is or is not cheating before action can be taken. (Assuming that the international community would ever take action about arms control treaty noncompliance—something it has not yet done in cases of cheating on other treaties.) It is not unreasonable to assume that if a BTWC multilateral group is asked to consider how to address compliance concerns, the process that led us to the Protocol—with the same arms control advocates, NGOs, and governmental representatives—will start all over again.

The question before us is whether there is an issue that would truly be appropriate for the BTWC multilateral process to address at the present time. The failure of the Ad Hoc Group efforts was not due to incompetence of the people, governments, or organizations involved. The technology simply does not exist to adequately verify the BTWC. Rather than waste the efforts of a large body of people on a fruitless exercise, the time has come to focus efforts into different channels. In recognition of the understandable desire for a truly verifiable BTWC, the States Party could set a date certain—perhaps in ten years—when a new effort would be initiated to examine technologies that may have been discovered or which may have evolved that would allow for a verifiable BTWC. Resources and energies should be refocused onto efforts that will be more fruitful. While it may be politically difficult to end the multilateral process—a process around which many people have built their careers and lives in Geneva—the threat of BTW is simply too great to be wasting our energies and resources on an exercise with little potential.

Conclusion

Since the BTWC came into force in 1972, the international community has been struggling to develop means by which compliance with the ban on BTW can be assured. Suspected violations (later admitted) by the Soviet Union/Russia and Iraq gave impetus to those efforts, which were centered in the Ad Hoc Group formed by parties to the BTWC. Despite heroic efforts, the Ad Hoc Group did not succeed in writing a consensus Protocol.

The key problems from the United States' perspective were: currently available technology does not enable one to ascertain whether biological or toxin agents are being developed, produced or stored; using the measures adopted by the CWC—declarations and inspections—will not work in the biotechnology arena and will actually cause harm to biotechnology entities; and, adoption of a CWC-like protocol would undermine existing export control processes designed to limit proliferation.

There is no question that the BTWC Protocol is dead. The politically hard decision that now should be made is to abandon fruitless multilateral efforts within the BTWC context in favor of other initiatives that have a higher payoff potential. In the future, if technologies are developed that would enable verification, the idea of a Protocol could again be considered.

For now, what is the most constructive course of action? Below are some of the priorities that deserve increased and sustained attention.[44]

[44] These proposals are based on ideas from David R. Franz.

1. Human-source intelligence is vital in knowing what BTW programs exist and what the intent of their owners is. Undoubtedly, gathering and processing intelligence on BTW is a priority already, but it must be continually assessed and developed.
2. Deterrence to BTW should be further clarified and communicated clearly to all. The way the US responds to the first use of BTW will largely determine whether other nations, groups, or individuals will also attempt use. Swift, proportional, and decisive response will deter those that can be deterred.
3. Medical countermeasures and the ability to identify the agent used are two of the most important steps in protecting citizenry from BTW attack. In this regard, measures that exist should be made available. Smallpox vaccinations should be given to those who wish to receive them.
4. International communications on BTW issues should be maintained. NATO, the G-8, WHO and other fora offer bureaucratic mechanisms to transfer information and organize initiatives.
5. Education and training of medical personnel should be nationwide. Personnel must be able to identify agents and undertake diagnosis, prophylaxis, and therapy of the most important diseases. They must also be trained and drilled on containment and mass-casualty patient management.
6. The public health infrastructure should be reevaluated regularly not only to assure effective surveillance, but also to improve laboratories and staffs at local levels.

Whatever steps are taken, there must be a continual “self-check” to assess whether our investments of time, money, and energy will genuinely affect our abilities to deal with the problem. The threat of biological and toxin weapons is too great to waste any resources.

Appendix A
The Nature of Biological and Toxin Weapons[45]

Biological agents are disease-causing organisms and materials[46]—whether viral, bacteriological, rickettsiae, fungal, or protein—that can cause damage to or death of humans, other animals, or plants. Toxins are the harmful chemicals that can be produced by bacterial, marine organisms, fungi, plants, and animals.

Bacteria are single-cell organisms.[47] A widely discussed bacterial agent is *Bacillus anthracis*, a hardy bacterium that causes the highly lethal disease pulmonary anthrax. One gram of anthrax bacteria theoretically contains 10 million lethal doses. Inhalation of 1000 spores of anthrax or less can produce fatal pulmonary anthrax in some members of an exposed population; 8000 spores, weighing 0.08 microgram, is fatal to a large proportion of those exposed.[48] Anthrax bacteria are easily and inexpensively produced. The disease, weaponized, can have a long shelf-life. In wet form, it could be frozen and kept viable for several years. In dry form, if kept in a cool and dark place, it can last many, many years. (Spores in nature can survive more than 40 years.)

Rickettsiae are bacteria that can only reproduce inside of animal cells. A well-known example is *Coxiella burnetii*, which causes Q fever.[49] It is extremely infectious; a single organism *of Coxiella burnetii* can cause infection in a human. Because it can create a spore-like form, it is highly survivable and is relatively easy to manufacture in quantity and to disseminate.

Viruses are intracellular parasites consisting of a strand of genetic material (DNA or RNA) surrounded by a protective coat that facilitates transmission from one cell to another. Variola virus, which causes smallpox, was explored by the Japanese military as a biological weapon in China during the years just prior to WW II. The virus could make a "good" weapon because it is not only very lethal, but also there is an effective vaccine that could be used to protect the population and troops of the user.

Fungal agents ordinarily do not cause disease in healthy humans, although they can be devastating to those with deficient immune systems. Rather, fungi that have been developed as weapons have predominantly been those that cause diseases of plants. Rice blast fungus, for example, is an agent that can cause massive economic damage and, in some situations, starvation. Little of the fungi is required to

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[45] This appendix is drawn, in part, from Kathleen C. Bailey, *The Biological and Toxin Weapons Threat to the United States*, (Fairfax, VA: National Institute for Public Policy, October 2001).

[46] Biological agents are either replicating agents (bacteria or viruses) or nonreplicating materials (toxins or physiologically active proteins or peptides) that can be produced by living organisms. Some nonreplicating biological agents can also be produced through either chemical synthesis, solid-phase protein synthesis, or recombinant expression methods. Office of the Surgeon General, US Army, *Medical Aspects of Chemical and Biological Warfare*, 1997, p. 4.

[47] This discussion of types of agents is drawn in part from US Congress, Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction* (Washington, DC: US Government Printing Office, December 1993), pp. 79-81.

[48] Barry J. Erlick, testimony before the US Senate Committee on Governmental Affairs, 9 February 1989, cited in *Technologies Underlying Weapons of Mass Destruction*, p. 78.

[49] Although *Coxiella burnetii* is classified in the family Rickettsiae, it is not included in the genus Rickettsia. The genus *Coxiella* has only one species.

make a potent weapon; experiments have shown that 3 g of rice blast fungi per hectare could infect between 50% and 90% of the crops exposed.[50] Additionally, some toxins are of fungal origin, such as T-2.

Some proteins can be used as weapons. Most bacterial toxins are large proteins that affect either the nervous system (neurotoxins) or damage membranes. An example of a neurotoxin is the toxin secreted by *Clostridium botulinum*, the most poisonous substance known. The fatal dose of botulinum toxin A by injection or inhalation is about 1 nanogram (billionth of a gram) per kilogram. It is fast-acting, usually causing death in 1-3 days in the majority of victims. Staphylococcal enterotoxins (an incapacitant) and botulinum toxin are 1000- to 10,000-fold more toxic than classical nerve agents.

There are weapons-usable proteins that are not derived from bacteria. They would be most likely used in small-scale terrorist or assassination scenarios, not in large-scale attacks. Ricin is a well-known example of a protein derived from a plant. It is produced by the castor bean and is readily available throughout the world. It is simple to separate ricin; individuals lacking any formal biology training have successfully produced large quantities of the poison. Venoms of various types are derived from animals. And, because the DNA sequences or genetic blueprints of many venom toxins have been determined, they can be produced in large quantities by molecular biological techniques.

Another protein which could conceivably become a weapons threat in the future is prions.[51] Prions are the protein that causes some neurodegenerative diseases, most notably bovine spongiform encephalopathy (BSE aka mad cow disease) and variant Creutzfelt-Jakob disease. Although a prion disease might be too slow-acting to be attractive to a BTW user, it is conceivable that the disease could be used as a weapon to cause terror and severe economic repercussions. A BSE outbreak in the United Kingdom during the 1990s cost the British Government between US $9 and $14 billion in compensation paid to farmers. The massive expenditure forced a sale of state-owned bonds, led to increased inflation, and put off implementation of interest rate and tax policies.[52] Similar drastic effects could result from, for example, a terrorist deliberately introducing tissues infected with prions into the food of cattle[53] or humans.

In addition to protein toxins, there are low-molecular-weight toxins. Examples are saxitoxin, a neurotoxin found in some shellfish, and trichothecene mycotoxins, which are produced by fungi. Some low-molecular-weight toxins can be produced by chemical synthesis.

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[50] Lester C. Caudle, "The Biological Warfare Threat," Office of the Surgeon General, US Army, *Medical Aspects of Chemical and Biological Warfare*, 1997, p. 4.

[51] Prions are proteinaceous infectious particles that lack nucleic acids. They are composed of an abnormal isoform of a normal cellular protein. Although there is no evidence of aerosol transmission of prions from one human to another, there are examples of transmission among humans under some circumstances, e.g., cannibalism in New Guinea causing kuru. See Jiri Safar, et al, "Agent Summary Statements Section VII-D: Prions," in *Emerging Infectious Diseases* at http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4s7d.htm. There is the possibility that prion diseases can be transmitted from persons who appear healthy, but who are incubating the diseases, through surgical and medical diagnostic procedures or through blood transfusions. See Paul Brown, et al, "Bovine Spongiform Encephalopathy and Variant Creutzfeldt-Jakob Disease: Background, Evolution, and Current Concerns," *Emerging Infectious Diseases*, Vol. 7, No. 1, January-February 2001, p. 6.

[52] Peter Chalk, "The Terrorist Threat to US Agriculture and Livestock," paper presented to a Workshop on Agro-terrorism at Cornell University, 12 November 2000, p. 11.

[53] Options by which BSE could be introduced into US beef and dairy cattle are discussed in Paul Brown, "Afterthoughts about Bovine Spongiform Encephalopathy and Variant Creutzfeldt-Jakob Disease," *Emerging Infectious Diseases*, Vol. 7, No. 3, Supplement 2001, pp. 598-99.

A theoretical possibility is that bioregulators—compounds produced by cells in one part of an organism that have regulatory effects on biological processes within the organism—could be used as weapons. They could be used to cause effects such as rapid unconsciousness, heart failure, or paralysis.[54]

Recent advances in biotechnology make it feasible for a number of toxins to be produced easily in large quantities. It may also be possible to use viral and bacterial vectors to deliver toxins or bioregulators to human targets. They might also be used to transfer the toxin or bioregulator gene to the target.[55]

Not all disease-causing agents are suitable for weaponization. In addition to the characteristics of the disease itself, there may be limiting features that make the agent difficult to make and deliver. A perpetrator probably would seek an agent that has high virulence, is easy to disseminate, and can remain effective from the time of production to the time of infection of victims. A consideration may be the time of incubation between infection and onset of symptoms. This would be particularly important if the target were to be military personnel in time of battle. Another consideration may be whether there are readily available vaccines or medical treatments for the disease that could mitigate the effects of the weapon.

Historically, toxins have been thought to be more likely chosen as workable terrorist weapons[56] than as weapons of mass destruction. This is because some toxins have been too difficult to produce in quantities that would make them usable in battlefield scenarios and some have had stability problems that make them unattractive weapons. With the advances being made in biotechnology, it is possible that these limitations will be overcome. Thus, toxins may be an increasingly used weapon in the future because they can be very stealthy and highly effective.

[54] US Government, *The Biological and Chemical Warfare Threat*, Revised Edition 1999, (Washington, DC: US Government Printing Office), p. 3.

[55] United Kingdom Secretary of State for Foreign and Commonwealth Affairs, "Strengthening the Biological and Toxin Weapons convention," p. 8.

[56] Of the 395 toxins known to US Government officials, only 17 would make useful battlefield weapons because they are relatively stable and can be readily manufactured in large quantities. 73 would be toxic enough to be used in an enclosed space such as the air handling system of a building or an aircraft carrier, or on a street corner during rush hour. See David Franz, Deputy Commander USA Medical Research and Materiel Command, testimony before the US Senate Joint Committee on Judiciary and Intelligence, 4 March 1998.

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