ASSESSING THE RISK OF CHEMICAL AND BIOLOGICAL WEAPONS PROLIFERATION TO TERRORISTS

by Jean Pascal Zanders

Dr. Jean Pascal Zanders directs the Chemical and Biological Warfare Project at the Stockholm International Peace Research Institute (SIPRI). He was previously a Research Associate at the Centre for Peace and Security Studies at the Free University of Brussels. He is the author of "The Destruction of Old Chemical Munitions in Belgium" in the 1997 SIPRI volume ***The Challenge of Old Chemical Munitions and Toxic Armament Wastes****, co-author of the SIPRI fact sheets "The Chemical Weapons Convention" (1997) and "Iraq: The UNSCOM Experience" (1998), and co-author of chapters in the* ***SIPRI Yearbooks 1997****,* ***1998****, and* ***1999****.*

On March 20, 1995, the Japanese apocalyptic religious sect Aum Shinrikyo released the nerve agent sarin in the Tokyo underground system. Thirteen people eventually died and more than 5,500 were injured. This strike was the sect's third intentional and indiscriminate release of sarin within a year. In March 1994, Aum Shinrikyo tried to assassinate the leader of a rival religious sect, the Soka Gakkai, but failed because the spraying system mounted on a van malfunctioned and contaminated its operators. The second attempt occurred in the town of Matsumoto on June 27, 1994, resulting in seven deaths and 600 injured. While the improved spraying system functioned in this attempt, the targets of the attack—three judges who were expected to rule against the sect in a land dispute—survived with relatively minor injuries as a consequence of a series of errors by the sect's strike team.[1]

Following these incidents, terrorism was said to have made a qualitative leap: for the first time a terrorist organization had discharged a weapon of mass destruction. While some analysts had predicted this development, many still have difficulty understanding the purpose of terrorist organizations resorting to chemical and biological (CB) weapons. Part of this confusion results from the focus on the potential consequences of such an attack: because of their classification as so-called weapons of mass destruction, which lumps them together with nuclear and radiological weapons, CB weapons are said to be able to produce huge numbers of casualties. The immensity of the envisaged consequences defies rational explanation of the political motives for the terrorist attack.

Much of the analysis of the threat of terrorism with CB weapons has so far been directed towards circumscribing the threat, by profiling organizations likely to resort to such weapons and investigating the requirements for consequence man-

agement. However, once it has been determined that a particular group has developed an interest in chemical or biological weapons, its eventual acquisition and release of these weapons is virtually taken for granted. Using nuclear weapons as a yardstick, CB weapons are seen as easy and cheap to obtain. This black box approach has diverted attention away from what is actually involved in the acquisition of chemical or biological weapons by a terrorist group.[2]

In an effort to improve our understanding of the potential for terrorists to acquire CB weapons, this article develops a framework to analyze the process of proliferation to sub-state actors. Because there are only a few documented cases of terrorist attacks using CB weapons, I also draw on a well-documented case where a CB agent of a non-weapon type was used. Previous to the Aum attacks, the best known case of terrorism with CB materials was the indiscriminate use of *Salmonella typhimurium*, a common cause of food poisoning, by the Rajneesh religious cult in The Dalles, Oregon, in September 1984. The direct motivation was to prevent the inhabitants from re-electing two commissioners of the Wasco County Court who were hostile to the cult's land development plans. The sect had already attracted thousands of homeless people to its community who, because of the liberal voting registration laws, would be able to vote for candidates favored by the sect. The use of the pathogen was intended to tip the electoral balance further in favor of the sect by incapacitating a large segment of the local population.

The cult also attempted to physically harm the commissioners. On August 29, 1984, during a routine fact-finding visit to the Rajneesh community, the two commissioners hostile to the sect were served water contaminated with *Salmonella typhimurium*. Both judges became sick and one had to be hospitalized. It is unclear whether this act was meant to intimidate or to assassinate the commissioners. Murder was not beyond the pale. In the planning stages of the plot to decrease voter turnout, sect leader Bhagwan Shree Rajneesh reportedly commented that it was best not to hurt people, but if a few died not to worry. Ultimately, 751 people became ill as a consequence of the restaurant contaminations in September. Despite this apparent success, the cult did not conduct any follow-on attacks; once it realized in October that the plot would fail to alter the election, it gave up the attempt to take over the county.[3]

Based on the Aum and Rajneesh cases, as well as other considerations, a distinction is first made between terrorism with CB *materials* and terrorism with chemical or biological *weapons*. The article then deconstructs current views of the terrorist threat from CB weapons, and sketches the evolution of the overall threat from CB weapons since the 1991 Gulf War. Third, it applies the "assimilation model," developed for studying the demand side of CB weapon proliferation in states, to sub-state actors. The assimilation model focuses on the way that political and military imperatives, as constrained by the state's material base, become reconciled with each other so that a new weapon becomes integrated into the state's military doctrine. It can be applied to non-state actors, because it focuses on the many thresholds the promoters of a new armament must overcome and the opportunity costs they are willing to pay to overcome these thresholds. With non-state entities, some thresholds identified for states will be virtually nonexistent, while others will feature much more prominently. The presence of certain thresholds and their respective heights can thus provide a way to structure analysis of the armament dynamic for a non-state actor.

Based on these insights, the article concludes that while the acquisition of CB weapons by terrorists is definitely feasible, such organizations nonetheless face enormous obstacles on the path to a CB weapon capability.[4] This decreases the likelihood of their proliferation to terrorists. Moreover, if terrorists acquire such a capability it is highly probable that the quality of the agents will be well below that of similar agents in military arsenals. Finally, from these insights the article suggests ways to prepare for a terrorist strike that utilizes CB weapons.

THE RANGE OF AGENTS USED BY TERRORISTS

To avoid muddling the discussion, an explicit distinction between terrorism with chemical and biological *materials*, on the one hand, and terrorism with chemical and biological *weapons*, on the other hand, has to be made. Terrorism with CB materials deals with the use of any toxic substance or pathogen in pursuit of certain goals. Terrorism with CB weapons refers to the use of

warfare agents, that is a toxic chemical designed, developed, and selected by the military to support certain missions laid out in the military doctrine of a state. This distinction highlights the deeper significance of the 1995 sarin attack in the Tokyo underground: for the first time, a terrorist organization turned to a warfare agent.

CB terrorism has been practiced throughout history and in all types of civilization. Poisonous substances, whether animal, vegetable or mineral, have been used for political assassinations or sabotage. Despite the risk of harsh punishments, the prospect of certain success attracted poisoners to the substances.[5] Such use was always limited, however, because only few people had access to the substances and possessed the learning to use them.

A qualitative change in knowledge and the accessibility of toxicants took place during the 19th century. With the development and rapid expansion of organic chemistry and the chemical industry, the number of poisonous compounds increased significantly. Poison appeared in the pre-World War I domestic law of several industrialized countries as part of the penal code or in health, food, drugs, or cosmetics acts. Greater scientific understanding of the propagation of infections contributed to the deliberate use of disease for sabotage. For instance, as part of a program coordinated in Berlin during World War I, German agents cultivated pathogens in the United States and tried to infect horses and livestock ready for shipment to the war theaters in Europe and the Middle East.[6]

Chemicals and pathogens were also used in World War II for assassinations and sabotage. On May 27, 1942, Reinhard Heydrich, Reichsprotektor of Bohemia and Moravia, was allegedly killed by a grenade charged with botulinus toxin supplied by Great Britain to Czech commandos.[7] Soviet agents reportedly had 9-mm pistol bullets containing 22 mg of aconitine for use against German administrative officials in occupied zones. The bullet produced a sure deadly effect even when it failed to hit a vital part of the body.[8] Polish and Soviet partisans were also reported to have used biological agents in sabotage or assassination operations against German troops.[9]

Since World War II, poison weapons have been mostly associated with secret services. In September 1978, the Bulgarian secret police assassinated the exiled writer Georgi Markov with a pellet containing ricin. The toxin is said to have been supplied from the Soviet KGB-run Laboratory 12, which specialized in substances that could kill quickly, quietly, and efficiently.[10] In September 1997, the Israeli secret service Mossad attempted to assassinate the head of the political bureau of the Palestinian militant-Islamic organization Hamas, reportedly with a lethal dose of the synthetic opiate fentonyl.[11] The Truth and Reconciliation Commission produced evidence that South Africa's apartheid regime developed various contraptions charged with a poison or a biological agent for use against the black population as part of its chemical and biological warfare program.[12]

Terrorist organizations, on the whole, have shown relatively little interest in CB materials. Ron Purver's 1995 survey on CB terrorism lists over two dozen reported instances of terrorist use or threat of use of biological materials and a considerable number of threats and incidents with poisonous substances,[13] ranging from apparently empty threats to reports of acquisition and actual discovery of possession.[14] Nevertheless, many of the listed cases could arguably be classified as attempts at homicide, suicide, or criminal extortion motivated by financial rather than political gain. Other cases involved the intelligence services of certain countries, as mentioned above.

Common to most examples is the discriminate use of the poisonous agents. Humans were targeted individually; horses and livestock also had to be infected one at a time. Even in those cases in which the assailant is never directly in contact with his victims—e.g., the poisoning with mercury of exported Israeli citrus fruits in 1978 by a Palestinian terrorist organization, or the lacing of foodstuffs in shops with toxicants[15]—the physiological consequences were limited to the person ingesting the toxic substances. Another shared characteristic is the clear mission-oriented purpose of the attacks with CB materials. In no documented attack with non-warfare agents, whether successful or unsuccessful, were such agents used for their own sake. On the contrary, they were used to achieve an immediate goal, rather than to trigger a large-scale panic by creating a risk of wider exposure to a CB agent. This direct goal–instrument relationship may explain, in part, why no "mass destruction" resulted from these strikes.

The scientific and industrial developments of the 19th century also laid the foundations for chemical and biological warfare in World War I. A huge number of toxic compounds were investigated for their suitability as weapons. In the 20th century, around 70 different chemicals were used or stockpiled as chemical warfare agents. Fewer were standardized, because the selection of an agent represents a compromise:

- A presumptive agent must not only be highly toxic, but also "suitably highly toxic," so that it is not too difficult to handle.
- The substance must be capable of being stored for long periods in containers without degradation and without corroding the packaging material.
- The substance must be relatively resistant to atmospheric water and oxygen so that it does not lose effect when dispersed.
- The agent must also withstand the sheering forces created by the explosion, as well as heat when dispersed.[16]

Thus, for example, the US binary nerve agents were less pure than the unitary ones, but to the proponents of the program in the 1980s the relative ease of production, storage, and transportation, the increased safety for the troops handling the binary munitions, and the less complicated processes of demilitarization and destruction more than compensated for this loss of purity.

Moreover, the military had several types of agent at their disposal and, depending on the mission, were able to select them on the basis of volatility versus persistency and lethality versus incapacitation. Candidate biological warfare agents were similarly selected on the grounds of a compromise among pathogenicity, survivability after release, and controllability. Military biological weapon programs included lethal, incapacitating, and anti-crop agents. This mission-oriented selection of chemical or biological warfare agents resulted in a close goal–instrument relationship.

Another common feature of the CB weapon programs was that, especially after World War II, the final production phases (synthesis of the actual warfare agent, manufacture of delivery systems, weaponization, testing) were conducted in facilities owned or controlled by government agencies. This limited the accessibility of these technologies. Furthermore, the public discourse regarding the necessity of chemical or biological warfare agents in military arsenals changed. As a consequence of the way the military envisaged using these agents, CB weapons were widely viewed as indiscriminate instruments of warfare. The user does not have full control over the agent after release into the atmosphere and, even in a tactical setting, the agent may spread far beyond the primary target area on the battlefield, affecting combatants and non-combatants alike.

The goal–instrument relationship for chemical or biological materials is markedly different from that for chemical or biological warfare agents. This is a direct consequence of the criteria underlying the selection of the agents. The compromises made in the name of military utility may therefore have been a disincentive for terrorist interest in warfare agents. While warfare agents can certainly be used for assassinations or sabotage, there is no immediate rationale available for their selection for these purposes. Moreover, the terrorist group would have to overcome the many technological difficulties involved in the manufacture, weaponization, and dissemination of these agents. Aum Shinrikyo, of course, did precisely that, but it is the only organization known to have attempted to acquire and use warfare agents on a large scale.[17] The current threat predictions—particularly those involving mass casualties—appear incommensurate with current reality. Before looking into the internal motivations for a terrorist organization to acquire CB weapons, it is therefore necessary to investigate whether the overall threat perception regarding CB weapons has, in fact, changed and, subsequently, been injected into threat projections regarding terrorism.

DECONSTRUCTING THE THREAT OF TERRORISM WITH CB WEAPONS

Part of the problem of rationalizing the use of CB weapons for terrorist purposes lies in the qualification of CB weapons as weapons of mass destruction. This has two major implications. First, it draws the attention of the analyst away from the political motives for resorting to CB weapons and towards the consequences of such employment. As small quantities of toxic chemicals, pathogens, and toxins are said to be able to produce massive casualties, prevention, emergency response, and logistics become the prime focus of policy analysis. The immensity of the envisaged consequences, in turn, defies any rational explanation of the political motives for the terrorist act

and adversely affects the assessment of the rationality of the perpetrators.

Second, the grouping of CB weapons with nuclear weapons into the category of weapons of mass destruction blurs the threat and consequence assessments for each individual class of non-conventional weaponry. The most plausible type of weapon to be used in a terrorist strike (chemical weapons) is mentally linked to the most destructive weapon category (nuclear weapons), and vice versa. Chemical weapons are thus implicitly associated with the far greater destructive power of nuclear arms, and the nuclear threat is heightened because of the greater plausibility of terrorist organizations acquiring chemical weapons. Biological weapons occupy the middle ground between these two extremes: they are said to be both easy to acquire and able to produce mass casualties. Within each of the three categories, the potentially most lethal agents are the ones considered. Furthermore, as Western analysts tend to use nuclear weapons as the yardstick to measure the complexity and cost of armament programs, CB weapons are almost by definition easy and cheap to produce. This, too, affects assessments of the terrorist threat from CB weapons.

The focus on the consequences of a terrorist attack with CB weapons has another important implication: it affects a state's "security deficit." A state always confronts a variety of security challenges. As it can never meet all security contingencies, a security deficit emerges. While the security deficit contains an objective component—for instance, the differences in numbers and types of weapons deployed by two or more adversaries—it is foremost an expression of the subjective appreciation of the threat(s).

In the analysis of the terrorism threat, the objective component is by and large absent: new organizations can spring up at different times; their motivations and causes will differ; knowledge of the weaponry at their disposal is fragmentary at best; and the strikes can come without any warning, in any place, and at any time. The only known factors of the security deficit are the state's own vulnerabilities. Consequently, these vulnerabilities define the threat. The high probability of a terrorist strike with biological weapons is thus assessed on the basis of, for example, the limited understanding of the behavior of pathogens under various environmental circumstances in built-up areas, the presence of essentially unprotected ventilation systems in modern buildings, the limited capability to detect these agents before people are harmed, or the lack of organizational preparedness to respond to the envisaged disaster. In this way, the threat of terrorism with CB weapons rests on worst-case analyses of every conceivable scenario and developments in a wide variety of terrorist organizations, which are then amalgamated into a single threat projection. Little distinction is consequently made between what is conceivable or possible and what is *likely* in terms of the terrorist threat.

This sense of vulnerability has developed rapidly and its origins are complex. On May 13, 1991, then-President George Bush declared that the United States would forswear the use of chemical weapons "for any reason, including retaliation, against any state" once the Chemical Weapons Convention (CWC) entered into force.[18] The announcement represented a major policy shift. The way in which victory had been achieved against Iraq in 1991 was then seen to have greatly devalued the military utility of CW. The new weapon technologies had basically rendered chemical weapons obsolete.[19] The confidence of 1991 cannot contrast more starkly with today's extreme sense of vulnerability to CB weapon threats.

Several events have contributed to this development. The use of chemical weapons by Iraq against Iranian soldiers in the 1980–1988 war, and against its own Kurdish population, brought the issue of proliferation to the fore. Many companies in Western Europe and the United States had supplied Iraq with key technologies for large-scale production of advanced chemical warfare agents and delivery systems. The Soviet Union and its satellite states had trained the Iraqi military in the conduct of chemical warfare and sold large quantities of weaponry, some of which Iraqi engineers succeeded in converting into chemical weapon delivery vehicles (e.g., the al-Hussein ballistic missile). At the time, chemical weapon armament programs were also reported in other countries in volatile regions (e.g., Libya and Syria).

However, only following Iraq's defeat in the 1991 Gulf War did the world learn of the extent and advanced nature of Iraq's CB weapon programs. Moreover, the great efforts the Iraqi leadership was undertaking to conceal components of these programs from UNSCOM inspectors testified to the high value modern-day proliferators attach to CB weapons. In addition, in the

years following the liberation of Kuwait many soldiers of the coalition forces suffered a variety of medical conditions, collectively known as the Gulf War Syndrome. The lack of conclusive evidence on whether low-level exposure to chemical or biological warfare agents may have been a contributing factor increased the sense of helplessness in the face of such weapons. This sense of helplessness has been further heightened by the possibility that medical pre-treatments to protect soldiers from the effects of CB weapons might actually have caused some of the conditions.

As the events in Kuwait unfolded, the bipolar world order was gradually giving way to a new multipolar international system. Many local and regional conflicts, which had been suppressed during the Cold War, flared up into open wars. Many of the conflicts proved intractable and led to significant casualties for intervening forces. It also gradually dawned on policymakers and military planners that, as a consequence of proliferation, their troops might one day confront an adversary armed with chemical or biological weapons. Whatever the causes of the Gulf War Syndrome, the phenomenon highlighted many inadequacies in current CB weapon defense, detection, protection, and prophylaxis. For forces unwilling to sustain high casualty rates (especially in view of the remarkably low number of casualties in Kuwait), asymmetrical warfare with CB weapons was suddenly perceived as able to defeat armed forces equipped with the most modern conventional weaponry.

Meanwhile, the international community was moving rapidly to strengthen the regimes banning the possession and use of CB weapons. In January 1993, the CWC was opened for signature. States parties to the 1972 Biological Weapons Convention (BWC) began to consider verification and other measures to significantly strengthen the treaty. However, certain events, beyond the discoveries in Iraq, raised questions about the value of the security offered by these treaties.

In 1993, Russian President Boris Yeltsin all but admitted to an offensive Soviet biological weapon program in violation of the BWC. Serious concerns continue to exist about Russia's compliance with the convention. Trilateral verification and transparency exercises by the three co-depositories of the BWC (Russia, the United Kingdom, and the United States) have come to a halt, feeding suspicions of Russian non-compliance, and, recently, highly publicized accounts by a former ranking official in the Soviet biological weapon program appear to confirm the worst fears.[20]

Similar reports have emerged regarding past Russian development of new chemical warfare agents. Neither the agents nor their precursors are featured in the lists of chemicals in the CWC, and may therefore escape detection under its routine reporting and inspection mechanisms.[21] The rapid deterioration of economic and social conditions in Russia increases the possibility of highly trained specialists with knowledge of chemical or biological weapon development and manufacture being enticed with financial incentives to countries suspected of seeking such weaponry. Low security at the various chemical weapon storage sites in Russia raises the possibility of theft.

The disarmament treaties themselves have an impact on the relative threat perception. After the entry into force of the BWC in 1975, CW gradually became seen as the greater threat; in the 1990s biological weapons are once again the larger threat as the CWC sets new standards for verifiability and enforceability. This perception is exacerbated by concerns about poor detection capabilities for biological warfare agents and the problems of consequence management if a release of biological weapons were to occur. Against the background of the debates on asymmetrical warfare, the CWC ban on in-kind deterrence or retaliation appears to hobble a state party. Yet the whole purpose of disarmament conventions such as the BWC and the CWC is that the parties to them must seek ways of ensuring security by means other than those that are prohibited.[22] This was precisely the deeper sense in President Bush's declaration on May 13, 1991. In a different context, the CWC seems to contribute subtly to the shift in focus towards the *consequences* of possible chemical weapon employment. The ban on use and preparations for use has removed all possible tactical, strategic, and geopolitical rationales for acquiring chemical weapons from current discussions, leaving only the element of casualty production.

Parallel to this evolution of the CB weapon threat perception, the face of terrorism also changed. A greater number of actors began resorting to such tactics. Terrorist attacks became more lethal, resulting in higher casualty rates per incident and

wholesale destruction (although these were entirely due to conventional attacks).[23] Instead of seeking to garner publicity or further a distinct political cause, the new perpetrators of acts of terrorism seem to view the maximization of casualties as a goal in itself.[24] Particularly the religious groups associated with apocalyptic millenarianism, redemptive fanaticism, or racist and ethnic hatred are said to find justification for their acts of violence in the higher authority of God.[25] Because of their belief systems, mass casualties are not an impediment to the furtherance of their goals. Although so far such groups have mostly carried out their indiscriminate attacks with conventional explosives, they are said to be more likely than other terrorist groups to cross the political and moral barriers to employing CB weapons.

Events in the United States have significantly contributed to the new threat perception of terrorism. During the Clinton presidency the United States suffered the first large-scale, indiscriminate terrorist strikes on its own territory. The 1993 bombing of the World Trade Center in New York left six dead and around 1,000 injured; the 1995 bombing of the Alfred Murrah Federal Building in Oklahoma City resulted in 168 fatalities and around 500 injured. Most importantly, the latter attack almost coincided with the release of the sarin nerve agent in Tokyo, creating a mental link between mass casualties and the release of chemical and biological warfare agents by terrorists.

A number of factors have thus come together in the 1990s to heighten fears of the likelihood of sub-state actors using CB agents to produce mass casualties. But the prospects of such an event depend on whether terrorists can actually acquire CB weapons, which is a question that has not yet been settled.

THE ACQUISITION OF CB WEAPONS

To judge the likelihood of terrorist attacks with chemical or biological weapons a clear understanding of the weapon acquisition process from the perspective of the demand side—the terrorist organization—is required. The demand side is often reduced solely to motivations, such as the relative power and prestige the possession of non-conventional weapons confers to a non-state group, and the difficulties of state retaliation against terrorist groups, because they know no territorial boundaries.[26] Such reasoning is based on a state-level analysis of nuclear weapon proliferation, even though it is far from established that these motivations play any significant role in the acquisition of CB weapons by states. For all its weaknesses, the 1925 Geneva Protocol, which bans the use in war of CB weapons, eroded the legitimacy of their procurement and possession considerably. Public acknowledgment of such armament programs therefore required extensive justification. Consequently, most possessor states shroud their CB weapon programs in extreme secrecy, so that they cannot assert their relative power and prestige based on these arms.[27]

Viewed from the demand side, CB weapon proliferation occurs when a political entity—a state, sub-state, or transnational actor—decides to acquire a CB weapon capability where such a capability does not yet exist, *provided this decision is followed by a CB weapon armament dynamic*. The armament dynamic that the proliferator must initiate and sustain is the central part of the definition: proliferation is not an automatic process, which, once started, leads to eventual use. Reversals of the initial decision may occur at any stage as a consequence of, for instance, the impact of dissenting views or insurmountable technical problems. In other words, CB weapon deproliferation occurs as soon as the political commitment to the initial decision ceases to be renewed or if the political entity explicitly reverses that decision (e.g., by unilaterally forswearing the weapons or joining a disarmament treaty).

The assimilation model of armament dynamics captures the tension between proliferation and the various pressures towards deproliferation.[28] Assimilation is the process by which political and military imperatives, as constrained by a political entity's material base, become reconciled with each other so that a new weapon, weapon system, or arms category becomes an integral part of the political entity's mainstream military doctrine. Any weapon, weapon system, or arms category must thus satisfy both political and military imperatives.

This implies the existence of a dual decisionmaking track: one on which military appraisals are fundamental, and another on which political considerations play the dominant role. The military track relates to those decisions taken by the military organization to effect a political entity's security policy, including first and foremost the development and implementation of a

military doctrine. These planners take into account external factors (e.g., the changing threat) and internal ones (e.g., decision outputs from the political track). On the political track, overall policy decisions on security and budgetary allocations are taken. As the military and political tracks interact with each other, each decision or set of decisions not only influences future decisions on the same track, but also has ramifications for progress on the other. A considerable level of tension may exist between the tracks, especially if operators on one track make demands that are irreconcilable with the basic goals or premises of actors on the other track.

Any initial proposal for a particular type of weaponry envisages a particular end result. However, the weapon that is actually produced and deployed may differ significantly from the originally anticipated one. This variance between the original concept and the final product is the aggregate of all the opportunity costs paid in the effort to achieve the original concept. The process involves many discrete decisions at the various stages of the armament dynamic. As the proposed weapon enters the decision process, it has to overcome multiple thresholds. These may involve a wide range of issues, including funding requirements, technical difficulties, political opportunism, public opinion, environmental concerns, constraints from international humanitarian law and disarmament treaties, and so on.

To overcome such barriers, an opportunity cost must be paid. It can involve financial expenses as well as the expenditure of political capital to ensure the continuation of the program at a particular stage. Different times and circumstances may thus result in different opportunity costs to be paid for similar decisions in a comparable phase of the armament dynamic. Decisions and conditions hampering the armament dynamic are just as crucial as those promoting it: they affect the outcome by increasing the variance between the original concept and the final product.

The nature of the thresholds is determined by intrinsic factors, which relate to the political entity's material base, and extrinsic ones, which refer to the domestic or international environment in which the weapon is conceived. The political entity's material base constitutes a particularly important independent variable, affecting the decision process on both the political and military tracks. It consists of the political entity's physical base—geographic location, territorial size, population, presence of natural resources, access to resources abroad, etc.—as well as the level of education, of scientific, technological, and industrial development, of economic strength, and so on. It thus involves factors that the decisionmakers can rarely influence within the time frame of the armament dynamic under consideration. In other words, all other factors being equal, differences in the material base of any two political entities may account for different characteristics and results of their respective outputs.[29] The intrinsic and extrinsic elements may thus raise or lower the opportunity cost for crossing a particular hurdle. Ultimately, should the aggregate opportunity costs be too high for the political entity, the armament dynamic fails, and this is one of the possible causes of deproliferation.

The assimilation model views material, political, and societal constraints as obstacles that decisionmakers must overcome if they wish to pursue a particular weapon program, and for which they must be prepared to pay certain opportunity costs. The assimilation model is especially relevant to proliferation because of the extra attention it pays to deficiencies in the material base of the political entity. Elements (alone or combined) that may play a role in raising a threshold are a scarcity of certain natural resources, a lack of technical skills, an inadequate research or industrial base, and the like.

Barring abandonment of the entire project, political leaders may try to develop the missing ingredients indigenously, seek them abroad, or both. Given the probable time frame in which the armament program has to be realized, importing the missing elements may be the only feasible and, in the short run, the cheapest alternative. Especially if the dearth occurs in the physical base of the political entity, importation may be the sole possibility. Importation of particular technologies, knowledge, or materials is, consequently, one way of structuring the political entity's armament dynamic, albeit one that entails a sizeable opportunity cost.

The assimilation model is a heuristic device designed for studying CB weapon armament programs in countries for which limited information is available on decisionmaking processes and the structure of armament programs. The identification of thresholds on the dual decisionmaking track and the assessment of how they may be overcome enable the study of the demand side

of proliferation, irrespective of the type of government. The same methodology enables the application of the assimilation model to non-state actors, such as terrorist groups. The nature of the thresholds can be assumed to be similar for all political entities. However, the relative height of the thresholds will vary among these entities. Certain thresholds identified for states will consequently play only a minimal or no role in a terrorist organization, while other ones will have a far greater relative impact.

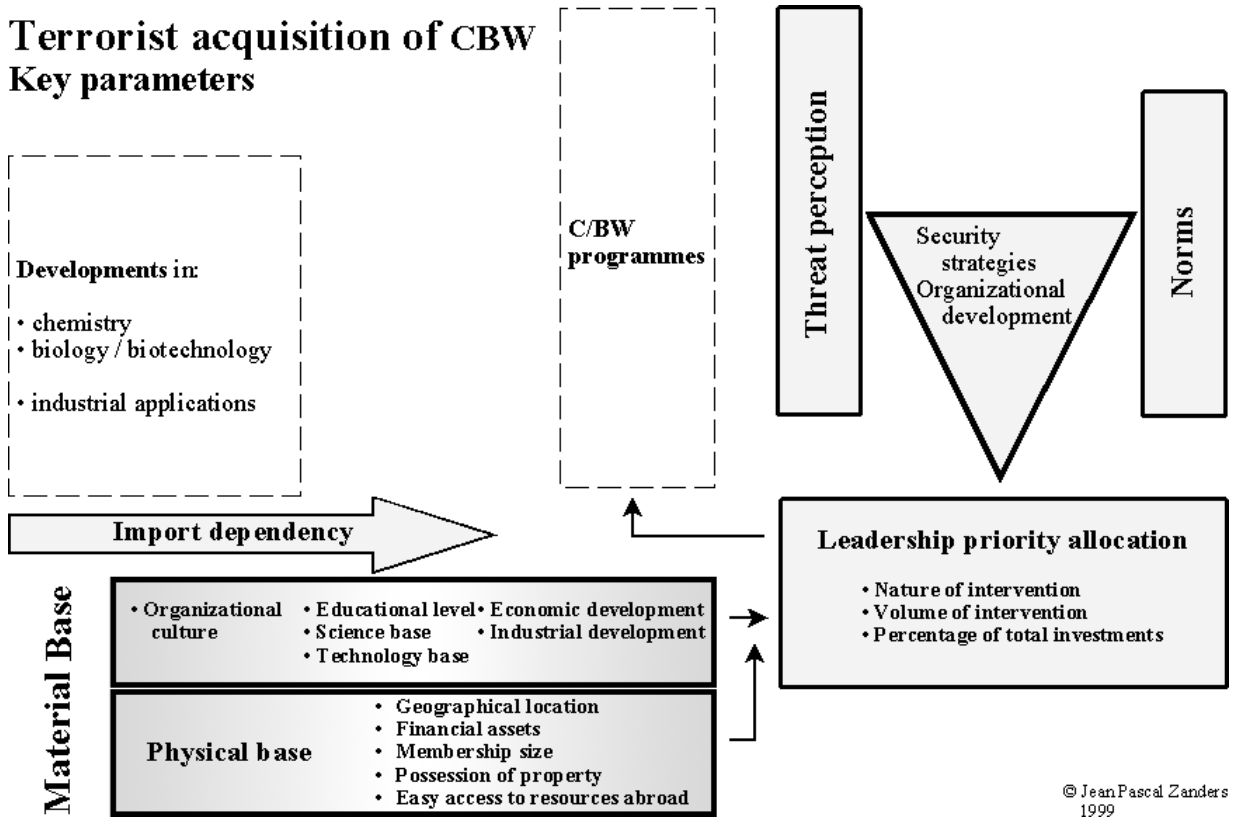
For instance, the distinct military track on which a political entity formulates its military doctrine is arguably non-existent for terrorist organizations. In this case, from the perspective of the assimilation model, it would mean that all relevant thresholds for the CB weapon armament dynamic in the terrorist organization are located on the political decisionmaking track. Nevertheless, such a group can be expected to have an idea, however vague, of why it is seeking such weaponry, even if it does not have a full-fledged "military doctrine." The assimilation model, as a heuristic device, suggests that incomplete or imprecise formulation of these goals increases the likelihood of a poor choice of agents, of inadequate dissemination devices and procedures, or of outcomes far below theoretical expectations. The way the political and goal-related (i.e., for a state actor, the military) imperatives are reconciled with each other directly affects the goal–instrument relationship of the selected weapon.

THE KEY PARAMETERS FOR TERRORIST ORGANIZATIONS

Material Factors

The material base of a terrorist organization seeking chemical or

Figure 1



biological weapons is a key determinant, because it consists of elements that the organization can only alter with great investment of resources or time (See Figure 1). The physical base, first, comprises elements that determine whether the organization will be materially able to acquire CB weapons. Some elements (e.g., membership size, financial assets, and possession of property and infrastructure) the organization can alter over time through targeted policies. Aum Shinrikyo attempted continuously to expand its membership and to extract the largest possible amount of wealth from its members, its members' families, and its sympathizers.[30] The transfer of property rights, including those of companies, was part of the initiation rites of novices.

A terrorist group has less direct influence over other components of the physical base. Its geographical location and the type of culture in which it is embedded have a direct bearing on the nature of the organization and its success. Aum Shinrikyo enjoyed its greatest success in Japan, where, for example, alienated members of the intellectual stratum of society were receptive to mysticism, and in Russia, where many victims of the social disintegration were similarly seeking solace in various kinds of mysticism. In contrast, the sect was unsuccessful in the United States and Germany, despite some targeted efforts. Other important components of geographical location for Aum Shinrikyo included the overall level of scientific, technological, and industrial development of Japanese society; the tax exemptions granted to recognized religious organizations, which enabled Aum to amass its considerable assets; and the general hands-off attitude of the Japanese authorities towards religious organizations as a consequence of the religious persecutions before 1945. In other words, the terrorist organization feeds from the society that spawned it.

The second component of the material base consists of the internal characteristics of the terrorist organization. The organization can relatively easily exploit, manipulate, or develop certain of these characteristics. As noted earlier, its culture may be based on social ideology, apocalyptic or millenarian visions, racial superiority, ethnic-nationalism, religious fanaticism, and so on. In the quest for chemical or biological weapons the level of education and training of the members as well as the science and technology base they are able to set up become important factors. Aum Shinrikyo launched repeated recruitment drives to attract promising young scientists and people with other required skills from Japan's leading institutes. These people were able to set up the programs and build the necessary installations.

An important weakness in the CB weapon programs, however, was the reliance on relatively unskilled sect members for the operation and maintenance of the installations, which contributed to accidents and leaks. Internal secrecy, and emphasis on dedication to the cause of Aum Shinrikyo in the selection of members to work on the CB weapon programs, were other contributing factors. Another negative factor on the operational side was Aum Shinrikyo's limited functional specialization. The people in charge of developing the agents were also responsible for developing the dissemination devices and executing the attacks. Their lack of experience in operational planning contributed to the many mistakes and failures. An organization's level of economic and industrial development thus determines the ways it is able to optimize its resources and allocate priorities in advancement of its goals.

Social Environment and Norms

The societal environment in which the terrorist organization evolves provides a second set of factors that influence the leadership in its choices regarding chemical or biological weapons. The tension between the organization's threat perceptions and the internal and external norms that govern its behavior has a major bearing on how the organization will develop and on the security strategies (plans for action or self-protection) it will adopt.

A terrorist group arises as a consequence of the fundamental dissatisfaction of its members with certain (or all) aspects of societal organization. Inevitably, that society will pose a threat to the very existence of the terrorist group. The greater the existential threat to the organization, the greater the chance of its resorting to extreme measures. In fact, this is the shared feature between the Rajneesh cult and Aum Shinrikyo: they both turned to the indiscriminate use of non-conventional means when public authorities threatened the continued functioning of the sects.

There is, in addition, a subjective side to the threat perception. As an officially recognized religious organization, Aum Shinrikyo enjoyed considerable tolerance of its activities by law enforcement agencies,

despite many complaints by parents of under-aged sect members and people living near sect compounds, as well as indications of the sect's involvement in murders. Isolation from the broader society was an effective way to hide its CB weapon-related activities, but also fomented paranoid projections of the threat to the sect posed by Japanese institutions and outside powers like the United States. The risk that the many, rather precise, apocalyptic predictions by the sect's leader, Shoko Asahara, might not be fulfilled provided another incentive to "help" events through chemical or biological weapons.

Norms are another major factor influencing the behavior of the terrorist organization and hence its willingness to pursue CB weapons. Norms, however, form a complex aspect of social interaction and often do not manifest themselves in an absolute, positivist form. For instance, one might anticipate that the release of sarin in the Tokyo underground weakened the norm against the use of chemical weapons or lowered the threshold for other groups to resort to CB weapons. But this would not indicate for whom or in relation to whom the norm was weakened.

The norm against CB weapons has essentially always been one between territorial, sovereign states, that is, between equal partners in the international system. In view of several gross violations of existing constraints (e.g., the 1899 Hague Declaration IV, 2, on projectiles containing asphyxiating gases; the 1925 Geneva Protocol) and the unwillingness of the international community to uphold the norm because of ulterior geopolitical interests (e.g., the 1936 war in Abyssinia; the 1980–88 Gulf War; the failure to disarm Iraq despite an explicit UN Security Council resolution) it cannot be said that these norms have been particularly strong.

The CWC offers a far stronger norm: not only use, but also possession of chemical weapons and all preparations for offensive chemical warfare are prohibited. The obligations are subject to international verification, and they are enforceable. The CWC obliges each state party to enact domestic penal legislation to ensure that none of its nationals (at home or abroad) or those present on its territory undertake activities in contravention of the treaty. In other words, since the Tokyo underground attack in March 1995, the norm against chemical weapons has definitely been strengthened and even extended to the sub-state level. Moreover, in the wake of the Aum Shinrikyo attack, Japan has promulgated legislation criminalizing the production, possession, and use of CW.[31] Many other states have also reviewed their existing laws to see whether an event such as the sarin attack is covered or have adopted explicit provisions to that effect in their CWC implementation legislation.

The BWC is, as noted earlier, far weaker in these respects than the CWC, but this norm should also be strengthened once the additional protocol, currently being negotiated in Geneva, enters into force. In addition, the UN General Assembly adopted the text of the International Convention for the Suppression of Terrorist Bombings on January 9, 1998.[32] Attacks fall within the scope of the convention if they are carried out with an "explosive or other lethal device."[33] These include not only conventional explosives or other incendiary devices, but also toxic chemicals, biological agents or toxins or similar substances, and radiation or radioactive material.[34] This is the first time that CB weapons are explicitly mentioned in an international counterterrorism agreement.

In summary, since March 1995 there has been a formal strengthening of the norms against CB weapons for states and sub-state actors and in relation to other states and sub-state actors. However, in practice norms are never absolute and are always weighed against other norms and interests. Domestic enforcement, for instance, may encroach upon freedoms of speech, religion, organization, and so on. It will depend greatly on the maturity of the political and legal system whether a society can differentiate between fundamental rights and criminal activities prepared and executed under the cover of these fundamental rights.

There is, however, a different angle to this debate. One historical aspect of the development of the taboo against CB weapons, which is often overlooked, is that the civilization that acquired such a mode of warfare clearly understood the military advantage it had over the enemy. It held a monopoly over the surrounding societies. Moral qualms about the application of noxious and poisonous agents in war were not a factor. Consequently, that civilization virtually never formulated legal or moral constraints against these weapons until the monopoly had disappeared or the military advantage had been balanced in an asymmetrical way. A similar sense of power

over the Japanese society, derived from the possession of sarin, was present among the leadership of Aum Shinrikyo. Rather than representing erosion of a taboo, which never existed for the cult, it accelerated the armament process and increased the internal pressures to demonstrate the possession of that power to the outside world. The apocalyptic visions of its leader provided the appropriate social discourse for the new technology within the religious community, but the new technology in turn also helped to determine the group's vision of the apocalypse.

The question regarding to whom the norm is applied also hinges on the recognition of the other party as an equal partner. International norms and laws emerged in the Westphalian state system because sovereign territorial states recognized each other as equal systemic units that could enforce the content of an international agreement within the territory of their jurisdiction.[35] In contrast, a political unit like a religious empire could not and cannot enter into such agreements. First, in such a unit's view sovereignty is derived directly from God and is therefore universal. Consequently, the religious political entity cannot tolerate a separate source of sovereignty.[36] Second, membership in the entity does not depend on territorial location but on adherence to the faith. The rules, norms, and values of the empire apply to all members of the faith wherever they may be, and do not apply to non-members.[37] Regulations, such as the prohibition of poisoned weapons, governed the conduct of belligerents sharing the same faith, but these weapons were quite permissible against infidels. History is replete with such examples from all great religions.[38]

For terrorist organizations founded in religion, these insights have a double implication. First, the norms maintained by the group may differ significantly from those of the broader society. Internal or external constraints that could raise the thresholds for acquiring CB weapons on the political track of the assimilation model may therefore simply be non-existent, and the success of the armament dynamic, if undertaken, may depend entirely on factors present in the material base. Second, because of their religious convictions, group members may differentiate themselves from the rest of society to such an extent that the elimination of non-members—even on a large scale—can easily be justified. This worldview may remove any objection to CB weapon use. Indeed, it may be an important promoter of the armament dynamic in its own right.

The strength of norms is also directly linked to the nature of the threat. Sovereign states facing an existential threat or perception that they must meet every security contingency at every level (total reliance on self-help) are less likely to adhere to international norms limiting their options, and are more likely to invest heavily in arms buildups, including chemical or biological weapons, and to defect from international security regimes (like disarmament treaties) if their vital interests are at stake. International law recognizes this tension through, for instance, the inclusion of withdrawal clauses in international treaties. The International Court of Justice did not contradict this principle in its opinion regarding the legality of nuclear weapons of July 8, 1996: it could not conclude whether nuclear weapon use was lawful or unlawful if the survival of the state in question was at stake, despite the potential for massive and indiscriminate destruction.[39] (Hence the smaller surface for "norms" than "threat perception" in Figure 1.) Translated to terrorist organizations, this raises the question of whether an existential threat, especially one that is gradually building up and that the group feels it cannot manage, contributes to the erosion of whatever norms the group might abide by. The Rajneesh cult decided on the dissemination of *salmonella* in salad bars precisely to avert such a situation. Aum Shinrikyo executed sarin attacks in the Tokyo underground to divert the attention of the police, who were poised to raid the sect's facilities, away from the cult.

Group Strategy and Structure

If the leadership of a terrorist organization decides to embark on CB weapon armament programs, it will have to make some key decisions regarding the allocation of its resources. The decision, and the nature of the program, will depend on the group's security strategies and structure. For example, a loosely structured, amorphous grouping with little central guidance (e.g., many transient right-wing groups and militias in Europe and the United States, including the abortion clinic attackers and the Oklahoma City bombers),[40] or an organization structured in small cells for maximum security, will find it much harder to set up an indigenous CB weapon armament program than a vertically integrated and ideologi-

cally uniform group, such as Aum Shinrikyo or the Rajneesh sect.

Organizations are also constrained by their material bases and may have to seek many, if not all, ingredients and technologies from outside. The nature and size of these constraints determine the degree to which a group must rely on external sources for its technologies, commodities, and expertise. For a terrorist organization this can be a formidable challenge. Unlike a state actor, which can buy technologies abroad and hire specialists, a terrorist organization must work in total secrecy because of the absence of a safe haven on the territory it occupies and the constant threat that law enforcement officials may raid the facilities. This means, for example, that the organization cannot hire a specialist or technician for a limited time to solve a certain problem, but must recruit him and convince him of the justness of its cause. This import dependency is also a function of the relative complexity of the weapon system the leadership has decided to acquire.

With the key components in place, the armament dynamic can continue along the dual track until the desired weapon is achieved. Decisionmakers must overcome the various thresholds and pay the various opportunity costs, while trying to keep the variance between the envisioned and the actual weapon as small as possible. The actual chemical or biological weapon in the hands of the terrorist organization will reflect the aggregate opportunity cost paid along the way (e.g., in terms of the quality of the agent): if the aggregate opportunity cost is too high for the organization, then the armament dynamic has failed (e.g., Aum Shinrikyo's botulinus toxin and anthrax programs).

The influence of the various parameters can be illustrated when comparing Aum Shinrikyo with the Rajneesh sect. The Rajneesh sect was responding to a rapidly evolving crisis that threatened its continued existence. The person in charge was a qualified nurse with sufficient skills to cultivate a pathogen, but not to set up a sophisticated biological weapon program. Moreover, the cult had no time to develop its material base. The goal was limited in scope and time, namely influencing the outcome of local elections. The sect thus opted for an incapacitating rather than a lethal agent, thereby narrowing the technical requirements for the laboratory. The choice of a *Salmonella* strain, which causes food poisoning, also simplified dissemination, as a liquid solution could be poured on food in public places. In addition, this reduced the need for functional specialization in the sect. The straightforward goal–instrument relationship also meant that as soon as the sect realized that it would not attain the desired outcome, it terminated its program.

Aum Shinrikyo's plans were far more ambitious: it sought to destabilize Japan and eventually take over all its governmental functions. To this end, the sect pursued a broad set of instruments, including conventional weapons, an earthquake machine, a laser gun, and a nuclear device, as well as CB weapons. While many accounts of Aum Shinrikyo's activities have focused narrowly on the CB weapon programs, the important point for demand-side proliferation analysis is that the sect actively sought a broad range of weaponry. This had two major implications.

First, the element of priority resource allocation by the sect leadership became important in the CB weapon armament dynamic. The sect spread its huge financial assets and other resources over several weapon programs, as it tried to become self-sufficient in every area. It even opted to establish its own production line for the Kalashnikov AK–74 rifle instead of purchasing the required firearms, even though the black market in Russia, where Aum Shinrikyo had a large following and many regional centers, could have provided ample opportunities. Each program placed increasing demands on manpower, the ability of the offices outside Japan to purchase the required technologies, and so on. Moreover, each program created its own follow-on imperatives. The prospect of mass-produced assault rifles, for example, raised the issue of training sect members to use these weapons and, in turn, placed fresh demands on the recruitment drive (e.g., to attract highly trained military personnel as instructors). Had the sect concentrated its resources more on the CB weapon programs, it might have achieved greater success in terms of creating a viable biological weapon or larger production batches of higher-quality chemical warfare agents. As it turned out, the sect was successful in few of its weapon programs.

Second, there was no rationale for the CB weapon programs without the other weapon programs. Aum Shinrikyo's ultimate goals were the creation of Armageddon, the toppling of the Japanese government,

the subjugation of the Japanese population, and, finally, the establishment of its own form of governance. CB weapons could conceivably play a role (e.g., through the creation of mass panic and exposing the weaknesses of the authorities to protect the population) in the first three phases, but were insufficient in and of themselves. Any large-scale release of chemical or biological warfare agents in isolation would invite a massive response from the law enforcement authorities (as ultimately happened after the Tokyo underground attack), leading to the potential demise of the organization. In other words, it was impossible in practice for Aum Shinrikyo to concentrate its resources on CB weapons. In view of its grand strategy, the leadership had to spread its large, but nonetheless limited, resources over the various programs. From the perspective of the CB weapon programs, this imperative raised the thresholds in the assimilation process, which contributed to the reduced quality and quantities of the chemical warfare agents and to failures with respect to the biological warfare agents. In summary, the factors that contributed to the establishment of the CB weapon programs were ultimately also responsible for the rather poor results.

CONCLUSIONS: RECONSTRUCTING THE THREAT

The Risk of Mass-Casualty Attacks

A terrorist strike with chemical or biological weapons is definitely feasible. Aum Shinrikyo demonstrated as much in 1995. Nevertheless, the likelihood of such an event recurring must be judged on the basis of realistic and testable parameters. The single most important problem in such an undertaking is the uniqueness of the Japanese cult and the armament programs it set up. In several instances it is difficult to judge whether certain elements are likely to re-occur (e.g., whether the cult was a phenomenon unique to Japan or whether it could also arise in a different type of society).

This article has attempted to construct an analytical framework for assessing the likelihood of a terrorist CB attack based on the assimilation model for studying the demand side of the proliferation process in states. The key question is, how does a proliferator structure its armament dynamic in order to acquire a chemical or biological warfare capability? The model focuses on the many thresholds to be crossed on the political and military decisionmaking tracks and on the wide range of opportunity costs that must be paid to overcome these obstacles so that, ultimately, the imperatives of the various actors involved in the armament process become reconciled with each other. This set of thresholds can be assumed to be similar for all countries. However, the height of the respective thresholds will vary between any two countries as a consequence of the differences in their respective material bases. Ultimately, these factors combined will account for the different outputs (including cases of failure of the armament dynamic) in these countries.

The assimilation model can be similarly applied to the proliferation of chemical or biological weapons to sub-state actors. The main differences between a state and a sub-state actor are in the makeup of the material base, resulting in different heights of the thresholds. In order to be able to contrast two similar actors, this study has used the 1995 Aum Shinrikyo attack on the Tokyo subway and the 1984 attempt at mass food poisoning by the Rajneesh cult, although the pathogen in the second case, *Salmonella typhimurium*, does not qualify as a warfare agent as defined in this paper. The comparison nevertheless reveals some interesting insights about the goal–instrument relationship.

Chemical and biological weapons only make sense in relationship to specified goals. To Aum Shinrikyo they represented possible avenues to the ultimate goal of destabilizing Japan and taking over the government. They were to be used in conjunction with other exotic or devastating weapons, as well as with ordinary conventional firearms. (Arguments such as ease of production or relative cheapness may bear upon how certain thresholds are overcome in the pursuit of these goals, but in the case of Aum Shinrikyo these factors were arguably of limited importance in view of the massive investments in the other weapon programs. They may have played a role in the sequence in which the various armament programs were launched.) Had the sect focused exclusively on CB weapons, it probably would have solved the problems of viability of the chosen pathogens, large-scale production of chemical and biological warfare agents, and effective dissemination. However, such an exclusive focus would not have served the totality of the final goals. Consequently, the sect had to engage in the politics of priority allocation of resources, and the CB weapon programs had to

compete with the other weapon projects. Many factors that increase the aggregate opportunity costs for weapon programs in states, such as inter- and intra-service rivalry in the military, institutional and parochial interests, influence peddling, and so on, were also observable in Aum Shinrikyo. The outcome was many unresolved issues in the CB weapon programs as well as in the other weapon projects.

The material base upon which Aum Shinrikyo could draw was huge and few other terrorist organizations will be able to match it. The cult's failures and difficulties are therefore significant for the threat assessment of terrorism with CB weapons. Variations in the composition of the material base have an immediate impact on the ability of an organization to successfully sustain a CB weapon armament dynamic. For instance, only a vertically organized, highly integrated, and ideologically uniform group appears to have the capacity to set up and operate a large-volume production line for chemical or biological weapons in absolute secrecy. Religious sects, more than any other group, come to mind. This definitely reduces the number of candidates that could sustain such an armament program.

High technical hurdles ultimately limited the range and affected the quality of the warfare agents Aum Shinrikyo was able to develop. Military-grade warfare agents are therefore unlikely to constitute the main threat. As the 1995 sarin attack in the Tokyo underground suggests, a terrorist CB weapon attack may result in relatively few fatalities, and most victims are likely to suffer short or low-level exposure to the chemical or biological warfare agents. The long-term effects of such exposure are still poorly understood, as evidenced by the ongoing debates surrounding the Gulf War Syndrome. Part of the resources for countering CB weapon terrorism should therefore be invested into researching the long-term consequences and treatment of such low-level exposures. Failure to do so can lead to demoralization in the affected society and ultimately contribute to the end goals of the terrorists.

Constraints in the material base can lead to a low-volume, high-quality manufacture of chemical or biological warfare agents. Loosely structured or cell-based terrorist groups, or even lone individuals, can produce small quantities of such agents. While this broadens the possibility of these agents being used in terrorist attacks, the probability must nonetheless be linked to the goal–instrument relationship maintained by the actor. Indeed, despite the toxicity or pathogenicity of the agents, small quantities are unlikely to result in mass casualties. Rather, these high-quality agents would be effective for targeting individuals or small groups. Such discriminate use of warfare agents, however, does not differ fundamentally from the more "traditional" use of chemical or biological materials. The question can thus be raised whether this development would fundamentally affect threat assessments. Over the past decades various kinds of terrorist organizations and individuals have been known to be in the possession of extremely toxic substances, but until recently this did not affect the overall assessment of the threat from terrorism.

A related question is whether, bearing the goal–instrument relationship in mind, the use of warfare agents for individual assassinations does not constitute a case of technological overkill. Possibly, a technological imperative distorts the goal-instrument relationship, whereby, for instance, toxicity or pathogenicity becomes the prime criterion for selecting a warfare agent. Technological overkill characterized some of Aum Shinrikyo's assassination operations: VX was injected into two victims with syringes, VX and sarin were used in three attempts to murder a lawyer assisting members seeking to leave the sect,[41] and phosgene was sprayed through a letterbox in a failed effort to silence a critical journalist.[42] The sect could arguably have resorted to more cost-effective instruments. Its interest in the potentially most lethal warfare agents was, of course, a function of its vision of Armageddon. The selection of sarin, VX, and anthrax was also influenced by the intense media attention to the consequences of these agents during the 1990–91 Gulf War.[43] However, the cult did not have the necessary mix of agents at its disposal to meet different types of contingencies (as it did not plan for them). It is not inconceivable that in this void the competition between the various departments of the sect led to lobbying efforts with Shoko Asahara to demonstrate the effectiveness of a particular weapon and contributed to the use of an overkill capacity.

Alternative Scenarios

The discussion so far has focused on variations of some key parameters in the assimilation model with respect to a terrorist organization

wishing to establish an indigenous CB weapon capability involving some of the most sophisticated warfare agents. The working hypothesis was the simple equation underlying most current consequence projections: increased toxicity or pathogenicity equals high casualties. The correlation, however, is far more complex and not necessarily positive. The assumed (military) grades of toxicity and pathogenicity in the threat projection are not easily attained by a terrorist organization in large production runs (around 7.5 liters of 30 percent pure sarin was made for the Tokyo underground attack). The dissemination of these agents, however, could lead to emergency contingencies for which there is little planning today.

Replacing consequence assessments with the goal–instrument relationship as point of departure for threat analysis reveals a different aspect, whose relevance may increase if terrorist organizations acquire greater sophistication and maturity with respect to CB weapons than Aum Shinrikyo. If the choice of a particular chemical or biological warfare agent by the military is a balance between potency and logistical considerations in relation to operational requirements, the question can be asked why a terrorist organization would not seek a similar balance between its technical capabilities and the type of CB weapons used to further its goals. This balance can be struck in two different ways. First, a terrorist group could decide on, for example, first-generation chemical warfare agents such as phosgene or hydrogen cyanide. Their manufacture is technologically less demanding than that of nerve agents, and the ingredients for their production are widely available. The purchase of these ingredients would therefore not necessarily arouse suspicion.

Second, over the decades the military have investigated and synthesized thousands of extremely toxic chemicals, but rejected most of them for weaponization.[44] The reasons that they were not ultimately incorporated into the arsenals may be of less relevance to a terrorist organization seeking a CB weapon capability. In other words, a terrorist organization can choose from a huge number of less-known toxic compounds to match its technical capabilities and aims. The first responders to a CB weapon terrorist attack may, consequently, be confronted with the effects of totally unexpected agents, a possibility that can be easily overlooked in the preoccupation with the threat of so-called weapons of mass destruction.

Finally, the prime reasons for using CB weapons on the battlefield are not necessarily casualty production. Denying terrain, degrading combat effectiveness by forcing the enemy to don protective clothing, degrading the operability of facilities and equipment together with imposing the need for elaborate decontamination procedures, causing terror and psychological exhaustion, flushing out enemy troops from strongholds, incapacitation, crop destruction, and so on, are all major applications of CB weapons. Terrorists, too, are not always interested in creating large numbers of casualties. Very often they hit high-value targets, such as train junctions, resulting in major disruptions. Relatively large sections of the population suffer the consequences. Persistent agents, e.g., mustard, could easily be used in this way. The release of an incapacitant, such as a potent lachrymator agent, into the air conditioning system of an airport can easily shut down all activities without causing a single permanent casualty. Opponents of genetically engineered food could resort to anti-crop agents to destroy harvests without physically harming a person. In summary, from the perspective of the goal–instrument relationship the variety of possible agents is enormous. Targets and effects would be limited, but, should the terrorist group so decide, the establishment of a domestic production capability for these agents would be less demanding on the material base of the organization.

Chemical and biological *warfare* agents have been the main consideration in this article, because they represent the new qualitative element in the terrorist threat. Toxicants and pathogens have been applied in assassinations and sabotage since time immemorial. The fact that today more people may have access to the knowledge and the technologies required to manipulate these agents can increase the quantitative dimension of the threat, but their use will not generally lead to mass casualties.

CB weapons, in contrast, are by their very nature indiscriminate, and some military-grade agents can, in theory, produce large numbers of fatalities and other casualties. Their insidiousness, moreover, makes them ideal instruments for terror and chaos. However, the processes to manufacture and disseminate them in sufficiently large quantities to obtain these effects are far more complex than those associated with other chemical and biological ma-

terials. Despite large investments, Aum Shinrikyo's CB weapon programs continued to be plagued by considerable problems. The dependency on outside sources for equipment and compounds combined with the fact that such a CB weapon program must be run in total illegality considerably complicates the quest for such weaponry. Contrary to widespread belief, the norms against both state and sub-state acquisition and use of CB weapons have been greatly strengthened. In addition, many sectors of society have acquired a greater awareness of the security risks involved in proliferation and will therefore be less likely to be unwitting partners in the acquisition of CB weapons by terrorists. These elements are and will remain major impediments to the widespread use of CB weapons for terrorist purposes.

[1] Anthony T. Tu, paper delivered to "Chem-Bio '98: Combating the Terrorist Threat," sponsored by Jane's Information Group, Washington, DC, October 6-7, 1998; David E. Kaplan and Andrew Marshall, *The Cult at the End of the World: The Incredible Story of Aum* (London: Arrow Books, 1996), p. 144.

[2] A similar approach has been noted in chemical weapon proliferation analyses, whereby the debate conjures up a continuum starting with the transfers from industrialized countries to the proliferator, and ending with the latter's acquisition of a chemical weapon capability. The predetermined end of this linear presentation of the chemical weapon acquisition process is probable (or at least possible) use. Jean Pascal Zanders, "Towards understanding chemical warfare weapons proliferation," *Contemporary Security Policy* 16 (April 1995), pp. 102–103.

[3] W. Seth Carus, "Bioterrorism and Biocrimes: The Illicit Use of Biological Agents in the 20th Century," Working Paper, Center for Counterproliferation Research, National Defense University, Washington, DC, August 1998 (March 1999 Revision), pp. 57–66.

[4] This article deals exclusively with internal processes of CB weapon acquisition and therefore not with state-sponsored terrorism and the possibility that a state may supply chemical or biological warfare agents. Several contributions in Brad Roberts, ed., *Terrorism with Chemical and Biological Weapons: Calibrating Risks and Responses* (Alexandria, VA: Chemical and Biological Arms Control Institute, 1997) deal with this threat.

[5] L. Lewin, *Die Gifte in der Weltgeschichte* [Poisons in world history] (Berlin: Verlag von Julius Springer, 1920), p. xiv. The author details many examples of poisoning for political purposes.

[6] Erhard Geissler, *Biologische Waffen—Nicht in Hitlers Arsenalen* [Biological weapons—Not in Hitler's arsenals], Studien zur Friedensforschung Band 13 (Münster: LIT Verlag, 1998), especially chapters 2 and 3; Mark Wheelis, "Biological sabotage in World War I," in Erhard Geissler and John van Courtland Moon, eds., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, SIPRI Chemical & Biological Warfare Studies no. 18 (Oxford: Oxford University Press, 1999), pp. 35–62. Both studies are based on documents from German archives.

[7] Robert Harris and Jeremy Paxman, *A Higher Form of Killing* ([No place given]: Triad Granada, 1983), pp. 88–94.

[8] Walter Hirsch (Col. Dr.), "Soviet BW and CW Preparations and Capabilities," (Washington, DC: US Army Chemical Corps, Intelligence Branch, May 15, 1951), pp. 505–6.

[9] Valentin Bojtzov and Erhard Geissler, "Military Biology in the USSR, 1920–45," in Geissler and Moon, eds., *Biological and Toxin Weapons*, p. 163; Harris and Paxman, *A Higher Form of Killing*, p. 89; Jan Nowak, *Courier From Warsaw* (Detroit: Wayne State University Press, 1982), p. 63.

[10] Harris and Paxman, *A Higher Form of Killing*, pp. 197–98; Ken Alibek, *Biohazard* (London: Hutchinson, 1999), pp. 172–74.

[11] Allan Cowell, "The daring attack that blew up in Israel's face," *New York Times*, October 15, 1997, p. A8.

[12] "South Africa's chemical and biological warfare programme," in Truth and Reconciliation Commission, *Final Report*, presented to President Nelson Mandela on October 29, 1998, volume 2, chapter 6, <http://www.truth.org.za/final/2chap6c.htm>.

[13] Ron Purver, *Chemical and Biological Terrorism: The Threat According to the Open Literature* (Ottawa: Canadian Security Intelligence Service, June 1995), <http://www.csis-scrs/gc/ca/eng/miscdocs/tabintre.html#preface>, chapters "Biological Terrorism" and "Chemical Terrorism."

[14] The recent spate of anthrax hoaxes in the United States has significantly increased the number of cases. For an overview, see Carus, "Bioterrorism and Biocrimes."

[15] Purver, *Chemical and Biological Terrorism*, chapter on "Chemical Terrorism."

[16] *Chemical Weapons: Threat, Effects and Protection*, FOA Briefing Book, no. 16 (Sundbyberg, Sweden: Defence Research Establishment FOA, 1992), p. 20.

[17] *Salmonella* is not normally considered a military agent and has been included in some listings precisely as a consequence of the Rajneesh attack. James A. F. Compon, *Military Chemical and Biological Agents* (Caldwell, NJ: The Telford Press, 1987), p. 373. *Salmonella* has also been described as an "unsophisticated agent." Edward M. Eitzen, Jr., "Use of Biological Weapons," in Frederick R. Sidell, Ernest T. Takafuji, and David R. Franz, eds., *Medical Aspects of Chemical and Biological Warfare* (Washington, DC: Office of The Surgeon General, Department of the Army, 1997), p. 447. The report of the 13th session (January 4–22, 1999) of the Ad Hoc Group negotiating a protocol to the Biological and Toxin Weapons Convention in Geneva does not list the pathogen. Procedural Report of the Ad Hoc Group of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, document BWC/AD HOC GROUP/44 (Part 1), January 29, 1999, pp. 152–54.

[18] "US will forswear CW use once treaty is in force," USIS Presidential Text EUR102, US Embassy, Brussels, May 14, 1991.

[19] Joseph Fitchett, "US Gulf lesson: Toxic arms devalued," *International Herald Tribune*, May 15, 1991, pp. 1-2; Pierre Simonitsch, "USA zu vollständigem Verzicht auf chemische Waffen bereit" [USA prepared for total renunciation of chemical weapons], *Frankfurter Rundschau*, May 15, 1991.

[20] Alibek, *Biohazard*. Ken Alibek also gave several widely reported testimonies to the US Congress and is regularly interviewed by the international press.

[21] Vil Mirzayanov and Lev Fyodorov, "A poisoned policy," *Moscow News*, no. 39 (September 27, 1992), p. 9. Vil Mirzayanov, "Poisons the treaty left out," *Wall Street Journal Europe*, May 25, 1994.

[22] Previous agreements, such as the 1925 Geneva Protocol, were mere contracts. Technically they ceased to be binding as soon as they were broken by another party and were not binding on non-contracting parties. From the outset it was clear that states parties to the BWC and CWC remain bound to the disarmament imperative irrespective of actions by other countries.

[23] Peter Chalk, "The evolving dynamic of terrorism in the 1990s," *Australian Journal of International Affairs* 53 (1999), p. 152.

[24] Joseph F. Pilat, "Prospects for NBC terrorism after Tokyo," in Roberts, ed., *Terrorism with Chemical and Biological Weapons*, p. 5; Jerrold Post, presentation on countering terrorist groups, in *Conference on Countering Biological Terrorism: Strategic Firepower in the Hands of Many? August 12–13, 1997*, Proceedings report PIPS-97-2 (Arlington, Virginia: Potomac Institute for Policy Studies, 1997), pp. 38–39.

[25] Kurt Schelter, "Antiterrorismuspolitik auf nationaler und internationaler Ebene" [Antiterrorism policy on the national and international levels], *Sicherheit und Frieden*, no. 4, (1997), p. 208; James K. Campbell, "Chemical and biological terrorism: Asymmetric warfare in the twenty-first century," in Gunnar Jervas, ed., *NBC–Weapons and Terrorism* (Stockholm: Swedish Defence Research Establishment, FOA, October 1998), pp. 27 and 38.

[26] Campbell, "Chemical and biological terrorism," p. 27.

[27] For example, only after the 1980–88 Gulf War did Iraq admit to possessing CW, although several UN investigation reports had accused it of waging chemical warfare. It was not until April 1990 that the Iraqi leadership began referring to its chemical weapon arsenal as proof of its technological and military prowess. Jean Pascal Zanders, "The chemical threat in Iraq's motives for the Kuwait invasion," in Jean Pascal Zanders, ed., *The 2nd Gulf War and the CBW Threat*, Proceedings of the 3rd Annual Conference on Chemical Warfare, Vredesonderzoek, Special Issue (Brussels: Vrije Universiteit Brussel, November 1995), pp. 41–42. When India admitted to secretly possessing chemical weapons in its declaration under the CWC in 1997, it not only embarrassed the military establishment and diplomats, but also affected its leadership position on nonproliferation issues among the non-aligned countries.

[28] Jean Pascal Zanders, "Tackling the demand side of chemical and biological weapon proliferation," in Dietrich Schroeer, ed., *Technology Transfer* (London: Ashgate Publishing Ltd., forthcoming 1999). The assimilation model is explained with graphics in the Internet Educational Module on CBW Non-Proliferation, created by the SIPRI CBW Project and the Centre for Peace and Security Studies of the Free University of Brussels, <http://cbw.sipri.se>.

[29] For example, the United States and Iraq both developed binary CW. In the United States the binary concept was viewed as the answer to many safety, ecological, logistical, and political objections to chemical weapons, and its promoters were willing to accept a less pure nerve agent, which was produced inside the munition on the way to the target rather than that in a unitary shell or bomb. In Iraq, the so-called binary agent consisted of a GB/GF (sarin/cyclohexylmethylphosphonofluoridate). Iraq is less sensitive to public objections.

[30] The references to Aum Shinrikyo in this section are based on the analysis by Kaplan and Marshall, *The Cult at the End of the World*.

[31] Richard Lloyd Parry, "Japanese shaken by new gas attack," *The Independent* (London), April 20, 1995, p. 12. T. R. Reid, "Gas fells 300 in new attack in Japan," *International Herald Tribune*, April 20, 1995, pp. 1, 6.

[32] *International Legal Materials*, vol. 37, no. 2 (March 1998), pp. 249–260.

[33] Terrorist Bombing Convention, Art. 2, para. 1.

[34] Ibid., Art. 1, para. 3.

[35] For example, the first known international agreement regarding the prohibition of the use of poison weapons was concluded in Strasbourg between France and the German Empire in 1675, 27 years after the Peace of Westphalia. Officers were to punish any person who possessed or used such implements. Lewin, *Die Gifte in der Weltgeschichte*, p. 563.

[36] This conflict of religious versus secular sovereignty was the source of the Thirty Years War (1618–48), which ended with the demise of the Holy Roman Empire. Many of the current internal conflicts in, for example, Iran and Israel are similarly rooted in the duality of religious versus secular sovereignty.

[37] For instance, Jews maintained a sense of community despite almost 2000 years of diaspora.

[38] For example, in his work published in the late Middle Ages, *Von allerlei Kriegsgewehr und Geschütz* (On types of gun and cannon), Wulff von Senftenberg expressed reservations about his own proposals for poisonous fumes if used against Christians, but had fewer misgivings regarding use against the "godless" Turks or other infidels. Julius Meyer, *Der Gaskampf und die chemischen Kampfstoffe* (Gas warfare and chemical warfare agents) (Leipzig: Verlag S. Hirzel, 1925), p. 277. Daniel Patrick Jones, "The role of chemists in research on war gases in the United States during World War I," Ph.D. diss., University of Wisconsin, 1969, p. 40.

[39] Shannon Kile, "Nuclear arms control," *SIPRI Yearbook 1997: Armaments, Disarmament and International Security* (Oxford: Oxford University Press, 1996), pp. 391–92.

[40] Chalk, "The evolving dynamic of terrorism in the 1990s," pp. 157–58.

[41] Entry from "Database of Incidents Involving Sub-National Groups and Chemical, Biological, Radiological, and Nuclear Materials, 1900–Present," CBW Nonproliferation Project, Monterey Institute of International Studies, 1999.

[42] Another assassination operation involved the 1984 sarin release in Matsumoto in an attempt to kill three judges. Bad execution of the assault (the sect's science chief overslept, forcing last minute changes to the plans), problems with the dissemination device that created panic in the strike team and made it flee leaving the sarin outlet open, and a sudden change in the wind direction were ultimately responsible for the several hundreds of casualties. Forty-four pounds of sarin had been manufactured in preparation for the attack, which is illustrative of the overkill approach.

[43] Aum Shinrikyo appears to have had an exclusive interest in agents that were formerly in the US arsenal or which the United States considers to pose the gravest threat. Although the sect obtained the production plans for sarin from Russia, it does not seem to have developed an interest in warfare agents typically in the former Soviet arsenals (e.g., soman or isomers of VX). In view of its large operations in Russia, the training of sect members by Russian military personnel and the general opinion that expertise and technologies can be easily bought in Russia, this is remarkable.

[44] For example, in the 1960s several lethal agents apparently reached an advanced stage of development in the United States. A whole range of so-called E-agents (experimental agents) was studied at Edgewood Arsenal. One of them, EA 1356 or the 1356th Experimental Agent, was field tested at the Dugway Proving Ground in 1969. SIPRI, *Chemical and Biological Warfare Volume II: CB Weapons Today* (Stockholm: Almqvist & Wiksell, 1973), p. 298.