
Parliamentary Joint Committee on ASIO, ASIS and DSD
Inquiry into Intelligence on Iraq's Weapons of Mass Destruction (WMD)

# SUBMISSION:
# BIOLOGICAL WEAPONS AS 'WEAPONS OF MASS DESTRUCTION'

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## Introduction

This submission is intended to assist the Committee by providing background information relevant to the Inquiry's term of reference (a):

a) the nature and accuracy of intelligence information received by Australia's intelligence services in relation to:
   (i) the existence of,
   (ii) the capacity and willingness to use, and
   (iii) the immediacy of the threat posed by, weapons of mass destruction (WMD).

The focus of the submission is the threat of biological weapons (BW) and the challenges associated with assessing and responding to that threat.

At the outset, it is important to understand, for intelligence purposes, the differences between BW and chemical (CW) and nuclear weapons (NW). Part One of this paper discusses problems with the language used to describe weapons categories deemed to be 'WMD' and emphasises the uniqueness of BW. An examination of the history of BW, and the technology required to target humans, shows that BW has uses and effects much more diverse than as a weapon of mass destruction. In the lead-up to the Iraq War, there was a great deal of concern about alleged Iraqi WMD possibly falling into the hands of terrorists. Accordingly, Part Two explores terrorists' motivations and capabilities regarding the use of BW. Part Three includes a general note on BW-related intelligence sources, and concludes with a discussion of the alleged Iraqi mobile BW production plants discovered in April and May of this year.

## Part One - the nature of BW

### 1. Language problems: 'WMD', 'NBC' and 'CBW'

The necessity, for policy purposes, of drawing a clear distinction between nuclear, biological and chemical weapons is a common argument in the expert literature on BW.[2] The linguistic device of grouping together, under one term, weapons that are technically vastly different carries the risk that the uniqueness of each will be overlooked by policy makers. In particular, the analysis of BW has often been held hostage to misplaced analogies to NW or CW. Abbreviated terms like 'WMD' (weapons of mass destruction) and 'NBC' (nuclear, biological and chemical) in the strategic lexicon are part of the problem. The apparent rationale for grouping these

weapons together is that the effects of each are regarded as similar – inflicting mass casualties, causing fear and panic in a population, and undermining government stability.[3] However, each weapon category differs greatly in terms of ease of production, challenges for deterrence, and effective defence measures.

There is also a tendency in academic and policy circles to classify chemical and biological weapons, grouped together as 'CBW', as a non-nuclear category of WMD. However, a report by the US National Academy of Sciences highlighted how pairing off chemical and biological weapons inappropriately blurred the distinction between the two. A practical consequence of this has been that the numerous US 'chem/bio' response teams are, in fact, almost entirely focused on detection, decontamination, and treatment of casualties in a chemical attack scenario only.[4]

Distinguishing clearly between weapon categories for the purposes of responding to a threat makes sense because it mirrors the choices made by potential users of WMD. Terrorists, in particular, would have in mind the specific effects they want a weapon to have. For three reasons, BW (as distinct from CW and NW) has special appeal for the purposes of mass destruction terrorism: (1) BW is easier to acquire than NW and does more damage with less material than CW; (2) the effects of BW on the target population are difficult to counter; and (3) the insidious nature of BW agents is perfect for generating fear.[5] BW terrorism is discussed further in a later section of this paper.

If the threat of BW is to be taken seriously, a vital first step is to take great care with the language and terms used to portray and deal with that threat.

## 2. Beyond 'WMD': the uniqueness of BW

Just as it is essential to distinguish BW from other 'weapons of mass destruction', it is important to note that BW may not always manifest itself as such a weapon. The ability to cause 'destruction' (a better word is 'casualties') on a vast scale is by no means a given property of BW, and the common tendency to classify BW as weapons of mass destruction is highly misleading. The ability to inflict mass casualties is not an inherent property of BW but is highly dependent on the type and quantity of agent released and the means by which it is delivered. Documented BW attacks have been small in scale and generally produced fewer casualties than conventional explosives. Historically, terrorist use of BW has been tactical use to kill or punish specific individuals.[6]

BW might be better characterised as a multifaceted threat encompassing bioterrorism, assassination, economic warfare against staple crops, tactical or strategic military use on the battlefield, and weapons of mass destruction.[7] The dimensions of biological warfare may be described in terms of the nature of the aggressor, the scale of release of the agent, and the target. There are three prominent divisions within each dimension:[8]

| Nature of the aggressor | Scale of agent release | Target |
|---|---|---|
| Nations | Point-source release | Human |
| Subnational groups | Medium-scale release | Animal |
| Individuals | Large-scale release | Plant |

According to the above table, a BW attack could take one of 27 different forms. This could range, for example, from a point-source criminal act by an individual against a particular human victim to a large-scale attack by a nation against an enemy's crops.

The choice of a particular BW agent is also relevant to the dimensions of biological warfare, in terms of whether an agent is contagious and how easily it can be treated. This is illustrated by the following scenarios:

- To murder an individual, an aggressor might use ricin - a non-contagious plant-based toxin.
- To commit mass murder, the best agent might be anthrax - a non-contagious bacterial disease.
- To cause contagion, an aggressor might use plague – a contagious bacterial disease that can be treated with antibiotics.
- To wield a weapon of mass destruction, a good choice might be smallpox – a contagious virus disease that cannot be treated after infection.[9]

While BW is so often included in the 'family' of WMD alongside CW and NW, clearly it has uses and effects much more diverse than causing mass destruction.

## 3. Human targets

A sub-genre of popular literature about some scientifically-inclined madman causing the end of life on Earth has been widely read and quite influential. Scientists and science fiction writers have presented a great many scenarios of biological warfare, all of them frightening. However, contrary to some of the more gloomy discussions of BW, biological attacks of any magnitude are extremely difficult to plan, develop, execute and fund. Popular accounts of how easy it is to *produce* biological agents often mask the real technological challenge required for a successful BW attack – *weaponisation* of the agent.

Weaponising a biological agent so that bacteria, viruses or toxins can effectively enter the human body involves highly sophisticated procedures. For example, producing 'weapons grade' anthrax requires lyophilization (freeze-drying) and micro-encapsulation to ensure that the *Bacillus anthracis* spores are of an optimal size (1 to 5 microns) for penetrating deep into human lungs.[10] Particles larger than this tend to drop straight to the ground rather than stay suspended in the air ready for inhalation. This technical requirement for precise particle sizes probably means that the frequently-imagined attack scenario of ordinary crop duster aircraft delivering BW is unrealistic.[11] On the other hand, specially designed or modified aerosol spraying devices could be highly effective at disseminating BW agents.[12]

Martin argues that despite recent technological advances, BW is still not well suited to battlefield use. Difficulties undermining the military utility of BW include: (1) the potential instability of biological agents and their vulnerability to weather conditions; (2) the potential unpredictability of the effects of a BW attack; and (3) the required incubation period between a target's exposure to BW agents and the onset of disease.[13] For Dando, however, there are now fewer uncertainties when considering the potential effectiveness of a BW attack. As a result of a tremendously increased

capacity for computer modelling, some countries now have a far greater understanding of the atmospheric and weather conditions requires for an optimal BW attack. In addition, a greater theoretical understanding of aerosols has developed in order to deal with a wide range of industrial and environmental problems. Of particular relevance to BW delivery issues, some countries now have an extensive understanding of how inhaled aerosols behave in the human lung.[14]

The caveat on arguments about military utility is that they stem mostly from theory and conjecture, not from practice – there has been no documented case of full-scale BW use in modern warfare.[15]

Against the backdrop of the biotechnology revolution, Dando concentrates on how current research might affect biological warfare in the future. Today the primary concern is with classic BW agents because they would not require large-scale testing by proliferators. In the future, through the use of genetic engineering techniques, new BW could be targeted at specific genetic characteristics of different ethnic groups.[16] Miller and her co-authors argue, however, that the genetic revolution is unlikely to produce completely new agents. Rather, the most likely danger is that classic BW agents will be customised to defeat drugs, antidotes and vaccines.[17]

The future of biotechnology may also carry the potential for precise, non-lethal forms of biological warfare. For example, bioregulators are naturally occurring chemical substances, not of themselves toxic, which operate by sending 'messages' inside the human nervous, endocrine and immune systems. The misuse of neuroscience, for example, could lead to new means of manipulating human behaviour (depression, temporary paralysis, sleep, fear) by chemical means.[18] For the present, however, bioregulators are probably too exotic for the purposes of a BW program, with most proliferators unlikely to go beyond research with these agents.[19]

**Part Two - biological terrorism**

While state possession is an important locus of BW threats, the greatest concerns today regarding actual use of BW are overwhelmingly directed to terrorism. In the lead-up to the Iraq War, one of the stated objectives of United States-led intervention was to prevent the Iraqi regime from passing WMD to terrorists. This section discusses the important factors that temper terrorists' motivations and capabilities for launching a major BW attack.

**1. Motivations**

Three advantages of BW for a terrorist are: (1) an optimal death to cost ratio; (2) BW agents are virtually undetectable; and (3) BW offers the potential for mass panic.[20] Terrorists contemplating using disease as a mass casualty weapon would also be mindful that epidemics throughout history in Europe, Asia and the Americas have killed many more people than wars.[21] Specific motivational factors for terrorist use of BW include:

- economic terrorism – e.g. against corporate icons, or to impose crippling agricultural clean-up costs;
- millenarianism – e.g. the cleansing apocalypse sought by Aum Shinrikyo, and survivalist Christians planning to precipitate Armageddon;

- exacting revenge or creating chaos – e.g. the Al Qaeda campaign against the United States (US);
- mimicking God - the fifth plague used by God to punish Pharaoh in the Bible's Book of Exodus was murrain - a group of cattle diseases that includes anthrax;
- the aura of science - that is, 'impressing' targets with high technology; and
- the copycat phenomenon – e.g. 'mysterious white powder' anthrax hoaxes.[22]

The most likely perpetrators of BW terrorism are religious and extreme right groups and groups seeking revenge. Such groups may display an extranormative, transcendental attitude to violence. They are unconstrained by fear of government or public backlash, since their actions are intended to please God and themselves, not to impress a secular constituency. And their victims, being outside their religion, may be viewed as subhuman.[23]

At the same time, there are many reasons why other terrorists might rule out the use of BW. For terrorists pursuing clear political aims in a given territorial area, such an attack will not generally appeal. This is because friends would be at risk, especially if a highly contagious agent were deployed. For example, a BW attack in Ireland would affect Catholics as well as Protestants, an attack in India would hit both Hindus and Muslims, and using BW in Israel would affect Arabs as well as Jews.[24] Other disincentives to terrorists using BW include the risk of provoking a massive government crackdown and alienating supporters. BW is also inherently dangerous to use. All these considerations may lead to the conclusion, from a terrorist's point of view, that conventional bombs as tried and true weapons are more 'obedient' than BW. As such, explosives may remain the terrorist's weapon of choice for the foreseeable future.[25]

Lastly, some authors theorise that terrorists construct their attacks as a form of theatre. There is a school of thought to say that if terrorists want a lot of people watching a spectacular event, rather than a lot of people dead, they are unlikely to turn to mass casualty weapons. For terror purposes, there is also an important psychological element in any attack. Most terrorists need the demonstration effect - that is, showy attacks that produce a great deal of noise. By contrast, a BW attack would by its very nature be silent.[26] On the other hand, the silence of a BW attack may be attractive for a terrorist wishing to perpetuate the 'perfect crime'. And theatrical considerations would matter little to terrorists with an apocalyptic bent for whom 'a lot of people dead', by whatever means, is the true objective.

## 2. Capabilities

In the more popular BW literature, there is no shortage of descriptions of terrorists possessing nightmarish capabilities. For example, a 1998 article in the *New Scientist* opened with the scenario of a private plane spreading an aerosol cloud of anthrax spores over San Francisco Bay, and the consequent deaths of 1 million people.[27] Osterholm and Schwarz present their book *'Living Terrors'* as a combination of fiction and non-fiction on bioterrorism. Commencing each chapter with a novel-like scenario, the authors then follow up with a discussion of the scientific and political factors that apply. Scenarios of the rogue BW terrorist include:

- a disgruntled laboratory worker who grows anthrax bacteria in an abandoned farmhouse then disperses it in a crop duster over a sport stadium;
- a hospital worker who steals a deadly strain of *E. Coli* bacteria and uses it to poison the food of hundreds of Catholic schoolchildren; and
- a former Soviet scientist who grows smallpox virus on fertilised eggs, spreads it though a shopping mall air conditioning system, then watches it spread through America.[28]

Unfortunately, a scan of the literature on bioterrorism reveals that insufficient attention has been devoted to assessing dispassionately whether hypothetical scenarios are likely to be transformed into reality. One of the most prevalent features in mainstream discussion of WMD terrorism has been the conflation of motive and capability.[29]

Expert opinion is divided on how easy it is to acquire a biological weapons capability, and estimates on the cost of a BW venture range from thousands of dollars to the millions. Some say that an undergraduate biology student could easily produce BW agents in a garage, tool room or kitchen, and that making BW is as easy as brewing beer. Other experts believe a much higher degree of expertise is required: a BW project would need a group of experts in several fields (for example, microbiology, aerosol physics, pathology and pharmacology), as well as access to a sophisticated bacteriological laboratory.[30] Oehler argues that any terrorist group small enough to ensure secrecy will probably not have the range of talents needed to execute a major BW attack. A group that does have all the necessary skills will probably be large enough as to be vulnerable to detection by intelligence and law enforcement agencies.[31]

The record of BW terrorism yields mixed lessons regarding capabilities. In Japan, the Aum Shinrikyo cult failed in several attempts to cause mass casualties with BW agents. This was despite ample finances and scientific expertise, including 20 university-trained microbiologists working in well-equipped laboratories.[32] In the US, by contrast, the October 2001 attacks using high-grade anthrax powder made clear that a group or individual had either successfully crossed the weaponisation threshold or succeeded in stealing it from a national defence program.[33]

Development and production of BW entails significant technical challenges for terrorists. Firstly, cultivating pathogens can be hazardous to one's health. Sloppy laboratory practices in Aum Shinrikyo's BW program led to some cult members becoming infected with Q-fever. Secondly, dissemination of BW can present insurmountable obstacles, whether a terrorist is contemplating aerosol delivery or food or water contamination with a BW agent.[34] On the issue of aerosol delivery, the CIA is presently concerned that Al Qaeda may use agricultural aircraft for large-scale dissemination of anthrax.[35] As discussed in an earlier section of this paper, effective aerosol dissemination requires freeze-drying a BW product and milling it into particles of uniform respirable size. Crop dusters are probably unsuitable for delivering a BW agent because they produce particles of too big a size to infect the lungs.[36] Contaminating food or drinking water with BW agents can also encounter difficulties. Dilution, chlorination and filtration work against water-borne BW, and cooking, pasteurisation and other routine food safety precautions are generally sufficient to kill pathogenic bacteria.[37] Nevertheless, food or water contamination

could still be an effective BW delivery method in less developed countries where such procedures are not standard.

Some authors propose that terrorist delivery of BW need not be high-tech at all. For example, highly contagious viruses could be effectively introduced by voluntarily infected terrorists - they would travel to the target area during the incubation period of the disease. Today's suicide bombers may become tomorrow's "suicide sneezers" carrying smallpox into an enemy population.[38]

Should terrorists find acquiring an effective BW program from scratch on their own too difficult, another possibility is that terrorists might simply be endowed with that capability by a supportive state. For example, US adversaries may "contract out" WMD terrorism to bypass a National Missile Defense system, using terrorists as delivery systems where the long-range missile option is nullified.[39] However, several authors argue that the notion of a state sponsoring mass destruction terrorism is highly problematic. Bearing in mind that only the most extreme and least rational terrorist groups are likely to employ BW, a state may fear loss of control or treachery by a BW-capable group.[40] The discovery of links between a BW terror incident and a state sponsor may also attract disastrous retaliation from the target. For these reasons, any state anxious for its survival would be most unlikely to place a catastrophe-scale BW capability in the hands of terrorists.

## Part Three - intelligence responses to the threat of BW

### 1. Sources of BW intelligence

Three aspects of BW production and proliferation present challenges for intelligence agencies. First, the concealment of BW production facilities is relatively simple because of the technical overlap with legitimate research and commercial biotechnology. Second, some countries are developing indigenous BW programs, thus limiting the possibilities for interdiction of imported ingredients. Third, ongoing advances in genetic engineering, particularly the advent of 'designer germs', are making it increasingly difficult for intelligence agencies to recognise all biological agents that could pose a threat.[41] Further challenges for responding to the BW threat relate to the main categories of information that intelligence agencies draw upon – human intelligence (HUMINT), imagery, signals intelligence (SIGINT) and open-source information.

HUMINT is arguably the key ingredient in any intelligence response to a BW threat. The major sources of HUMINT are not spies, but rather moles and informants controlled by highly manipulative professionals.[42] Inside information from well-placed sources is especially important as regards the more intangible questions of intentions and objectives. But HUMINT can sometimes be vague or inaccurate. A source may present his or her own assessments, suppositions and interpretations as facts, and these may be false. Misunderstanding by a source is a particular problem when the intelligence relates to high technology, as is often the case with BW. A source may also have his or her own political agenda or may be feeding an intelligence agency disinformation on behalf of the target.[43]

Obtaining imagery intelligence (film, photographs and infra red) obtained from aerial platforms (satellites and aircraft) and SIGINT on BW is made difficult by the easy concealment and dual-use nature of BW program ingredients. For example, a BW production facility could be located in a city and be virtually indistinguishable from other buildings in a satellite image. By contrast, NW-related facilities tend to be more readily identified, especially where radioactivity can also be detected. A telephone call to request a fermentation unit for a medical facility could indicate the assembling of BW program components or it could simply be a legitimate request for a common piece of laboratory equipment.

A large source of BW intelligence is open source data, especially that which is published on the internet. For example, such data can provide indications of the current or near future state of relevant biological technology. In the context of the rapidly accelerating 'biotechnology revolution', the challenge for intelligence agencies is how to monitor effectively the sheer quantity of information in this area that is being posted and exchanged.

For the purposes of domestic security, the processes for collecting and sharing intelligence also need to be compatible with a traditional criminal law enforcement response to biological terrorism. An act of terror is also a crime, to be investigated and punished, or prevented if possible. However, the use of some intelligence for law enforcement purposes may be problematic. For example, intelligence data is often gathered in ways (and is so often imprecise) that may render it inadmissible as evidence in criminal trial proceedings. By its very nature, intelligence is generally focused on the future, is much less specific, and is source sensitive. Exposing intelligence information to rigorous scrutiny by the legal system may compromise vital sources and so jeopardise possibilities for preventing BW attacks in the future.

## 2. The case of Iraq's 'WMD'

The recent Iraq War provides an interesting case study to assess the value and effectiveness of intelligence responses to the BW threat. Prior to the commencement of war in March 2003, the US presented the United Nations (UN) with intelligence information intended to show that Iraq was running WMD programs in contravention of UN resolutions. Disarming the Iraqi regime of alleged WMD was put forward as the main goal of, and justification for, the US-led attack on Iraq. In the aftermath of the war, the failure of the US and its allies to produce conclusive evidence of Iraq's WMD has reignited the fierce pre-war political debate over whether going to war was the right thing to do. This in turn has created a crisis of confidence in the intelligence community. In the US, the United Kingdom and Australia, parliamentary inquiries have been launched to investigate, *inter alia*, whether governments may have used faulty or exaggerated intelligence on Iraq's weapons to justify the war.

Senior members of the Bush Administration have attempted to downplay the WMD intelligence dimension. Defense Secretary Donald Rumsfeld was reported as saying the US acted in Iraq not because of new evidence of Iraq's WMD, but because it saw existing evidence in a new light after 11 September 2001.[44] Deputy Defense Secretary Paul Wolfowitz has stated that the US government must be able to act on "murky" intelligence to prevent future attacks. The alternative, he argues, is to act after the

fact.[45] Nevertheless, the US is persisting in its pursuit of WMD evidence that would validate its pre-war intelligence assessments.

For the purposes of this paper, the most significant WMD intelligence issue is the discovery of two Iraqi trailers alleged to be part of a mobile biological warfare production unit. These trailers, found by US forces in April and May 2003, have been offered as proof that Saddam Hussein was hiding a BW program. The idea is that, by making its BW production facilities mobile, Iraq could more easily circumvent the pre-war UN inspection process. The significance of the trailers has been the subject of intense debate within the intelligence community, with experts divided on technical grounds over whether the trailers could actually have produced BW.

At the end of May 2003 the CIA and the US Defense Intelligence Agency (DIA) jointly issued a report on their analysis of the trailers. The report describes the results of examinations as being largely consistent with US intelligence reporting before the war. Certainly, the general configuration and design of the trailers are very similar to the mobile BW plants described by US Secretary of State Colin Powell in his presentation to the UN in February 2003. The two trailers are alleged to have been designed to produce pathogenic agents in unconcentrated, liquid slurry form. For this purpose, they were equipped with fermenters, water supply tanks, a water chiller and gas collection devices. The report argues that the trailers were unlikely to have been used for legitimate purposes such as water purification, vaccine production or biopesticides. Rather, the size and nature of the equipment inside the trailers indicates that BW agent production is their only logical purpose.[46]

In opposition to the report's findings, skeptical experts have pointed out that the trailers lack gear for steam sterilisation, normally a prerequisite for any kind of biological production. Not having such equipment available between production runs would, they argue, result in contamination and failed weapons. On the other hand, the trailers might have obtained steam sterilisation functions by connecting up to a separate supply truck. Another theory is that the trailers were used to produce hydrogen for weather balloons.[47]

Significantly, the CIA/DIA report supposes that a third trailer would need to have been involved for post-production processing, such as spray-drying the liquid into a more useful powder form.[48] As this further processing would have been essential for weaponisation of BW agents, a clear inference to be drawn from the report is that the two trailers, in themselves, do not constitute conclusive evidence of a working BW program.

According to a 1993 report by the US Office of Technology Assessment, producing biological agents is only the first step towards acquiring a militarily significant offensive BW capability. Beyond mobile BW production plants, an effective Iraqi BW program (if it existed) might also have featured, for example:

- tried and tested delivery systems, such as cluster bombs for dispersing bacteria;
- aircraft or missiles adapted to the delivery system;
- an established network of logistical support;
- stocks of appropriate vaccines for individual and collective defence;
- strategic and tactical BW battle plans; and

- a program for training troops to use BW and operate in a BW environment.[49]

The case of the alleged BW trailers well demonstrates the difficulties the US has had in producing evidence that its pre-war claims of Iraqi WMD were correct. It is in the nature of BW that such weapons are highly unlikely to be found in ready-to-use form. A nuclear missile, a rifle or a land mine has but one use – as a weapon. The dual-use nature of biological agents, however, means that 'finding' BW is inherently much more complicated. BW intelligence is further challenged by the technical reality that BW agents can, as required, be grown rapidly and destroyed virtually without a trace.

**Conclusion**

For the purposes of this Inquiry into Iraq's alleged WMD, it is important to remember that nuclear, biological and chemical weapons each have unique characteristics that demand different intelligence responses. The tendency to include BW in the general category known as 'weapons of mass destruction' can obscure the reality that the scale of germ warfare can vary enormously. Weaponisation of biological agents can still present huge challenges, both for states and terrorists. As such, it is inappropriate to conflate the motivation to use BW with the capability to do so effectively. Potential state sponsorship of BW terrorism, an accusation levelled at Iraq, is also problematic insofar as a state may fear betrayal by terrorists and retaliation by the victim.

The technical nature of BW is such that accurate intelligence, much less evidence, about illicit activities is extremely difficult to obtain. Even the discovery of two alleged BW trailers has not been enough to satisfy many experts that Iraq was undoubtedly conducting a covert BW program. In the words of Paul Wolfowitz, BW intelligence is often simply too "murky". Obtaining accurate intelligence information on the existence of, the capacity and willingness to use, and the immediacy of the threat posed by, BW in Iraq was bound to be a huge and possibly insurmountable challenge.

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**Notes**

[1] BA(Hons) LLB(Hons) *Sydney*. PhD thesis tentatively entitled 'Biological Weapons and Security in East Asia: Assessing the Threat, Evaluating Responses'.
[2] O'Neil, Andrew (2003) 'Terrorist Use of Weapons of Mass Destruction: How Serious is the Threat?' *Australian Journal of International Affairs* vol. 57. no. 1, April 2003: p101; Osterholm, Michael T and John Schwarz (2000) *Living Terrors: What America Needs to Know to Survive the Coming Bioterrorist Catastrophe* New York: Delacourt Press: p189; Tucker, Jonathan B (2000) 'Introduction' in Jonathan B Tucker (ed.) *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* Cambridge (Mass.): MIT Press: p3.
[3] Roman, Peter J (2002) 'The Dark Winter of Biological Terrorism' *Orbis* Summer 2002: p470 n2.
[4] National Academy of Sciences (1999) *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response* Washington D.C.: National Academy Press: p13.
[5] O'Neil, *Australian Journal of International Affairs* p103.
[6] Tucker, Jonathan B (2000) 'Chemical and Biological Terrorism: How Real a Threat' *Current History* April 2000: pp147, 150.

[7] Dando, Malcolm (2001) *The New Biological Weapons: Threat, Proliferation and Control* Boulder: Lynne Rienner: pp1-2.
[8] Wheelis, Mark (1997) 'Addressing the Full Range of Biological Warfare in a BWC Compliance Protocol' Paper presented at Pugwash Meeting No. 229, Geneva, 20-21 September 1997: cited in Dando *The New Biological Weapons* pp121-122.
[9] Kellman, Barry (2001) 'Biological Terrorism: Legal Measures For Preventing Catastrophe' *Harvard Journal of Law and Public Policy* vol. 24, no. 2, Spring 2001: pp437-438. The extent of damage from a BW attack is also highly dependent on the capacity of a target country's public health system to treat victims and contain contagion.
[10] Croddy, Eric (2002) *Chemical and Biological Warfare: a Comprehensive Survey for the Concerned Citizen* New York: Copernicus: p16.
[11] Id. pp79, 82.
[12] See Office of Technology Assessment (OTA) (1993) 'Technical Aspects of Biological Weapon Proliferation' *Technologies Underlying Weapons of Mass Destruction* OTA-BP-ISC-115, United States Congress, Washington D.C.: p95.
[13] Martin, Susan B (2002) 'The Role of Biological Weapons in International Politics: the Real Military Revolution' *Journal of Strategic Studies* vol. 25, no. 1, March 2002: pp65-66. Regarding the onset of disease, it is important to note that biological toxins (non-living, 'natural' chemical agents) have a more rapid effect than bacterial or viral agents and might be preferred over the relative slowness of live pathogens where a speedy result was required: Dando *The New Biological Weapons* p19.
[14] Dando, *The New Biological Weapons* p108.
[15] Martin, *Journal of Strategic Studies* p71.
[16] Dando, *The New Biological Weapons* p11.
[17] Miller, Judith, Stephen Engelberg and William Broad (2001) *Germs: the Ultimate Weapon* Sydney, Simon & Schuster: p316.
[18] Dando, *The New Biological Weapons* p12.
[19] Croddy, *Chemical and Biological Warfare* p217.
[20] Kellman, *Harvard Journal of Law and Public Policy* p427.
[21] Laqueur, Walter (1999) *The New Terrorism: Fanaticism and the Arms of Mass Destruction* New York: Oxford University Press: p64.
[22] Stern, Jessica (1999) 'The Prospect of Domestic Bioterrorism' *Emerging Infectious Diseases* vol. 5, no. 4, July-August 1999: pp517-519.
[23] Id. p521; Muir, Angus M (1999) 'Terrorism and Weapons of Mass Destruction: the Case of Aum Shinrikyo' *Studies in Conflict and Terrorism* vol. 22: p81.
[24] Laqueur, *The New Terrorism* p70.
[25] Croddy, *Chemical and Biological Warfare* p66; Muir *Studies in Conflict and Terrorism* p81.
[26] Laqueur, *The New Terrorism* p70; Stern *Emerging Infectious Diseases* p517.
[27] MacKenzie, Debora (1998) 'Bioarmageddon' *New Scientist* vol. 159 no. 2152, 19 September 1998: p42.
[28] Osterholm and Schwarz, *Living Terrors* pp24, 78, 91.
[29] O'Neil, *Australian Journal of International Affairs* p109.
[30] Laqueur, *The New Terrorism* p65.
[31] Oehler, Gordon C (1999) 'Warning and Detection' in Sidney D Drell, Abraham D Sofaer and George D Wilson (eds.) *The New Terror: Facing the Threat of Biological and Chemical Weapons* Stanford: Hoover Institution Press: p140.
[32] Tucker, *Current History* p152.
[33] Chyba, Christopher F (2002) 'Toward Biological Security' *Foreign Affairs* vol. 81, no. 3, May/June 2002, full text format online: p3.
[34] Tucker, *Toxic Terror* pp7-8.
[35] Central Intelligence Agency *Terrorist CBRN: Material and Effects* May 2003: p2. <http://www.cia.gov/cia/publications/terrorist_cbrn/CBRN_threat.pdf> (7 June 2003)
[36] Kellman, *Harvard Journal of Law and Public Policy* p444; Zanders, Jean Pascal, John Hart and Frida Kuhlau (2002) 'Chemical and Biological Weapon Developments and Arms Control' *SIPRI Yearbook 2002: Armaments, Disarmament and International Security* Oxford: Oxford University Press: p702.
[37] Tucker, *Toxic Terror* p7.
[38] Miller et al., *Germs* p316; Wheelis, Mark, Rocco Casagrande and Laurence V Madden (2002) 'Biological Attack on Agriculture: Low-Tech, High Impact Bioterrorism' *BioScience* vol. 52, no. 7, July 2002: p571; Martin, *Journal of Strategic Studies* p79.

[39] O'Neil, *Australian Journal of International Affairs* p105.
[40] Tucker, *Current History* p151; Stern, *Emerging Infectious Diseases* p522; Muir, *Studies in Conflict and Terrorism* vol. 22: p86.
[41] Gannon, John C (1999) 'The US Intelligence Community and the Challenge of BCW' in Drell et al., *The New Terror* p128.
[42] Trevan, Tim (2000) 'Exploiting Intelligence in International Organisations' in Raymond A. Zilinskas (ed.) *Biological Warfare: Modern Offense and Defense* London: Lynne Rienner: p209.
[43] Id. p211.
[44] Reuters Online, 'Rumsfeld: No New Iraq Weapons Evidence Before War', 9 July 2003.
[45] Global Security Newswire, 'US Response: "Murky" Intelligence Can Be Basis for Action, Wolfowitz Says', 28 July 2003.
<http://www.nti.org/d_newswire/issues/2003/7/28/1p.html> (29 July 2003)
[46] Central Intelligence Agency (CIA) and Defense Intelligence Agency (DIA), *Iraqi Mobile Biological Warfare Agent Production Plants*, 28 May 2003: pp1, 2, 4.
[47] New York Times (online), 'Some Analysts of Iraq Trailers Reject Germ Use', 7 June 2003.
[48] CIA and DIA, *Iraqi Mobile Biological Warfare Agent Production Plants* p2.
[49] OTA, *Technologies Underlying Weapons of Mass Destruction* p83.