



# Biological Weapons: Bioterrorism and the Public Health

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## ***About MEDACT (SA)***

MEDACT (SA) is the South Australian Branch of MAPW, the Medical Association for Prevention of War (Australia). MAPW is an organisation of doctors and other health professionals with the following mission statement:

*The central objective of the organization is to relieve and prevent the human death and suffering which arise from war and preparations for war, including civil conflict. To this end, the Association will engage in research, education and advocacy, and in particular will:*

- i. educate medical and other health practitioners, governments and the general public about the consequences to health of war and its preparations, especially nuclear, biological and chemical warfare;*
- ii. work for the elimination of all weapons of mass destruction;*
- iii. urge that the excessive financial, technical and human resources spent on armaments be directed to uses which promote the health and welfare of humanity;*
- iv. examine the psychological mechanisms by which people come to accept war as a necessity;*
- v. promote non-violent means of conflict resolution at all levels.*

MAPW is the Australian affiliate of International Physicians for Prevention of Nuclear War (IPPNW), a long-established global federation of medical organisations holding aims similar to those of MAPW. IPPNW received the Nobel Prize for Peace in 1985 for the cooperation of physicians from countries on both sides of the Cold War in the education of decision-makers and the general public about the realities of a nuclear attack on human populations and its advocacy of the urgent need to prevent nuclear war. IPPNW and MAPW continue to work for the abolition of nuclear weapons and other weapons of mass destruction.

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## Introduction

Most Australians are now aware of the existence of biological weapons through movies such as *Outbreak* and *Twelve Monkeys*, popular novels such as *The Cobra Event* and episodes of *The X-Files* and other science fiction series and hospital dramas on television. These examples of popular fiction sensationalise and exaggerate the threat of biological weapons and usually depict large-scale, catastrophic events. Media reports about Iraq's chemical and biological weapons facilities and the many frustrations of the UNSCOM inspectors who were to oversee their destruction have also increased public awareness of the existence of biological weapons without providing a realistic assessment of the threat.

This book aims to provide a calm and reasoned assessment of the risk that biological weapons will one day be used against Australians, either by an enemy government or by a terrorist group. It is an introductory text which aims to be readable and to avoid sensationalism. It explains the difficulties faced by groups wishing to develop these weapons and to successfully deploy them. It describes the few successful uses of biological weapons as well as the many attempts which have failed. It explains why it is unlikely that a terrorist attack using biological weapons will cause the widespread devastation depicted in popular science fiction.

It is important to acknowledge, though, that there is some danger of a successful bioterrorist attack, especially if the terrorist group in question receives assistance and substantial resources from a state which is itself developing biological weapons. There is also a danger that these weapons could become more devastating in the future because of advances in biotechnology, or if the knowledge acquired in large-scale state-run biological weapons programs (such as the former program of the Soviet Union) is purchased by other states.

Given that there is a risk of the use of biological weapons in Australia, even though it is a small one, another function of this book is to raise awareness about what the effects of a biological attack might be. The information presented here about the diseases which might result from the use of biological weapons is presented in lay language for a general readership, but it could also be a useful introduction to primary health care providers who wish to be able to identify suspicious outbreaks of disease. This book encourages health care providers, and especially hospital staff, to be suspicious of unusual presentations of disease or sudden epidemics of serious diseases, and to communicate with public health authorities about these cases. It is hoped that a high degree of suspicion and a willingness to initiate an investigation will enable biological weapons attacks to be identified promptly, and will also be useful in containing outbreaks of naturally occurring infectious diseases.

There has been much debate about the appropriate response to the threat of biological weapons. Proposals in the literature have ranged from widespread vaccination and military control of much medical research to the establishment of international organisations to collect information on new outbreaks of disease around the world. This book suggests that the response should be in proportion to what is a fairly small threat and should take account of the limited resources available and the limits of existing technology. Australia's preparation for biological attack should make use of existing health and epidemiology services. It should pursue low-cost measures such as education of emergency ward and public health staff, and build on existing disease surveillance



systems. There should not be a diversion of funds from health programs which tackle real and immediate threats from naturally occurring diseases.

Finally, this book joins the call for stronger measures to enforce the international prohibition of the development and production of biological weapons. Stronger enforcement of the Biological Weapons Convention, in addition to freer exchange of scientific information and international cooperation on preventive medicine and other health measures, will reduce suspicions between countries and discourage a biological arms race. And if states cease working on the development of biological weapons then it will be much more difficult for non-state groups to do so.

Biological weapons have the potential to cause painful and often fatal diseases. We should all retain a sense of abhorrence at the thought that they might ever be used again, and encourage an international climate in which the development of these weapons is seen as unacceptable. Members of the medical profession, who are part of the intended audience of this book, will probably feel this abhorrence especially strongly.

**Most societies invest a great deal of money, capital, belief, and ritual into opposing sickness and disease. Biological warfare, obviously, is an absolute perversion of that belief. So there is a powerful emotional quality about using biological agents to make people sick; such a purpose is completely contradictory to our basic belief system.**

(Leonard Cole, quoted in MacLean 1992: 111)

While maintaining this belief that the development of biological weapons is unacceptable, we should see the risk in proportion. Nuclear weapons are far more dangerous than biological weapons but are possessed by several states around the world, including by outspoken opponents of biological weapons. Landmines cause more injury and death than biological weapons are ever likely to and are still deployed around the world, despite the fact that they are now prohibited in international law. And there are ways in which states cause the spread of infectious diseases other than through biological weapons. Reductions in health budgets are followed by an increase in avoidable disease. This is one reason why diverting funds from health budgets and into biological defence seems misguided. And, finally, the economic sanctions which have been imposed on Iraq in retaliation against its chemical and biological weapons programs cause more disease than Iraq's biological weapons ever could. Those of us who are serious about tackling preventable disease and suffering should oppose the use of biological weapons, but should also recognise the effects of conventional conflicts, poverty and health policy decisions on the health of people around the world.



## Chapter 1: What are biological weapons?

### ***Definitions***

A biological weapon is a weapons system that intentionally uses bacteria, viruses or toxins to cause death or disease in people, animals or plants. A biological weapon is a combination of a biological agent (the bacteria, virus or toxin) and the means of keeping the agent alive and virulent, transporting it to where it will be dispersed and a dissemination mechanism. For example one biological weapon could be anthrax spores, a plane and a pesticide sprayer. Another might be salmonella bacteria bred in a laboratory, transported in a vial and poured into some food. Some biological weapons are suited to large-scale production and dissemination for use in war, some are more likely to be considered for use in a smaller-scale terrorist attack, and others are only suitable as weapons of assassination, as described below.

The World Health Organization has defined biological agents as 'those that depend for their effects on multiplication within the target organism' (World Health Organization 1970: 12). This definition does not include toxins which are produced by microorganisms. As these toxins are produced and can be disseminated in similar ways to living microorganisms, they are often included in discussions of biological warfare and they will be discussed in this book.

Biological weapons are often included with chemical and nuclear weapons in the term 'weapons of mass destruction'. A number of writers have chosen to use the term 'weapons of mass casualties' instead, as biological agents do not cause any destruction to buildings or infrastructure. Even then, achieving mass casualties with biological weapons is a difficult task which depends on the agents used, the quantity of agents and the means of dissemination (Gilmore Report 1999: iii). Biological weapons may be used as weapons of individual assassination or in small-scale targeted attacks, so it is misleading to speak of them as weapons of mass destruction or casualties, anyway. In the past, attempts to use biological weapons in individual assassinations or small-scale attacks have generally been more successful than attempts to cause mass casualties.

### ***Likely agents***

The biological agents which are most suited to use in a biological weapon are those which are easy to produce in a laboratory, can be stored (perhaps in a dried or frozen state), can be dried, are stable in the air (if they are to be disseminated in aerosol form), and are infective in fairly small doses. The biological agent which has been most popular in both biological weapons programs and terrorist attempts (and hoaxes) is anthrax. It is fairly easy to grow, sturdy and relatively easy to disseminate in spore form, and has a high fatality rate. Smallpox is also easy to produce and stable and has the added advantage of being transmissible from person-to-person, but it is now more difficult to acquire the virus in the first place. Plague and botulinum toxin are probably the next most likely agents to be weaponised. They are effective in very small doses and they cause dangerous diseases, though ones which are rarely fatal if prompt and appropriate medical treatment is given. Q fever is a sturdy and extremely infectious agent, and one which might be considered if an attacker wanted to spread an incapacitating, nonfatal illness.

Some infectious agents would not be suitable for biological weapons because they occur so commonly worldwide that much of the population is immune, or because



immunisation against them is so common. For example, in developed countries much of the adult population is immune to mumps, measles, polio and rubella. Some biological weapons are more suited to small-scale uses. For example, the venom of snakes, spiders and scorpions is quite toxic but difficult to produce in large quantities. Venom would be more suited to an individual assassination than to a large-scale aerosol attack. Ricin, similarly, is often considered as a weapon of assassination. It is easy to produce but not highly toxic when dispersed in an aerosol.

The agents which are most likely to be used in a biological weapons attack, and the diseases they cause, are described in more detail in Chapter 2. There is a fuller list of potential biological agents in Appendix 2.

### ***Weapons targeting plants and livestock***

Biological weapons containing human pathogens receive more attention and understandably create more fear than plant and animal pathogens. But destruction of livestock and crops would be easier to achieve than mass human casualties and could have a great impact on the target country. These agents also have the advantage of posing little threat to the people developing them and their use is less likely to lead to strong reprisals or loss of public support. They could therefore be attractive as a terrorist weapon. During World War II the government of the United Kingdom considered feeding linseed cakes containing anthrax to German cows and infecting Japan's rice crops with a fungus, but instead chose to use more conventional weapons with more immediate effects.

Modern agricultural techniques in western countries make crops especially vulnerable to biological attack. Large areas of land are planted with genetically identical crops and cropping is highly intensive. Whole regions are therefore vulnerable to attack with just one agent (Caudle 1997: 460; Gilmore Report 1999: 11–12). A biological attack on livestock or crops could cause great economic hardship in the target country, which would be reinforced by the trade restrictions which might be imposed by importers of the goods. It could also have effects on the health of the people in the area, especially in poorer countries. There could be food shortages, and the elimination of one species from a region might cause an increase in the population of a disease-bearing species such as rats or mosquitoes (World Health Organization 1970: 16).

### ***New technology and biological weapons***

The possibility of using new technologies to create more dangerous biological weapons has been much discussed in the last few years. Biotechnology could be used to increase infectivity (for example, to produce a new strain of influenza to which no member of the population is immune), to make an agent more stable, to combine two agents together (perhaps one which is more infectious with one with a higher fatality rate, or one with a shorter incubation period to make victims more susceptible to the second), to combine a toxin with a mechanism for targetting a particular part of the body, to make diseases difficult to diagnose and therefore treat appropriately, or to create a strain which is resistant to certain antibiotics or vaccines (Takafuji et al 1997).

The last use is perhaps the most likely, although antibiotic-resistant strains can be developed without biotechnology and, in fact, appear all too often without any human intervention at all. It would be fairly easy to produce a strain of an agent which is resistant to one type of antibiotic. Producing an agent which is resistant to all of the commonly available antibiotics and is still virulent would be an extremely difficult task



(and one which would be dangerous for the scientists involved), but it is theoretically possible.

The Soviet Union's biological warfare program used increasingly sophisticated technology in the 1980s. It has been reported that Soviet scientists worked on the development of strains of several agents which were resistant to some antibiotics and that they were working on combining the properties of some agents, for example creating a virus which could cause both Ebola fever and smallpox (Gould and Connell 1997: 108; Barnaby 1999b: 103, 143; Alibek 1999). Other biological weapons experts believe that there are plenty of naturally occurring highly infectious and dangerous diseases and that there is little reason to spend years of work and enormous amounts of money making them even nastier. It would be almost impossible for a terrorist group to harness the resources necessary to genetically engineer more dangerous biological agents even if a group wanted to spend years planning a biological attack. The use of a genetically engineered weapon by a terrorist group would almost certainly indicate state-sponsorship and may well reveal which state is involved (Purver 1995: 9)

Fears have also been expressed recently that it would be possible to genetically engineer biological agents which target members of one racial group (for example in a recent report by the British Medical Association: see Barnaby 1999a). This would be an almost impossible task, as racial and ethnic differences are more cultural than biological, and there are as many genetic variations within one racial group as between groups. Nonetheless, it may be possible in the future to identify genetic markers which are common to one group, but developing a weapon which targets these markers is a task which is unlikely to be achieved in the near future (Barnaby 1999a; Butler 1997).

### ***Preparation and dissemination***

Dry powders containing microorganisms are more difficult to prepare than liquids, but are much easier to disseminate in aerosol. Specialised equipment such as large centrifuges and drying apparatus is needed to create the dry powder, and great care must be taken to avoid killing the organisms during the drying process. If a slurry (a thick mud-like liquid) is used instead of dry powder it is difficult to spray the particles any distance, the particles may not be of an ideal size, and the majority of the organisms can die before they are inhaled. Anthrax spores in a dry state are much hardier and easier to disseminate than anthrax slurry, but some would-be biological attackers have found it too difficult to get anthrax to sporulate in a laboratory. (See the examples of Iraq and the Aum Shinrikyo sect in later chapters.) Applying the right amount of heat or certain chemicals can prompt anthrax spores to form, but too much can kill the bacteria first. Particles of 1 to 6 microns are the ideal size for reaching the human lower respiratory tract. Larger particles will not get through the nose and smaller ones are easily exhaled.

Once dry particles of the right size have been produced, they can be disseminated in several ways. They can be dropped from a plane, possibly using commercial crop-spraying equipment. It would be important to do this in correct weather conditions, otherwise the agents would be widely dispersed and the concentration would be too low for anyone to inhale a sufficient dose. The ideal weather condition is an inversion, when a layer of warm air traps colder air below it, trapping particles of dust (and in this case biological agents) close to the ground. The dried agents could also be sprayed from a single point, such as from the back of a truck or a rooftop. This is less dependent on ideal weather conditions but the agents would not be spread as far. Placing agents on



the ground and hoping cars or pedestrians will kick them up is not very effective. There is no evidence that there will be enough 'secondary aerosolisation' of particles to infect humans once the particles have settled on the ground. When anthrax spores were accidentally released from a biological weapons laboratory at Sverdlovsk in the Soviet Union it appears that no infections resulted from secondary aerosolisation (Meselson et al 1994).

Immediately after aerosolisation most of the organisms will die because of heat or natural decay, some will clump and some will fall to the ground. Spores will decay more slowly than bacteria and viruses. After aerosolisation a cloud of Marburg virus loses 11.5% of its infectivity every minute, although this rate could be reduced by mixing it with stabilising agents. Some infectious agents are much more stable in aerosol than this. Influenza loses only 1.9% per minute and the smallpox virus only 0.34% per minute. Anthrax spores are the most stable of all.

The Japanese and American biological warfare programs in the mid-twentieth century included experiments on how to breed and disseminate mosquitoes and fleas. This is more difficult to achieve on a large scale than aerosolisation and has fallen out of favour. There are so many agents which can be aerosolised that it would be unusual now to spend the time breeding insect vectors and keeping them alive in readiness for a biological attack. Iraqi scientists tried putting biological agents in missiles, planning to disperse them with the blast of an explosion. This is not a very effective method as the heat and blast of the explosion would kill most of the organisms and others would be driven into the ground rather than dispersed through the air.

Attacks on a smaller scale can be made by poisoning food. The most successful bioterrorist attack since the Second World War involved poisoning restaurant salad bars with salmonella bacteria. (See Chapter 4.) Successfully infecting water supplies is much more difficult. Chlorine will quickly kill most agents, and the agents would be too dilute to be effective anyway in any large water source. It would be possible to poison a rainwater tank, for example, in a very small-scale attack, as some agents can survive for a time in pure water.

A great variety of methods could be used in individual assassinations. Toxins such as ricin which are fairly easy to produce but not very effective when dispersed as an aerosol can be used in assassination weapons. In one successful assassination, described in Chapter 4, a pellet filled with ricin was shot out of the end of a fake umbrella.

Biological weapons are not suited to some military uses, such as seizing territory, because their effects are only manifest after an incubation period, and they can be rather unpredictable and vulnerable to weather conditions. But they could be suitable as a terrorist weapon if the terrorists could overcome the obstacles to successfully producing and disseminating them. They could certainly be used in a small-scale terrorist attack intended to produce widespread fear but very few casualties.

### ***Dangers for would-be biological attackers***

At least three laboratory staff in the United States and probably many more in the Soviet Union died after being infected with the agents they were working on. The dangers to attackers during dissemination could be greater. Chapter 3 describes the incident in 1939 in which Japanese soldiers crossed into the Soviet Union to poison wells and feed



anthrax to livestock. Many Soviet soldiers and animals died, but thousands of Japanese soldiers were also infected. Some methods of dissemination would be more hazardous to the attackers than others. In 1954 the United States Army conducted tests known as Operation Big Itch, which involved dropping fleas from planes. The tests showed that fleas could survive the drop and would soon attach themselves to animal hosts on the ground. However, the pilot, the bombardier and observers on the planes were also bitten many times (Hay 1999a: 219–220).

### ***Effects of a biological attack***

The World Health Organisation has estimated that 50 kilograms of anthrax spores properly disseminated over an area of 40 km<sup>2</sup> could cause tens of thousands of deaths, or possibly 100 000 in a densely populated city. Fifty kilograms of plague disseminated over 20 km<sup>2</sup> in the right conditions, they estimated, could kill 36 000 people in a very large city in a developed country, and would lead to more casualties later through secondary infections. There could be more fatalities in countries which do not have adequate affordable health care. The same amount of Q fever disseminated over a large city could infect a quarter of a million people, but would cause few deaths (World Health Organisation 1970: 98–99).

Most of the likely biological weapons agents are not transmissible person-to-person. Exceptions are smallpox and plague. If these were disseminated epidemics could spread over time if the diseases were not diagnosed and patients isolated quickly. Some biological attacks directed at humans would also infect animals, possibly creating new animal reservoirs of the disease which could cause future outbreaks.

The impact of the fear and panic which would be caused by a biological attack should not be underestimated, too, and in fact could cause more damage than the actual agents. When the Japanese Aum Shinrikyo sect released the nerve gas sarin into the Tokyo subway system they caused 12 deaths and injuries to about 90 people. However, more than 5000 people presented for medical treatment, with most suffering from psychosomatic symptoms or emotional stress. Reports of a biological weapons attack could cause many members of the community to experience symptoms of anxiety, such as rapid breathing, sweating, nausea and vomiting, which could be mistaken for the effects of the agent (Holloway et al 1997: 425). Fear may make it more difficult for people to distinguish between the symptoms of different illnesses and to take in and believe information about the real level of risk (such as the information that the agent is not contagious.) A large-scale attack would also place hospitals under great pressure, exhaust and demoralise hospital staff and use up supplies of drugs such as antibiotics. There could be long-term casualties suffering from post-traumatic disorders.

The World Health Organization warned in 1970 that panic after a biological attack could cause people to take antibiotics incorrectly, to attack others attempting to access scarce antibiotics, to flee cities even after the danger is passed, and to fear those who may be infected with the disease even if the agent is not in fact contagious. A breakdown in communication, transport and food distribution as a result of mass panic could endanger more lives than the actual weapons used (World Health Organization 1970: 126). This is illustrated by the experience of the people of Israel during the Gulf War who lived in fear of a chemical or biological weapons attack from Iraq. These weapons were not used, but there were a number of casualties resulting from panic. Hundreds of people were hospitalised after overdosing on atropine and even more were admitted with symptoms of severe anxiety (Franz 1997: 608). Three elderly women suffocated when they put on



their gas masks without removing the seals from the filters. A three-year-old girl also suffocated as her parents struggled with her to put on her mask (Cole 1997: 111).

The World Health Organization estimates assume that virulent strains have been acquired, properly prepared and efficiently disseminated. In practice this is not an easy task. The Soviet Union and the United States probably managed to produce very effective biological weapons when they had offensive research programs, though their effectiveness was never really tested. The Japanese military managed to begin some epidemics in China during the Second World War, with unknown numbers of casualties. However, Iraq, with its comparatively small-scale biological weapons program did not produce extremely efficient weapons, as described in Chapter 3. The Japanese Aum Shinrikyo sect, famous for its partially successful chemical weapon attack on the Tokyo subway, was unable to perfect dissemination systems for its biological weapons. Most other terrorist groups have been unsuccessful in their attempts to produce biological weapons. In 1999 an advisory panel set up to advise the US President and Congress on the risk of terrorist biological attack concluded that using biological agents to cause mass casualties appears to be 'beyond the reach not only of the vast majority of existent terrorist organisations but also of many established nation-states' (Gilmore Report 1999: 21). In practice, biological attacks have caused fewer casualties than those using conventional bombs.

One recent article counterpoised the hyperbole and the reality particularly well with these two opening comments:

- In November 1997, [US] Defense Secretary William Cohen told ABC-TV's *This Week* audience that a supply of anthrax the size of a 5-pound bag of sugar would kill half the population of Washington, D.C.
- Question: Over the past 100 years, how many people have died in chemical or biological terrorist attacks in the United States? Answer: One. (Tucker and Sands 1999: 46)

The threat posed by biological weapons should not be exaggerated. 'Some public pronouncements and media depictions, about the ease with which terrorists might wreak genuine mass destruction or inflict widespread casualties, do not always reflect the significant hurdles currently confronting any nonstate entity seeking to employ such weapons' (Gilmore Report 1999: 38). But a successful biological weapons attack is still a small possibility, and one which is perhaps as great as ever now. It is feared that the knowledge acquired during many years of research in laboratories in the Soviet Union may have spread to 'rogue states' and terrorist groups, especially now that many of the scientists from the former Soviet Union are now unemployed (or technically employed but rarely paid) and may be easily tempted to sell their expertise (eg Alibek 1999: xi). Biological weapons are also attractive to those governments which see them as a cheap alternative to nuclear weapons and a way to minimise the difference in military power between themselves and their more powerful enemies.



## Chapter 2: Biological warfare agents

There are scores of biological agents which could be used as weapons, as the list in Appendix 2 demonstrates. Many of them, though, are not sufficiently virulent to be worth weaponising, or are difficult to produce, store or disseminate. The agents described below are those which are most likely to be used, either in a war or by terrorists. (For more information on these and other agents see Franz et al 1997; World Health Organization 1970 and Sidell et al 1997.)

### ***Anthrax***

Anthrax is caused by *Bacillus anthracis*, a bacteria found in the soil in many regions around the world. The disease occurs naturally mainly in grazing animals, and particularly affects cattle, sheep, goats and horses, although it also causes the deaths of some of the herbivores in Africa's game parks. Cases also occur in some parts of the eastern States of Australia. Anthrax bacteria form spores if they are deprived of nutrients. The spores can survive for decades in the environment and quickly return to their bacterial form inside a human or animal host. Anthrax spores are a particularly stable weapon and easy to aerosolise. Anthrax spores are about one micron in size, so are an ideal size for an aerosolised weapon. The infective dose for a human is estimated to be 8000 to 50 000 spores. The infective dose might be higher for children, judging by the fact that no children at Sverdlovsk were infected. (Alternatively, this may have been because no children were outside near the research facility at the time of the release.) The lethal dose for livestock is lower than for humans, and widespread loss of livestock could be a long-term effect of a large-scale aerosolised attack aimed at humans.

Humans can contract three forms of anthrax. The most commonly occurring form is cutaneous anthrax, which occurs when the spores get into cuts in the skin after contact with infected animals or animal products. This is most common among abattoir workers. Gastro-intestinal anthrax can occur after eating the meat of infected animals. Inhalational anthrax, the most dangerous form of the disease, occurs when spores are inhaled. Inhalational anthrax occasionally occurs naturally among people who work with wool and animal hair and hides, and is also known as woolsorter's disease. An attempt to use anthrax as a weapon would probably aim to produce inhalational anthrax.

After anthrax spores are inhaled and deposited in the lungs they travel to the mediastinal lymph nodes, where they germinate into bacilli. The bacteria produce toxins which can cause haemorrhaging. After an incubation period of one to five days the first symptoms appear. The example of the Sverdlovsk anthrax outbreak (described in Chapter 3) demonstrates that the incubation period may be much longer if only small doses are inhaled, possibly up to 43 days. The initial symptoms are fever and malaise, possibly accompanied by a cough. Symptoms may then improve for a few days. The next stage of the illness develops rapidly, and involves high fever and laboured breathing. The skin turns blue, blood pressure falls, and death occurs rapidly, sometimes within hours of the onset of the second stage. The mortality rate is estimated to be 80%.

Inhalational anthrax is difficult to diagnose because the symptoms initially resemble influenza. If a large number of patients report flu-like symptoms in a short space of time, and their illnesses progress to respiratory distress and death within a few days, then an anthrax attack should be suspected. A diagnosis can be confirmed by a chest x-ray showing a widened mediastinum. A blood culture will also confirm the diagnosis if



the disease has sufficiently progressed, although pathology staff will not routinely test for or recognise anthrax unless they have been warned that they should do so.

If antibiotic treatment is begun before symptoms appear and continued for several weeks it should protect against development of the disease. Once symptoms appear it is usually too late for treatment to be effective. The level of toxins in the body will have reached such a level that death will follow even if the live bacteria are eliminated.

Cutaneous anthrax occurs if spores germinate in skin tissue after entering pre-existing cuts. The experience at Sverdlovsk indicates that some cases of cutaneous anthrax would occur after aerosolised exposure. Toxins produced in the skin result in an ulcer which progresses to a large black lesion. The ulcer resolves after one to two weeks. Systemic disease may result if antibiotics are not given. The mortality rate for untreated cutaneous anthrax is 20%, and is virtually zero with antibiotics.

Gastrointestinal anthrax can occur when spores enter the gastrointestinal tract. Patients experience nausea, vomiting and malaise followed by bloody diarrhoea and acute abdominal pain. Mortality rates are high.

There is a vaccine for anthrax which must be given in six doses followed by annual boosters. It was developed to protect against cutaneous anthrax, and its effectiveness against inhalational anthrax is uncertain. The vaccine would not be effective against the genetically altered strains which allegedly were developed in Soviet laboratories. Despite this, the US military has a policy of vaccinating all of its personnel against anthrax. Some US veterans have claimed that the anthrax vaccine is the cause of 'Gulf War syndrome'. Military spokespeople claim that this is unlikely because the vaccine has been used extensively among people in high-risk occupations such as vets, but some personnel have still refused to be vaccinated. In Australia, some soldiers who were sent to the Gulf War have received anthrax vaccinations, but there are no stockpiles of the vaccine for civilian use.

## ***Plague***

Plague is caused by the bacterium *Yersinia pestis*. It can be transmitted from rodents to humans via fleas, leading to bubonic plague. Or it can be transmitted by respiratory droplets from animals to humans or humans to humans, leading to pneumonic plague. Bubonic plague was the infamous Black Death in fourteenth-century Europe. Plague is present in rodents in many parts of Africa, the Americas and Asia. Human epidemics develop in these areas periodically. The most famous recent outbreak was in India in 1994. As a biological weapon plague would probably be delivered in aerosolised form, so it is the pneumonic form which is discussed here. The infective dose is estimated to be 100 to 500 bacteria.

After an incubation period of about three days, pneumonic plague begins with the acute onset of high fever, malaise, chills, headache, myalgia and cough with the production of bloody sputum. A chest x-ray at this stage will reveal bronchopneumonia. The disease progresses quickly to include laboured breathing and bluish skin. There may also be a bruising of the skin (as described in the phrases Black Death and ring-a-ring-a-roses). Death may follow from respiratory failure and shock. Pneumonic plague is almost always fatal if treatment is not begun within 24 hours after the onset of symptoms. Antibiotics are effective if begun early. Unlike most of the diseases considered here, pneumonic plague is transmissible person-to-person via respiratory particles, so patients must be isolated and hospital staff should wear surgical masks. There is a vaccine which is



effective against bubonic plague, but it may not protect against aerosolised infection and it also can have significant side effects.

If aerosolised plague were introduced into Australia some rodents might (or could) become infected and thus become a reservoir for the disease. Bubonic plague could then reappear in the future.

## ***Tularaemia***

Tularaemia is also known as rabbit fever or deer fly fever, and is caused by a small bacterium called *Francisella tularensis*. Humans usually acquire the disease naturally after being bitten by infected deerflies, mosquitoes or ticks, though it is also possible to contract it through inhaling contaminated dust or eating contaminated food. It can be aerosolised for use as a biological weapon, and 10 to 50 organisms are enough to cause infection.

After inhaling the organisms, humans would develop the typhoidal form of tularaemia. The incubation period is 2 to 10 days, and symptoms include fever, prostration and weight loss. There may be chest discomfort and a nonproductive cough. Diagnosis is difficult as the symptoms are nonspecific. Antibiotics are effective, but if they are not given the fatality rate is about 35%. Person-to-person transmission is very unusual. A vaccine is available in the United States, but it is not stocked in Australia.

## ***Q fever***

Q fever is caused by *Coxiella burnetii*, a bacterium related to the organism causing legionnaires disease. It is found throughout the world. It produces a spore-like form which can withstand heat and can survive in the environment for weeks. Infections can occur in humans who work near infected livestock and inhale the particles. Q fever is one of the most infectious agents; inhaling 1 to 10 of the organisms can be sufficient to cause the disease. It is very rarely a fatal disease, though, and would be used in a biological attack as an incapacitating agent.

After an incubation period of 10 to 40 days a variety of symptoms may appear. The symptoms usually include fever, chills and headache. Malaise, fatigue, sweating, loss of appetite, weight loss and myalgia are also common. Some patients develop a cough and possibly chest pain. Some patients will develop neurological symptoms or symptoms of hepatitis. The fever usually resolves within a fortnight, but patients can experience fatigue for months after the acute stage of the infection. In a small minority of cases chronic fatigue will result. Antibiotic treatment will shorten the disease, or prevent it altogether if taken during the incubation period. There is an effective vaccine which is available in Australia.

## ***Influenza***

The symptoms of influenza are well-known. The mortality rate is usually low, though some danger is posed to the elderly and those with pre-existing respiratory difficulties with any strain of the influenza virus. New highly virulent strains sometimes occur naturally, as in the case of the 1918 influenza pandemic which caused the deaths of 20 million people. A particularly virulent strain of influenza developed in a laboratory, either by combining existing strains or by genetic manipulation, could be a very effective biological weapon. Influenza is easy to grow and store and is very infectious in aerosol form. It would only be necessary to infect a few people and an epidemic could develop



quickly through person-to-person transmission. It would take months to develop a vaccine which is effective against a totally new strain.

## ***Smallpox***

In 1980, after a lengthy vaccination campaign, the World Health Organization declared that interruption of the transmission of variola major, the virus which causes smallpox, had been achieved world-wide. To prevent laboratory accidents, the WHO approved only two repositories of the virus: the Centers for Disease Control and Prevention in Atlanta, USA and the Scientific and Production Association, Novosibirsk, Russia. In theory, therefore, it should be difficult for terrorists or governments (other than those of Russia and the US) to obtain the smallpox virus. It is known, though, that smallpox was produced and weaponised in the Soviet Union and it is not known whether all of those stocks were destroyed before they could fall into the hands of corrupt officials, criminal organisations or other regimes. Other pox viruses such as monkeypox are less dangerous for humans; camelpox is not known to infect humans, although concerns have been raised that they could now be genetically modified to increase their virulence. Chickenpox would not be an effective biological weapon because of widespread immunity.

If supplies could be obtained, smallpox would be an effective biological weapon. It is easy to produce and store, stable, highly infectious, transmissible person-to-person and has a relatively high mortality rate. Vaccination for smallpox ceased in 1980 (except among some laboratory staff) so the world's population would now be very susceptible. If smallpox were released it would put great pressure on hospitals, as a number of very ill patients would have to be strictly isolated in rooms with filtered air, and it would stretch health resources as authorities tried to prevent a widespread epidemic. The lengths to which the government of Yugoslavia went to control an epidemic after the reintroduction of smallpox to the country are described in Chapter 5.

After aerosol exposure to the smallpox virus, an incubation period of 7 to 17 days is followed by a period of malaise, fever, vomiting, headache and backache. Some patients may develop delirium. Smallpox is very difficult to diagnose at this stage. A few days after the onset of symptoms a rash begins to appear on the face, hands and forearms. The rash spreads to the torso over the following week. The rash develops into pus-producing lesions which eventually form scabs which heal to leave scars. There are more lesions on the lower limbs and face than the torso, and this is one way to recognise that a patient has smallpox rather than a severe case of chickenpox.

The mortality rate is around 30%. Haemorrhagic complications lead to very high mortality rates. The haemorrhagic form is easy to misdiagnose and highly infectious. There is no treatment, although if patients are vaccinated during the incubation period onset of the disease may be prevented. The vaccine cannot safely be given to people with compromised immune systems, and most countries stock only very small quantities of the vaccine, if any. Research is being conducted into antiviral drugs and these may have some use in the treatment of smallpox. Patients must be isolated and their contacts quarantined. Patients are contagious until all of the scabs heal, and are especially so if they have a cough. Everything a patient comes into contact with should be disinfected. Any confirmed case of smallpox could lead to drastic responses from other countries such as closure of borders and refusal to allow planes from the suspect country to land.



## ***Viral encephalitis***

There are a number of encephalitis viruses which have been considered as biological weapons. The ones which are most likely to be weaponised are Venezuelan equine encephalitis and eastern and western equine encephalitis. These viruses are naturally transmitted by mosquitoes, but are very infectious in aerosolised form. They are easy to produce and fairly stable.

The initial symptoms of the equine encephalitis in humans are fever, headache and myalgia, usually followed by nausea and vomiting. They are therefore difficult to diagnose in the early stages, although the presence of dying horses in the area could give a strong clue. Eastern and western equine encephalitis often progress to neurological disease after up to 11 days of fever. Patients may experience confusion, loss of coordination, partial paralysis, muscle spasms and seizures. Coma and death may follow in some cases. Young children and the elderly are the most susceptible. Venezuelan equine encephalitis involves high fever, chills, headache, malaise, sore throat, photophobia, myalgia, nausea and vomiting. Neurological complications are fairly rare and the disease is generally not fatal except in young children.

There is no specific treatment for the equine encephalitis viruses, although treatment aimed at managing specific symptoms can be effective. There is a vaccine for the Venezuelan form, but it commonly leads to systemic side effects and is not available in Australia.

## ***Viral haemorrhagic fevers***

Viral haemorrhagic fevers are caused by several families of viruses. The diseases typically involve high fever, vascular permeability and abnormalities of circulatory regulation. Some haemorrhaging occurs with most of these fevers. The viruses are naturally spread through contact with infected animals or insect vectors. For example, epidemics of Rift Valley fever in Africa are associated with increases in the mosquito population. Congo-Crimean haemorrhagic fever is spread by ticks and appears from time to time in Europe, Africa and Asia. Hantaviruses are transmitted by contact with rodents, but they are more difficult to reproduce in a laboratory so are less likely to be weaponised. Yellow fever is easier to produce and is very infectious as an aerosol, but may not be a first choice as a weapon because an effective vaccine is widely available. Viral haemorrhagic fevers generally are very infectious in aerosolised form and some have high mortality rates.

The most notorious of the viral haemorrhagic fevers are Ebola fever and the closely related disease Marburg fever. Ebola fever was first recognised during a 1976 outbreak in Zaire. The mortality rate was 92%. The reuse of unsterilised needles and syringes assisted in transmitting the disease. The 1995 outbreak was equally devastating; an outbreak in Uganda in 2000 was causing concern at the time of writing. Ebola and Marburg begin with fever, myalgia and prostration and develop to include a spotty elevated rash, generalised mucous membrane haemorrhaging and shock.

Junin and Machupo viruses also cause neurological and haemorrhagic symptoms; haemorrhage is less common with Lassa fever. Yellow fever typically leads to jaundice.

Treatment for viral haemorrhagic fevers is restricted to relieving the symptoms, replacing lost blood where necessary and treating secondary infections. Antiviral drugs may be of use against some of the viruses. Vaccines for most of these viruses, with the



exception of yellow fever, are only in the development stage. The United States Army Research Institute of Infectious Diseases has recently announced that it has developed a vaccine against Ebola, but it will take several years of testing before it is available for human use (Day 2000).

### ***Botulinum toxin***

Botulinum toxin is produced by the bacterium *Clostridium botulinum* and the disease it causes is called botulism. Botulinum toxin is an extremely toxic substance, and only 0.001mg per kilogram of a person's body weight is needed to cause symptoms. Intoxication can result from ingestion or inhalation of the toxin. Botulism usually occurs after eating canned food which has not been properly sterilised. Botulinum toxin can be aerosolised, and this is the most likely biological weapons scenario. It would also be possible to deliberately contaminate food or water with botulinum, although the toxin would be destroyed when the food was cooked. The toxin can remain active in nonchlorinated water for a week. Botulinum toxin can be produced on a large scale in a laboratory.

Once inside the body, the toxin binds to nerve terminals and blocks the transmission of neural signals. Symptoms may appear 24 hours after exposure or may not appear for several days, depending on the dose. Early symptoms include dilated pupils, blurred vision, impaired speech, dry mouth and difficulty swallowing. Muscle weakness follows then a descending and progressive paralysis. If death occurs it is usually due to respiratory failure.

An individual case of botulism could easily be confused with a neuromuscular disorder such as Guillain-Barré syndrome or myasthenia gravis. If a number of patients present at the same time with progressive paralysis and no fever then botulism should be suspected. There is an antitoxin which is effective if given early in the course of the disease, but it is not produced in Australia. Artificial ventilation will prevent fatalities in most patients. It may take several weeks before a patient is fully recovered.

### ***Staphylococcal enterotoxin B***

SEB is one of the toxins produced by *Staphylococcus aureus*. It is a stable toxin, even when heated, and is a common cause of food poisoning. It is stable in aerosol form and infective (though not fatal) in small doses. It could also be used to contaminate food.

Symptoms appear a few hours after inhaling the toxin. They include sudden onset of fever, headache, chills, myalgia and a cough. Some patients will experience laboured breathing and chest pain. Those who have also swallowed the toxin will probably experience nausea, vomiting, abdominal cramps and diarrhoea. Cases caused by food poisoning will present with the gastrointestinal symptoms only. A high fever can last for five days, and patients can take two weeks to recover.

The symptoms of SEB inhalation can easily be confused with influenza. An attack using aerosolised SEB would only be suspected if large numbers of patients presented within 24 hours. An influenza epidemic would develop over a longer period. Treatment should involve supportive care with ventilatory assistance and rehydration if needed. Most patients recover without any specific treatment.



## Chapter 3: History and use of biological weapons

Biological weapons have been used for centuries, though usually not in very sophisticated forms. Allegations of biological attacks have also been used for propaganda purposes for centuries, and it is often difficult to determine the truth behind such allegations. It can be difficult to distinguish naturally occurring epidemics from attacks with biological weapons. This is particularly so in times of war when health and sanitation systems come under severe strain. It has often seemed convenient at these times to blame an enemy for a country's increasing health problems. This is not a new phenomenon. In fourteenth-century Europe some Christian leaders alleged that Jews were poisoning wells and thus causing the plague epidemic known as the Black Death. These allegations sparked violent pogroms against Jewish communities (Moon 1992: 54).

### *Early history of the use of biological weapons*

The earliest known use of biological weapons was the practice of some of the indigenous peoples of South America of using toxins derived from plants as poison on their arrow heads. There are records from 300 BC indicating that Greeks polluted the wells and drinking water of their enemies with the corpses of dead animals. Roman and Persian soldiers did the same. The bodies of dead soldiers and animals were also used to pollute wells during some battles in medieval Europe (Poupard and Miller 1992: 10).

A famous early example of biological warfare occurred in 1346 during the siege of Kaffa. The Tatars who had the city under siege catapulted the bodies of soldiers who had died of plague over the city walls. A subsequent epidemic of bubonic plague prompted the surrender of the city. There are differing opinions about whether this incident promoted the spread of Black Death through Europe over the next few years, and even about whether plague-carrying fleas would have remained on the corpses or whether they were more likely to have entered the city through rats. Nonetheless, it did become a technique of war for a time and it is depicted on some medieval tapestries (Poupard and Miller 1992: 10–11; Christopher et al 1997: 412).

In another infamous use of disease in war, Sir Jeffrey Amherst, British Commander-in-Chief in North America, deliberately promoted the spread of smallpox among Native Americans. He was meeting aggressive resistance from the native people of Western Pennsylvania, with no prospect of reinforcements from England in the near future, and Native Americans were known to be very susceptible to smallpox. Amherst therefore suggested that his men give blankets used by smallpox patients to the Native Americans. Suggestions that settlers deliberately sought to spread smallpox and measles among the indigenous populations of Australia and other parts of the Americas (Poupard and Miller 1992: 11–12; Hall et al 1998: 2) have been questioned by Fenner (1984), who suggested earlier contact from the Macassas as a more likely origin for Australian smallpox.

### *Germany*

During the First World War Germany was accused of releasing cholera in Italy and plague in St Petersburg. It is also alleged that Germany used glanders and anthrax to infect sheep and horses in Romania, mules in France, Argentina and Mesopotamia, and even reindeer in Norway (Christopher et al 1997: 413; Poupard and Miller 1992: 13; Wheelis 1998). Ampoules of bacteria were apparently concealed in sugar cubes and fed



to animals to prevent them being used in the Allied war effort. Germany, of course, denied these allegations.

Germany apparently did not possess biological weapons in World War II, although there is some evidence that it polluted a Czech reservoir with sewage. The UK made accusations of biological weapons use by Germany, but with little evidence. When West Germany re-established its sovereignty in 1954 it renounced the manufacture of nuclear, biological and chemical weapons.

## ***Japan***

Japan's biological warfare experiments of the 1930s are the most vicious example of biological weapons use in history, and probably caused more fatalities than all of the other examples put together. In the 1930s Japan was expanding into Asia. The government believed that Japan's small population and lack of natural resources could be overcome if it had superior weapons to its Asian neighbours. Biological weapons were a central part of its plans. (For a thorough account of the Japanese program see Harris 1992.)

Ishii Shiro, director of Japan's biological weapons research program, believed that only limited knowledge could be gained from research using animals. He set up his first secret complex to conduct tests on human subjects in Harbin, Manchuria in 1932. Chinese prisoners were infected with diseases including plague, cholera, glanders and typhus. Within a month of being infected they were executed and dissected. New complexes were built in Manchuria and Nanking as the program expanded. Here, Chinese prisoners were infected with a great range of diseases including smallpox, several of the viral haemorrhagic fevers, salmonella, tuberculosis, tetanus, dysentery and gas gangrene. There were even experiments with venereal diseases and frostbite. The Japanese scientists tested the amount of pathogen needed for a fatal dose, whether people could be infected using contaminated food, clothes, or tools, and how to infect people using fleas dropped from planes.

Estimates of the number of people killed in these experiments vary. According to one account, more than 10 000 Chinese died in these tests (Harris 1992: 30), and the human experiments were allegedly also carried out on prisoners of war from other countries including the USSR, US, UK and Australia.

When Japan and the Soviet Union had a border dispute in 1939, known as the Nomonhan Incident, Japanese soldiers were sent into Soviet territory to poison wells and feed anthrax to livestock. Many Soviet soldiers and livestock became ill or died as a result, but so did several thousand Japanese soldiers.

Japanese scientists also conducted field tests in China. They placed typhoid, typhus and anthrax bacteria in wells, and dropped plague-infested fleas from planes. They tried impregnating chocolate with anthrax and giving it to local children, and handing out dumplings injected with typhoid and cholera in villages. Some of the experiments were more successful in spreading disease than others, but the epidemics of plague, cholera and typhus in northern China in the 1940s probably resulted from these field experiments.

When reports of the Japanese program first reached the west they were frequently dismissed as Chinese propaganda. After 1945, though, both the United States and the Soviet Union realised that information gained through the Japanese experiments could



be very useful for their own weapons programs. The United States military allegedly agreed to cover up the Japanese experiments and prevent prosecutions for war crimes in exchange for data from the experiments. There is speculation that the Soviet Union did the same, despite some show trials of Japanese scientists (Harris 1992: 41–42).

## ***United Kingdom***

The United Kingdom began a biological weapons research program in 1934. It was a period in which many nations were developing new weapons systems and biological weapons research was beginning in Belgium, France, Italy, the Netherlands and Poland, and was already established in the Soviet Union (Christopher et al 1997: 413).

The UK began research into anthrax and botulinum toxin. In 1941 and 1942 it tested the use of anthrax in aerosolised form at Gruinard Island, off the coast of Scotland. Anthrax spores were sprayed at sheep, who all died. The scientists working on the program did not know how to decontaminate the island afterwards and it remained uninhabited until 1990.

The UK also stockpiled cakes of linseed meal containing anthrax spores. The intention was to feed these to German cattle in retaliation if Germany used a biological weapon against Britain. In 1944 Winston Churchill considered using anthrax bombs on six German cities, believing that half of the population would die of inhalational anthrax and the other half would have to be evacuated. Bombs were ordered from the US which were to be filled with anthrax, but the war ended before they could be used (Barnaby 1999b: 77–79). When Germany's potato crop was infected with disease it accused the UK of biological warfare, but there was no real evidence of this.

The UK set up a biological research station at Porton Downs in the 1940s and research continued there after the war. It tested the agents which cause anthrax, brucellosis and tularaemia on animals. It sprayed biological agents over animals in rubber dinghies out to sea. It also sprayed simulants in the Caribbean, off the coast of Scotland and even in the London Underground to see how far they would spread. It collaborated with Canada, which had begun outdoor testing of potential weapons agents. The UK's offensive biological research program ended in 1957.

## ***United States***

The United States military began research into biological weapons in 1943. It collaborated with the UK and Canada in their experimental releases of microorganisms from ships in the Caribbean. The US and the UK also conducted joint research into anticrop agents during World War II. They considered using a fungus to destroy Japan's rice crop, but concluded that other types of weapon would have a more immediate effect (Caudle 1997: 460). During the war the American program was fairly modest, but afterwards the knowledge gained from Japan's more advanced biological warfare program encouraged the US Army to expand its own program. By the fifties America's biological warfare program was the world's largest.

The American program involved extensive testing of virulent agents indoors and on animal subjects and testing of simulants outdoors. Bacteria which were considered relatively harmless were disseminated over large areas of farmland, cities including Norfolk, Virginia and San Francisco, and in the New York subway and Washington DC airport. The army also wished to study how to infect people with yellow fever using mosquitoes, so it released large numbers of uninfected female mosquitoes, then



interviewed civilians about how many times they had been bitten. There was a theory that Soviet citizens would be very susceptible to yellow fever because it is not found naturally in Asia. Fleas were also reared and dropped from planes onto animals below.

American scientists also studied meteorological conditions across Europe and Asia, focusing especially on cities in the Soviet Union and China, to assess their vulnerability to biological attack. They also studied the medical facilities, health administration and vaccination practices in these areas.

The American program also included some tests on human subjects. Seventh Day Adventists who wished to avoid military service were instead allowed to volunteer to be exposed to nonlethal agents. They were placed in an aerosolisation chamber and exposed to *Francisella tularensis* and *Coxiella burnetii*. After a few days they were given antibiotics to help them recover from the infections.

Until 1956 the US military had a policy of defensive use of biological weapons only. After this it continued to expand its research program and stockpiled several different agents. The US built up stockpiles of weapons containing anthrax, botulinum toxin, tularaemia, brucellosis, Q fever, staphylococcal enterotoxin B and Venezuelan equine encephalitis. It also stockpiled the anticrop agents which cause rice blast, rye stem rust and wheat stem rust. It conducted research on other agents including the organisms which cause plague, psittacosis, smallpox, Rocky Mountain spotted fever, typhus, coccidioidomycosis, melioidosis and yellow fever, as well as several toxins and the animal pathogens rinderpest and foot-and-mouth disease. The CIA studied the use of cobra venom, saxitoxin and other toxins as weapons of assassination.

The American biological warfare research was not free from problems. There were 424 nonfatal infections among the staff of the program and three deaths, two from anthrax and one from Bolivian haemorrhagic fever. There has also been a report of a janitor dying from anthrax after changing a light bulb in a contaminated building (Cole 1997: 44). There were also illnesses among civilians. In 1950 the US Army sprayed San Francisco with *Serratia marcescens* to test its dissemination systems. This agent was considered harmless, but eleven patients in a San Francisco hospital were infected with *Serratia* within the next few days. One patient died. His family attempted to sue the government but failed, and the government insisted that it was a coincidence that the infections had occurred so soon after the test (Cole 1997: 17). The use of *Serratia marcescens* and other bacteria such as *Bacillus subtilis* as biological weapons simulants has been widely criticised, as they can cause infections in the very young, very old or others with weakened immune systems (Cole 1997: 17–23; Christopher et al 1997: 414).

In 1953 the US Army sprayed clouds of zinc cadmium sulphide over Minneapolis to test its dissemination. Reports emerged years later of higher numbers of stillbirths and miscarriages in the area (Gould and Connell 1997: 105). The Dugway Proving Ground in Utah was the site of tests of biological and chemical agents in the 1960s. The open-air testing of virulent agents was stopped after 6000 sheep on neighbouring farms died during a nerve gas test in 1968, but spraying of simulants continued despite protests from residents of the area (Cole 1997: 59–61, 71).

On 25 November 1969 President Nixon issued an executive order which ended the US offensive biological warfare program. He stated that the US renounced 'any form of deadly biological weapons that either kill or incapacitate' and that the existing stocks of biological weapons would be destroyed. On 14 February 1970 he added that the stocks



of toxins produced by microorganisms would also be destroyed. Only small amounts of these agents were to be retained for defensive research. (Despite this, as a congressional hearing in 1975 revealed, the CIA had illegally kept its supplies of some toxins.) It seems that the army had concluded that biological weapons had little strategic value and that resources should be channelled to more effective and predictable weapons systems. Biological weapons were seen to be untried, unpredictable and possibly dangerous to users. Also, once the American program was ended the US could work to prevent the proliferation of the cheaper weapons of mass destruction, for example through the Biological Weapons Convention. This would help to maintain the position of power it derived from the possession of nuclear weapons, which were beyond the reach of most countries (Christopher et al 1997: 416).

## ***Soviet Union***

The Soviet Union began research into biological weapons in 1929. Its program was initially small in scale, but increased after World War II with the benefit of knowledge gained from the Japanese and American programs. In fact, the Soviet program conducted very similar research to that done by the US army until 1969, probably because of information exchanged by spies for the two countries (Alibek 1999: 230).

In the 1980s the Soviet program expanded to allow for industrial-scale production and weaponisation of many different organisms. It is difficult to find reliable information about the Soviet program, but some reports suggest that tens of thousands of scientists were employed to produce these weapons and that worrying new techniques were applied to make the weapons more powerful (Barnaby 1999b: 102–105). There has been more than one report that Soviet scientists worked on the production of strains of plague and anthrax that were resistant to antibiotics (Gould and Connell 1997: 108; Barnaby 1999b: 103, 143). Ken Alibek, a defector from the Soviet program, alleges that they succeeded in producing antibiotic-resistant strains of anthrax, plague, tularaemia and glanders, and that they attempted to genetically modify organisms to increase their stability and infectivity and to alter some organisms so that they could cause two diseases, for example one virus which could cause both Ebola fever and smallpox (Alibek 1999).

If the testimony of Ken Alibek can be believed, the list of diseases studied in the Soviet program was extensive. It included anthrax, tularaemia, glanders, plague, smallpox, dengue fever, Rift Valley fever, Marburg fever, Ebola fever, typhus, brucellosis, Q fever, Venezuelan equine encephalitis, Lassa fever, monkeypox, melioidosis, Russian spring-summer encephalitis and the diseases caused by the Junin and Machupo viruses and botulinum toxin. The Soviet program also included some research on plant and animal pathogens. Some human pathogens such as HIV were considered as potential biological weapons for a time but were eventually dismissed as unsuitable.

Like the American program, the Soviet biological weapons program had a number of casualties among both military scientists and civilians. There was an outbreak of tularaemia in Russia in 1941 and 1942. One cause which has been suggested is that the Soviet army was attempting to infect German troops with aerosolised tularaemia, and that many Soviet troops and civilians were accidentally infected as well (Alibek 1999: 30–31). There were several outbreaks of plague in Central Asia from the 1970s onwards (Alibek 1999: 16). The Soviet authorities denied that this might be connected to their weapons tests. There were a number of laboratory accidents which released dangerous organisms, too. The most famous incident is the anthrax outbreak at Sverdlovsk,



described below. There was an earlier leak of anthrax in Kirov, leading to infections mainly in rodents, and several anthrax deaths among laboratory staff. The number of Soviet laboratory staff who died after being infected with biological agents is unknown.

On 11 April 1992 Russian President Boris Yeltsin signed a decree banning offensive biological weapons research. Biological weapons facilities began to be converted for civilian biological research. There has been more than one allegation of offensive research continuing in Russia, including on antibiotic-resistant strains, possibly without the knowledge of the country's leaders (Alibek 1999: 263; Gould and Connell 1997: 109).

### **The Sverdlovsk anthrax outbreak**

In 1980 reports reached the west of an outbreak of anthrax in the Soviet city of Sverdlovsk (now Ekaterinburg). The reports alleged that more than sixty residents had died in April and May of 1979. The Soviet authorities claimed that these were cases of gastro-intestinal anthrax resulting from the consumption of animals who had died from naturally acquired anthrax. The reports caused many people outside the Soviet Union to suspect an accidental release of anthrax from a laboratory. This was the first evidence that the Soviet Union was developing biological weapons despite having signed the Biological Weapons Convention.

In the early 1990s western medical personnel were allowed to visit Sverdlovsk and investigate the outbreak for the first time. They discovered that there were at least 66 deaths in the outbreak, mainly of people who were living or working in a narrow zone downwind of a military microbiology facility. Livestock in villages downwind of the facility were also infected. The timing of the deaths and pattern of infections indicated a release of anthrax on a single day and airborne dissemination of the disease. The pathologists who had conducted autopsies confirmed that the deaths were from inhalational anthrax (Meselson et al 1994).

The response from the Soviet authorities at the time was to warn the population not to eat uninspected meat and to avoid contact with sick animals. The local police shot stray dogs and arrested black-market meat vendors. Families of the victims were given antibiotics, and a voluntary immunisation program was begun in mid-April. The bodies of the dead were carefully guarded and pathology reports suppressed. Any links with the military facility in the town were denied at the time.

In 1992 Russian President Boris Yeltsin finally publicly acknowledged that the Sverdlovsk anthrax outbreak was the result of an accidental release of anthrax from a military research facility (Cole 1997: 178). Details of how the release occurred are difficult to verify. Ken Alibek, a scientist formerly employed in the Soviet biological weapons program, reports that there was a large biological arms production facility at Sverdlovsk which produced anthrax spores. His theory is that a clogged air filter was removed at the end of a shift, but not replaced before production on the next shift began. This enabled anthrax spores to travel through the exhaust pipes and into the air outside the factory, from where it was carried downwind (Alibek 1999: 73–74).

This is an account of the last three days in the life of Sverdlovsk resident Mikhail Markov, affectionately known to his family as Misha:



**Misha's illness, his sister-in-law begins, started on April 6, when he came down with a cough. He went to the local clinic, where the doctor said that he might have the flu and should go to the neighbourhood hospital if he felt worse later. Instead, the next day, feeling a little better, Misha went back to work. The false revival characteristic of anthrax made him optimistic. Then on the afternoon of April 8, as his brother and sister-in-law were preparing to take a pig they had raised to the state slaughterhouse, Misha complained of feeling cold. When it came time to help his brother load the animal into the car, he stood aside, shivering...**

**Misha tried to help, but he was on the verge of collapse and shivered all through the expedition. When he got home, he went straight to bed, still shivering but feeling feverish, too. His brother went out and bought vodka as a remedy, but when Misha's wife offered it to him, Misha just took a sip. He grew weaker until, finally, they called the Stanica Skoraya to have him transported to Hospital 20. When his wife telephoned there the next morning, someone told her her husband was doing fine. But later, when she went to the hospital, she discovered to her shock that he had died during the night and that his body had been taken away. (Guillemin 1999: 90)**

The suffering of Misha's family was increased by the official cover-up and by the story that the outbreak was caused by consumption of contaminated meat. Misha's wife worked at the meat-packing plant in Sverdlovsk, and she was ridiculed at work for feeding her husband bad meat. The family was refused permission to take away the body to prepare it for burial. They took his best clothes to the hospital so that he could be dressed in them, but they were turned away. The city organised the funeral and police guarded the coffin throughout. The death certificate stated that the cause of death was 'sepsis'.

### ***Southern Rhodesia***

During the civil war in Southern Rhodesia (now Zimbabwe) in the late 1970s there was a sudden outbreak of anthrax in guerilla-held areas. There were 10 000 cases of human anthrax, mainly of the gastro-intestinal kind, and 182 deaths. This seems suspicious given that there were only 334 human cases of anthrax in the country in the previous 29 years (Barnaby 1999b: 93). It has been suggested that the Rhodesian army dropped anthrax spores from planes into guerilla areas either in order to kill the cattle of the tribespeople who were helping the guerillas or in order to infect the guerillas themselves. Most of the human cases resulted from the consumption of infected cattle (Gould and Connell 1997: 111; Barnaby 1999b: 73).

### ***South Africa***

In the apartheid era the South African government set up 'Project Coast' which investigated ways to assassinate people and make the deaths appear to be from natural causes. They produced anthrax, cholera, botulinum toxin, salmonella and snake venom. They tried placing them in chocolate and cigarettes, and putting them on envelopes and in whiskey and deodorants. Some of the experiments met with little success, but the South African police did manage to assassinate a Russian adviser to the ANC using anthrax (Barnaby 1999b: 112–113).

South African scientists were under instructions to work on the development of biological agents which would only harm black or coloured people or which would make black



women infertile. This was an almost impossible task and certainly beyond the resources of the South African scientists at the time. It has also been alleged that South African police plotted to hasten the spread of AIDS among the black population by sending HIV-positive men to patronise Johannesburg prostitutes (Purver 1995: 20).

### ***Cold War allegations of biological weapons use***

In 1951 communist leaders in North Korea and China alleged that the United Nations Command in Korea was using biological weapons. North Korea delivered an official protest to the United Nations in 1952. The allegations claimed that the US had used smallpox, plague, cholera, typhus, dysentery, typhoid fever and anthrax, and that these agents had been disseminated with the use of fleas, spiders and voles. They also included the claim that biological agents were tested on North Korean and Chinese prisoners of war. The Soviet Union also promoted these allegations for propaganda purposes. For a time the allegations sounded convincing to many people because the US had not signed the Geneva Protocol, had protected Japanese biological weapons scientists and was working on its own biological weapons program. In reality, though, the US was just setting up its biological weapons production facilities at the time, had a policy of using biological weapons only in retaliation and was trying to avoid escalating the conflict in Korea. The fact that North Korea and China refused to allow proposed investigations by the UN, the Red Cross or the World Health Organization also decreases the credibility of the accusations. It is likely that North Korea was attempting to hide the fact that its health care systems had collapsed during the war (Moon 1992).

In the 1970s the United States alleged that the Soviet Union and North Vietnamese dropped clouds of tricothecene mycotoxins, described as 'yellow rain', in Laos to dislodge hill tribes from their villages. The same claim was made of the Soviet Union during the war in Afghanistan. Scientists sent to investigate the clouds of yellow rain failed to prove that it contained any toxins. One theory they proposed instead was that the clouds consisted of the faeces of swarming bees. It has been pointed out that the claim of Soviet use of toxins was pursued in the United States at a time when the Department of Defence wished to gain more funding for its bio research program.

The other allegations of biological attacks from this time appear to be equally unfounded. Egypt accused Israel of a biological weapon attack whenever it experienced an outbreak of disease, and Israel accused its Arab neighbours. India expelled a World Health Organization team who were researching ways to eliminate malaria, accusing them of planning hostile uses of the disease. The Soviet Union claimed that the US used biological weapons against China, Cuba and indigenous peoples in South America and Canada. And Cuba blamed the United States for many outbreaks of disease, including outbreaks of swine fever causing the slaughter of 800 000 pigs, the loss of sugar cane through sugar cane roya, blue mold on its tobacco crops and an epidemic of haemorrhagic dengue fever which caused 158 deaths.

### ***Iraq***

Iraq conducted some research on biological weapons in the 1970s, and it began an offensive program in earnest in 1985. Iraqi scientists imported anthrax from France and the US and also isolated locally occurring strains. The American Centre for Communicable Diseases and the American Type Culture Collection in Maryland reportedly exported samples of anthrax, tetanus, plague, dengue fever, West Nile fever and botulinum toxin to Iraq (Cole 1997: 85). Iraqi scientists conducted some research into Congo-Crimean haemorrhagic fever and yellow fever, but decided not to weaponise them



because they require insect vectors. They considered using camelpox, not regarded as infectious to humans, perhaps presuming that people brought up in parts of the world in which there are no camels would be particularly susceptible.

The three agents Iraqi scientists decided to weaponise were anthrax, botulinum and aflatoxin. Aflatoxin seems an unusual choice because it is not very toxic and its main toxic property is as a long-term carcinogen. It has been suggested that Iraqi scientists were under pressure to come up with another weapon quickly and aflatoxin was easy to produce (Zilinskas 1997: 421). They also tried placing ricin in artillery shells, but this was found to be an ineffective delivery method.

Iraq created bombs filled with anthrax, botulinum and aflatoxin. The bombs had an explosive charge which would rupture the outer wall of the bomb enabling the agents to be dispersed. This is not a very effective dissemination method. The agents would lose virulence in the explosion, some of the organisms would be driven into the ground and the aerosolised particles would vary in size (Zilinskas 1997: 421). Another shortfall in their program was that they were using anthrax slurry, not anthrax spores. Slurry is easier to manufacture but can lose its virulence and is more difficult to aerosolise.

During the Gulf War the US and its allies suspected that Iraq possessed biological weapons and feared that they would be used. Many American soldiers were immunised against anthrax and botulinum toxin before they were sent to the Gulf, and the Israeli population was issued with gas masks in case of either a chemical or biological attack. In fact, there is no evidence that Iraq attempted to use its biological weapons. This might have been because of fear of more aggressive retaliation, because they knew their weapons might be ineffective, because of the destruction of meteorological stations in allied bombing raids, because aircraft were frequently shot down, or because Iraqi soldiers were not trained or equipped to protect themselves.

Allegations have been made that Iraq used its biological weapons in its war with Iran and against its Kurdish population. But the high fevers and diarrhoea which were reported in these areas would have been common in wartime conditions, and there is no strong evidence that they were caused by a biological attack (Cole 1997: 92–93). It is more widely accepted that chemical weapons were used during the Iran-Iraq War, though.

Some western soldiers returning from the Gulf War have since complained of rashes, fatigue, diarrhoea, chronic cough, joint pain and memory loss, a collection of symptoms which have been termed the Gulf War syndrome. Some of these veterans have alleged that they must have been exposed to either chemical or biological weapons. Again, there is very little evidence of this. Other theories which have been proposed are that the syndrome was caused by anthrax inoculations (although anthrax immunisation in the past has not resulted in such widespread systemic reactions), a parasite found in the Gulf area, the use by the US of depleted uranium weapons, or the overuse of the drug pyridostigmine bromide which was taken in anticipation of chemical weapons attacks. The most likely cause is probably the use of pyridostigmine either alone or in combination with other chemicals (Cole 1997: 129–139) or the practice of giving troops several different vaccines at the same time (Price 1997).

At the end of the Gulf War, on 3 April 1991, the United Nations Security Council passed Resolution 687 which required, among other things, that Iraq reaffirm its obligations under the Geneva Protocol and the Biological Weapons Convention, to allow its stocks of biological and chemical weapons to be destroyed under international supervision and to



allow inspections of its scientific facilities. The UNSCOM inspectors met with a great deal of misleading information and non-cooperation, but did manage to supervise the destruction of some facilities and weapons. The Iraqi government did eventually admit to weaponising anthrax and botulinum toxin, and insisted that it has now destroyed all such weapons. It is well-known, though, that Iraq could manufacture more biological weapons fairly quickly because the scientists who worked on the old program are still present and civilian biotechnology laboratories could soon be converted to offensive uses (Zilinskas 1997: 422).

It is worth mentioning at this point that the economic sanctions which the United Nations Security Council imposed on Iraq in 1991 are preventing vaccines, antibiotics, painkillers and other essential medical supplies from reaching the Iraqi people. Over a million Iraqis have died as a result of the sanctions, and Iraqi children continue to die of avoidable or treatable infectious diseases at the rate of up to 200 a day (Pilger 2000). This form of biological warfare is causing far more deaths and suffering than Iraq's biological weapons were capable of.

### ***Offensive biological weapons programs today***

It is difficult to be absolutely certain of which countries possess biological weapons. The Soviet Union conducted its offensive program without the knowledge of western governments until two of its high-level weapons scientists defected and the details of the Sverdlovsk outbreak became known in the early 1990s. Iraq's research was originally a secret, although many in the west were highly suspicious. It is unclear how much biological weapons research continues in Russia and Iraq today.

A report to the US Senate in 1995 named seventeen countries believed to possess biological weapons: Libya, North Korea, South Korea, Iraq, Taiwan, Syria, Israel, Iran, China, Egypt, Vietnam, Laos, Cuba, Bulgaria, India, South Africa and Russia. Sudan has also been suspected. In 1993 the Russian Foreign Intelligence Service released a statement claiming that North Korea is conducting research into anthrax, cholera, plague and smallpox and testing them in its island territories (Caudle 1997: 461–462). American intelligence reports have also alleged that China has an offensive biological weapons program and Russia has made similar claims about Egypt. Two epidemics of haemorrhagic fevers in North East China in the 1980s may have resulted from accidents at biological laboratories (Alibek 1999: 273).



## Chapter 4: Bioterrorism: the threat and the realities

In an international climate in which most governments shun the use of biological weapons, or fear great retaliation if they do use them, civilians in western countries are unlikely to suffer a military biological attack. A terrorist attack would seem to be more likely. In practice, there have been very few terrorist attempts to use biological weapons, and such attempts have had to overcome a number of difficulties. But using biological weapons, or threatening to use them, may be attractive to contemporary terrorists for a number of reasons.

Terrorism is 'violence, or the threat of violence, calculated to create an atmosphere of fear or alarm, through acts designed to coerce others into actions they otherwise would not undertake or into refraining from actions they desired to take' (Gilmore Report 1999: iii). Biological weapons are particularly suited to creating an atmosphere of fear or alarm. Biological agents cannot be seen, smelt or tasted, and they cause diseases which are unfamiliar in many countries. No-one would know for certain that they had been exposed until symptoms began to appear, and even then symptoms of anxiety due to fear of exposure may mimic the onset of the disease.

Biological weapons are not suited to many military objectives. Their effects are too uncertain and too dependent on meteorological conditions. But they may be attractive to some terrorist groups precisely because of this uncertainty (Danzig and Berkowsky 1997: 431). A biological attack would be a very effective way to cause fear and panic among a civilian population. Some terrorist groups may be satisfied with the infliction of only a few casualties if they are accompanied by mass panic. In fact, even an incompetent attempt to use a biological weapon would attract great publicity, which may be the desired effect.

Those who fear that terrorists will increasingly turn to biological weapons in the future claim that there have been increasing numbers of casualties in terrorist attacks over the last ten years. Terrorist groups might now be competing for attention and seeking more dramatic methods. There are other reasons why biological weapons may be more popular with terrorists in the future. The end of the Cold War and the conflict with Iraq has ended the popular preoccupation with nuclear weapons and raised awareness about chemical and biological weapons. There are a number of unemployed or underpaid scientists who used to work on the biological weapons programs of the Soviet Union, Iraq or South Africa. Some of them might be tempted to sell their knowledge or expertise. It is also rumoured that some of Russia's secret criminal gangs possess biological agents which were developed in the Soviet bioweapons program (Alibek 1999: 272).

In the past Australia has seemed to be fairly safe from biological attack. Biological weapons were seen to be a potential problem for Kurds, Israelis and possibly Americans but the threat seemed much more remote for Australians. It is possible, though, that Australians could be targeted in 2000 because the Olympic games will be held here. The Olympics will bring a large influx of people from around the world and will direct the world's attention here. This could be seen as a rare opportunity for a terrorist group seeking world-wide publicity.

Biological weapons could also be attractive to terrorists who wish to remain anonymous and to appear as 'enigmatic, unseen, and unknown assailants' (Gilmore Report 1999: 11). Attempts have been made to use toxins in assassinations to avoid detection. Such



weapons might be less attractive to groups who wanted to claim immediate credit or to be obviously linked to their crimes. Terrorists who wanted to cause great damage to a country's economy could use plant or animal pathogens. The damage would be exacerbated if trading partners then imposed trade barriers to prevent the spread of the disease. A very effective attack with human pathogens could also exhaust a region's health resources and cause economic strain.

Some members of terrorist groups, like any other people, may experience a sense of revulsion at the thought of using biological weapons. The psychological constraints against using these weapons may have lessened after the publicity given to the Aum Shinrikyo cult's use of a chemical weapon and attempted use of biological weapons. Many mainstream groups may still feel constrained, though, especially if they enjoy the support or sympathy of part of the population. Some groups would also be reluctant to resort to bioterrorism for fear of greater retaliation than that which would follow a conventional bombing.

In the past the groups who have been most attracted to biological weapons have been those who do not seek or expect outside support, and who want to kill as many of their perceived enemies as possible or to create significant social upheaval. These have tended to be fundamentalist, exclusive religious groups and extreme single-issue groups such as white supremacist groups in the United States (Gilmore Report 1999: vii). The old assumption that terrorists act rationally, want to remain in control of events and seek political ends rather than mass casualties was challenged in the 1990s by the Aum Shinrikyo cult, the World Trade Center bombing and the Oklahoma City bombing (Gilmore Report 1999: 42). As former US Senate staff member John Sopko stated,

**...past assumptions that those in possession of weapons of mass destruction are rational, informed opponents who calculate the risks and benefits before using such force do not apply when these groups are driven by 'divine intervention', messianic leadership or suicidal instincts.**

(Quoted in Gilmore Report 1999: 44)

Conventional bombs and firearms will continue to remain attractive to most terrorists. They can be bought or made cheaply, are much more reliable and predictable than biological weapons and have immediate effect. They are less likely to accidentally injure members of the terrorist organisation. In the past they have proved to be a more effective way to kill significant numbers of people. For example in 1995 Timothy McVeigh, apparently acting alone and using a conventional bomb, managed to demolish a federal office building in Oklahoma City killing 168 people and injuring several hundred. It would be extremely difficult for a single person even to create a biological weapon. Terrorists groups may prefer the single, explosive event anyway: it has been argued that terrorists have a general preference for 'things that shed blood and go bang and explode in a fairly well-circumscribed time and place' (Stanley Weiner, quoted in Purver 1995: 23).

There has been much talk in the United States recently about the risks of chemical and biological terrorism, but there has only been one death in the US caused by the use of a chemical agent and none through biological terrorism. That one death occurred in 1973 when members of the Symbionese Liberation Army (which later became famous for kidnapping Patty Hearst) shot one person with a cyanide-tipped bullet.



Norman Rabkin, director of national security preparedness issues at the US General Accounting Office, recently reported to the US House of Representatives that he believed that

**...some of the public statements intelligence community officials have made about the terrorist CBRN [chemical, biological, radiological and nuclear] threat do not include important qualifications to the information they present. For example, terrorists would have to overcome significant technical and operational challenges to successfully make and release many chemical or biological agents of sufficient quality and quantity to kill or injure large numbers of people without substantial assistance from a foreign government sponsor. These types of qualifications are important because, without them, policy makers in both the executive or legislative branch may get an exaggerated view of the terrorist CBRN threat.**

(Rabkin 2000: 1–2)

The difficulties of creating effective weapons should not be underestimated. Some commentators claim that it would be possible to create effective biological weapons with only US\$10 000 worth of equipment; some say \$200 000 would be a minimum and others believe a group would need \$2 million (Cole 1996: 31; Gilmore Report 1999: 23). The group would need to employ staff trained in microbiology and preferably also pathology, aerosol physics and meteorology. These trained scientists would have to be willing to risk infection themselves, willing to kill large numbers of people, and able to work effectively in conditions of secrecy and probably great stress. The Aum Shinrikyo cult had a number of suitably trained scientists and the requisite laboratory equipment, but the staff were operating in a climate of paranoia, delusion about the cult's abilities and pressure to produce weapons quickly. This made it impossible to perform the necessary laborious, time-consuming procedures (Gilmore Report 1999: 24).

Acquiring the relevant biological agents is not the difficult part of developing biological weapons. Agents can be ordered from germ banks by any terrorist who can convincingly pretend to be a university-based researcher. They could be stolen from a laboratory or possibly bought from unethical scientists working on biodefence or offensive programs in other countries. Some agents can be isolated from the soil or from natural occurrences of the disease. Some plant-derived toxins can be produced fairly easily, such as ricin from castor beans, or tricothecene mycotoxin from a fungus found on corn crops.

The most difficult task for a would-be bioterrorist is transforming the agent into a weapon. The agent must be reproduced, stored and made stable, all without reducing its viability. Then the agent must be disseminated with appropriate equipment and in suitable weather conditions. Members of the group working on the agents must be protected from infection. The weapons cannot easily be tested without attracting police attention. In practice, drying and aerosolising the agents has proved to be too difficult for the various purported bioterrorist groups described below.

There have been several unsuccessful attempts to obtain supplies of dangerous agents from laboratories. In May 1995 an American man named Larry Harris ordered three vials of *Yersinia pestis* from the American Type Culture Collection, using the supposed letterhead of a fictitious research laboratory. The ATCC was not suspicious until Larry rang four days later to ask why the organisms had not yet arrived. This alerted staff to the fact that he was not familiar with laboratory timetables and they contacted the Centers for Disease Control and Prevention. Larry was charged with fraud and receiving



stolen property. He claimed that he wanted to conduct research to help counteract a biological attack by Iraq. This did not sound convincing when it emerged that he was a white supremacist and a member of the supremacist group Aryan Nations.

When two Canadians ordered tetanus and botulinum toxin from the American Type Culture Collection in 1984 they claimed to be employees of the corporation ICM Science. ICM Science staff noticed this when they were sent the invoice, and the two were soon arrested. An earlier American attempt to blackmail an employee of an army biological defence facility into supplying biological agents also failed. Suspicions were aroused when the employee requested supplies not related to his work.

It has proved to be difficult for a terrorist group to successfully develop biological weapons without the aid of a state which already possesses them. This should not be discounted as a possibility, though. As the Gilmore Report warns, 'Iraq, Iran, Sudan, and North Korea ... continue to shun internationally accepted norms of behaviour; remain—at least outwardly—unreconcilably opposed to the major Western powers; and persist in their support for antigovernment movements' (1999: 15). On the other hand, such states have reason to be wary of freely giving away their biological weapons expertise. It might cause retaliation from target countries, and the state would not be able to control how the terrorist group used the weapons. Even so, discouraging governments from possessing biological weapons through political and legal means will mean terrorist groups cannot easily acquire such weapons and are less likely to be inspired to use them (Cole 1996: 35).

### ***Aum Shinrikyo***

The Aum Shinrikyo sect was a very large religious group based in Japan but with followers world wide. At their height in 1995 they had at least 60 000 members, up to a billion US dollars in assets, plenty of cash to spend on weapons development and at least a hundred trained scientists devoted to a biological and chemical weapons development program. Leaders of the Aum sect prophesied that most of the world's population would die in cataclysmic events, leaving only those faithful to the sect alive. Using chemical and biological agents was seen as one way to fulfil the prophecy.

Scientists within the Aum sect spent years attempting to developing destructive weapons. They possessed sarin, VX, tabun, soman, mustard gas and sodium cyanide to use as chemical weapons. The biological agents they possessed included anthrax, Q fever and botulinum toxin. Members of the sect traveled to Zaire during the 1995 Ebola fever outbreak, ostensibly on a humanitarian mission, but secretly planning to collect samples of the virus. They even purchased a large sheep station in Western Australia in order to mine uranium for use in nuclear weapons.

Despite their resources and expertise the Aum cult failed to infect a single person with their biological agents. They attempted to disseminate botulinum toxin on seven occasions and anthrax twice, using sprayers on rooftops and the back of trucks. It turned out that the botulinum they had produced was not highly toxic. They had found it difficult to acquire an appropriate strain of bacteria. They had also found it too difficult to get their anthrax to form spores and had instead tried to spray anthrax slurry. This clogged their sprayers and did not aerosolise effectively.

Even their famous 1995 chemical weapon attack in the Tokyo subway, using the nerve gas sarin, was not as successful as they had expected due to impurities in the agent. Twelve people died in the attack and less than a hundred others received any real injury



(though there were thousands of panicked people seeking medical attention). Their 1994 sarin gas attack in Masumoto caused seven deaths and 144 injuries. These were serious incidents but not the cataclysmic events the Aum members were aiming for. In all, the Aum Shinrikyo case is a reassuring reminder that biological weapons are very difficult for nongovernment groups to create no matter how wealthy they are, and especially if they are following paranoid leaders who do not have sound scientific judgement.

### ***The Rajneeshee salmonella case***

In the early 1980s followers of Bhagwan Shree Rajneesh established a commune in The Dalles, Oregon. They purchased a substantial amount of land on which to build, then were frustrated when the local council's planning decisions were not all in their favour. They devised a plan to influence the outcome of the next local council elections, due in November 1984, by infecting a large number of the residents of The Dalles with salmonella bacteria to discourage them from voting. As a trial run, they put the bacteria in the salad bars of ten local restaurants over a three-week period in September of that year. This caused 751 cases of salmonellosis, of whom at least 45 had to be hospitalised. There were no fatalities. This was the most successful bioterrorist attack of recent times in terms of the number of people infected. It did not influence the election results, though, because all the salad bars in the town were closed in November while the unusual outbreak of salmonellosis was investigated (Török et al 1997).

The Oregon health authorities initially did not suspect deliberate contamination of the salad bars. They closed the bars and carefully investigated the hygiene standards in the restaurants. After extensive testing, authorities became suspicious that there were so many cases caused by a single, fairly rare strain of *Salmonella Typhimurium*. They did not find enough evidence to connect the outbreak with the Rajneeshee cult until a year after the contamination. Their suspicions were finally confirmed when some commune members admitted responsibility. Two commune members were sentenced to 4½ years gaol each for breaching the US antitampering Act.

### ***Other examples of terrorist possession and use of biological weapons***

There has been one well-known successful assassination using ricin, but it was only achieved with support from two governments. In 1978 Georgi Markov, a Bulgarian man living in exile in London, was shot in the leg with a tiny pellet fired out of the bottom of a fake umbrella while he stood at a bus stop. He died a few days later and it was discovered that the pellet had been filled with ricin. It later emerged that the assassination was sponsored by the Bulgarian government with technology supplied by the Soviet Union. A similar attempt several days earlier to kill Vladimir Kostov, a Bulgarian dissident living in Paris, failed when the pellet did not penetrate far enough into his skin (Eitzen and Takafuji 1997: 420).

There have been several unsuccessful attempts to create biological weapons for terrorist use. In 1972 the US right-wing extremist group Order of the Rising Sun was found to possess 40 kilograms of typhoid bacteria. They planned to put it in the water in a number of cities. This would have been ineffective due to the chlorination of the water, but two members of the group became scared and notified the police before the bacteria could be used, anyway. In 1980 the German Baader-Meinhof gang was caught producing botulinum toxin in a home laboratory. The Paris 'Red Army Faction' also had home-grown botulinum toxin. In 1995 two member of the Minnesota Patriots Council were



arrested while planning to put ricin on doorknobs in an attempt to assassinate tax agents.

There have also been terrorist hoaxes, in cases in which there was no evidence that the agents had been acquired, let alone the weapons developed. In January 1984 a man contacted the Queensland government threatening to infect cattle with foot-and-mouth disease unless certain reforms were made in prisons. This threat was taken very seriously because of the importance of the beef industry to Queensland's economy, and Australian authorities sought advice from their American counterparts on meeting bioterrorist threats to livestock. It was eventually discovered that the threat was a hoax and was made by a Queensland prisoner.

In 1992 a group known as the Animal Aid Association claimed that it had injected HIV into chocolate bars in Canada as a protest against the use of animals in research. There was no evidence that they had in fact done so. In fact, claiming that a syringe of blood contains HIV has possibly become the most common threatened use of a biological weapon. A German biologist threatened to place anthrax and botulinum toxin in a town's water supply unless he were paid a large sum of money. (This method would not, of course, have infected anyone even if he did possess these agents.) (See Purver 1995 on all of these attempts.)

In the late 1990s there were numerous anthrax hoaxes in American cities, probably inspired by the increased media attention given to bioterrorism in the US during a time of weapons inspections in Iraq, presidential statements about the importance of preparing to meet the threat of unconventional terrorism, and popular novels and movies about bioterrorism. It seems that none of the hoaxers had actually acquired anthrax and few had any idea about how it should be disseminated. This did not stop the hoaxes fuelling the rhetoric in American media and political statements about the supposedly imminent risk of a bioterrorist attack (Cole 1999).



## Chapter 5: Responding to the threat

The response of any government to the threat of biological weapons should be in proportion to what is a fairly small threat and should take account of the limited resources available, and in particular the many demands on resources in the health area.

The United States government spent more than a billion dollars on biological defence research between 1945 and 1995. This included the trebling of the biodefence budget during the Reagan years, which caused concern among American civilians and internationally that the United States military might be secretly preparing to resurrect an offensive biological weapons capability. And then President Clinton announced further massive increases in the biodefence budget for 1999, taking it to US\$1.4 billion (Cole 1999: 9).

The Pentagon talks about the threat of rogue states using 'weapons of mass destruction' in order to justify the large defence budget it continues to enjoy in the post-Cold War era (Cole 1999: 8). Recent media hype and exaggerated estimates of the casualties which biological weapons could cause only create hysteria and encourage anthrax hoaxes, and are of benefit only to the budget of the United States Department of Defense (Swint 2000).

The United States military and Department of Health and Human Services has plans in place for worst-case, mass casualty scenarios. This does not reflect the past reality that biological attacks have usually been small in scale, when they have succeeded at all, and that conventional bombs have usually produced more casualties (Tucker and Sands 1999: 47–48). The Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction, appointed in 1999 to advise the United States President and Congress, criticised this focus on large-scale attacks. It sought to challenge the assumption 'that any lesser incident can be addressed equally well by planning for the most catastrophic threat'. Small-scale attacks, the panel argued, would present challenges of their own and might require a local response, not a large-scale mobilisation of federal resources (Gilmore Report 1999: 53–54).

The question comes to mind about some of the threat analyses as to whether they are real, or the acting out on paper of the nightmares of a few individuals. Whilst it is entirely appropriate for the US to consider whether its security could be under threat, it is questionable whether nightmare scenarios help to create a climate suitable for biological weapons disarmament to take place. (Hay 1999a: 230)

Norman Rabkin, the director of the United States General Accounting Office, has also criticised the size and focus of the current American response. He criticises the current focus upon 'vulnerabilities' rather than 'credible threats', and the use of improbable 'worst case scenarios' which are not supported by the US government's own intelligence data. He also points out that the program run by the US Department of Health and Human Services to establish a national pharmaceutical and vaccine stockpile does not reflect intelligence assessments of the agents most likely to be used and the difficulties of protecting the population against all of them. Rabkin praises the anti-terrorist measures of smaller countries, which have fewer resources and cannot afford to set up programs which protect against unlikely threats. Instead, they usually strengthen their existing capability to respond to health or law enforcement emergencies (Rabkin 2000).

Israel is a small country which often experiences terrorist attacks and which is surrounded by enemy states, some of which probably possess biological weapons.



Despite this the Israeli intelligence services states that the risk of a biological weapons attack is 'slim'. The Israeli government has taken some steps such as distributing gas masks to much of the population and stockpiling antibiotics, but has not diverted disproportionate resources to biodefence research (Gilmore Report 1999: 37; Fishman 1998).

Australia is another country with a relatively small population and limited resources, and one which is less likely to face a biological attack than Israel. The Australian government has, accordingly, only made modest preparations for a biological weapons attack. The government of New South Wales did introduced several new measures in time for the Sydney Olympics, including putting more resources into intelligence-gathering and appointing new staff to monitor presentations in hospital emergency departments.

All governments, law enforcement and intelligence personnel, and emergency services should be aware of the risk of biological attack and of appropriate responses, but the small risk does not justify the establishment of expensive new agencies or the appointment of new, specialised staff. The bomb squad is still more likely to be needed than a specialised biological response squad. And, as discussed below, it is medical personnel who are likely to be the first responders in the case of a biological attack. The staff of accident and emergency departments, medical wards and intensive care units, need to be aware of the risk of biological attack and the range of symptoms which may result. Well-funded and fully staffed public hospitals, combined with preventive health measures such as surveillance of infectious diseases and collection of epidemiological information, amount to a good biological defence system. Biodefence measures which strengthen the ways in which our health system treats and prevents infectious diseases generally are to be preferred to biodefence measures which divert money from where it is really needed.

### ***Biodefence research***

Biodefence research began back in the days of the offensive American biological weapons program. In 1951 the Centre for Disease Control established the Epidemic Intelligence Service to train epidemiologists in case of a biological weapons attack against the United States (Franz et al 1997: 409). In the 1950s the American military also studied meteorological conditions to determine how vulnerable US cities were to aerosol attack.

Current defensive research focuses on a number of areas, including vaccine development, treatment of disease, and rapid detection of biological attacks. The research on biological detectors is at an early stage. The most sophisticated detector currently available is the Biological Integrated Detection System (BIDS). This is a mobile laboratory which can be placed on a battlefield. It takes air samples, determines whether they contain particles of a size which can be inhaled, and exposes these samples to antibodies which react with particular agents. It is only of use if the use of biological weapons is anticipated (so that the system can be placed in the relevant area and activated) and if the agent used is one of a small number of agents which react with those antibodies, and one which has not been genetically altered.

The Defense Advance Research Projects Agency (DARPA) has traditionally focused on engineering and electronics research, but now also provides large sums of money for new areas of biological research. It supports projects which most other funding agencies would dismiss as too speculative. This includes research on sensors to detect the presence of biological agents, new ways of diagnosing diseases quickly and ways to



enhance the body's immune system. Particular areas of investigation include a way to 'program' red blood cells to remove viruses from the bloodstream and drugs which prevent viruses from replicating or maturing in the body (Stephenson 1997; Marshall 1997).

The vast sums of money spent on biodefence research in the United States continue to fuel suspicion in other countries that the American military is secretly studying offensive weapons. The Soviet military justified its expenditure on its biological weapons program to its leaders by claiming that the United States had a technologically superior offensive program. Before that, Japan had justified its program by citing false reports of biological weapons research programs in western countries. Similarly, the American military today justifies the massive sums it spends on biodefence by repeating suspicions about the offensive programs of other countries (Sidel 1999). The fact that the American biodefence industry is controlled by the American military in turn increases the suspicions of other countries. The World Health Organization warned in 1970 that extensive biodefence programs or elaborate measures to defend one's own population against biological attack could increase the suspicions of other countries and promote a biological arms race (World Health Organization 1970: 19–20).

### ***Biological defence research in Australia***

The Australian 'National Biological Defence Research and Development Program', which has been conducted by the Defence Science and Technology Organisation since the mid-1990s, is rather modest compared with the American program. The major focus of the current work is to develop new ways to detect the presence of biological agents. The DSTO is producing antibodies to a number of agents and investigating ways to use them to rapidly detect those agents. There are also studies on the feasibility of using DNA analysis to detect biological agents. The DSTO is also investigating other methods of rapidly detecting aerosolised particles, including the use of mass spectrometry. The DSTO has also conducted tests of the naturally occurring 'background' of biological particles in the air at a number of sites around Australia, so that an artificially produced aerosol can be recognised. Finally, the DSTO has funded a small amount of research on treatments for intoxication with certain toxins, with a current focus on ricin.

### ***Distinguishing offensive and defensive research***

Some commentators insist that it is easy to distinguish offensive and defensive research and that the difference is one of intent (Huxsoll 1992: 181). But scientists working with good intentions now may not be able to prevent their results being used for another purpose later. Dr Huxsoll, a former commander of the United States Army Medical Research Institute of Infectious Diseases says that defensive research focuses on detection of agents, treatment of diseases, protection of the population and decontamination. Offensive research, he says, would also involve the production and storage of large quantities of agents, and research to improve their stability in aerosol and delivery systems. Others argue that it is not that simple and that the distinction between defensive and offensive biological weapons research is 'hopelessly blurred' (Sinsheimer 1990: 75). Defensive research, they say, could easily be turned into offensive weaponisation. For example, to produce vaccines it is necessary to grow the biological agents. To develop more effective vaccines it may be useful to develop more virulent agents. It is then only a small step to produce these agents in larger quantities. Strauss and King also argue that research into detection of agents and decontamination techniques, and training military personnel in how to protect themselves against



biological attacks, could be part of an offensive program as well as a defensive one (Strauss and King 1986: 69).

Offensive research would include a focus on drying, stabilising and dissemination. But some scientists engaged in defensive research have claimed that they should be prepared for any developments enemy scientists may come up with, so they should investigate how biological agents may be disseminated. The US Department of Defense has stated that testing agents in aerosol form is necessary to develop defences against an aerosol attack. This sort of 'defensive' research is rather ambiguous and provocative.

John Quigley argues that if the American biodefence program were genuinely only defensive it would be advantageous to conduct research which is multilateral, transparent and overseen by a civilian agency such as the World Health Organization (Quigley 1992: 139). The US Department of Defense has resisted all suggestions that biodefence research should be controlled by civilians.

### ***Mass vaccination and vaccination of military personnel***

Mass vaccination is not an effective way to protect a population against biological attack. There are so many agents which could be used, and so many alternative strains of these agents, that it would be easy for an attacker to choose an agent to which the population is not immune. Mass immunisation carries the risk of side effects and could also increase the level of fear of an attack in the general population (World Health Organization 1970: 102).

Some American commentators have recommended the stockpiling of smallpox vaccine. Others believe that this would only encourage the development of new strains of smallpox. It could also lead other countries to fear that the United States was developing a smallpox weapon (Sidel 1999). A World Health Organization publication from 1988 includes the warning:

With the cessation of vaccination and vaccine production, it will become increasingly difficult for any person or group contemplating the release of variola virus to assure themselves and their colleagues of protection against smallpox. A country's resumption of vaccination against smallpox would now be interpreted as a sign that it might be considering the use of variola virus for aggressive purposes. (Fenner et al 1988: 1341)

Vaccinating military personnel but not civilians against certain diseases (as in the case of the United States military and anthrax vaccinations) puts civilians at risk and encourages other nations to specifically target civilians for biological attack. Victor Sidel argues that leaving civilians vulnerable in this manner 'comes dangerously close to a violation of the Geneva Conventions' (Sidel 1999). There are risks for military personnel, too. They may be more reckless if they believe themselves to be immune to biological weapons. In reality the effectiveness of the anthrax vaccine, for example, against inhalational anthrax and against high doses of anthrax is uncertain. There is also an issue of medical ethics if personnel are not allowed to refuse to be vaccinated (Sidel 1999).

### ***Military control of biodefence***

When asked why biodefence research in the United States should not be conducted by a civilian agency, Dr Huxsoll, a former commander of the United States Army Medical Research Institute of Infectious Diseases, replied:



**The problem of biological threats is really a military problem, and the military needs to maintain control over the biological defense research program just as it does with other defense research programs that are designed to neutralize threats to the United States.**

(Huxsoll 1992: 187)

One could just as easily say, though, that the problem of biological threats is really a problem for the health system and that health authorities need to maintain control over biological defence measures.

Discussions of the merits of military or civilian oversight of biodefence research are not new. In 1941 Henry Stimson, the US Secretary of War, decided to establish a civilian agency to review the US biological research program to ensure that the public would think the program was legitimate. He said:

**Entrusting the matter to a civilian agency would help in preventing the public from being exercised over any ideas that the War Department might be contemplating the use of this weapon offensively.**

(Quoted in Halvorson 1992: 192)

Safety controls may not be as stringent or as open to scrutiny in research controlled by the military. The US Senate Subcommittee on Oversight of Government Management in 1988 heard submissions on the safety of the US biodefence research program. It heard reports of biological agents going missing, laboratory fires going unreported and numerous minor laboratory accidents. It found that there were no Department of Defense safety inspections, and no single person or body in charge of safety. In February 1991 the US Occupational Health and Safety Administration found that the army's inspection program did not meet federal inspection requirements (Cole 1997: 45–46).

The safety of civilians is not always carefully guarded, either. The Dugway Proving Ground in Utah is still used for testing simulants outdoors and virulent agents indoors (eg when testing detectors). In 1991 a group of Utah residents who were concerned about their own health filed a suit in a federal court to prevent further biological tests. The suit failed because the risk of injury was considered too speculative (Cole 1997: 71). The US Army refuses to admit, let alone investigate, the possibility of harm to the health of civilians or of long-term environmental harm due to its biodefence testing.

There are a number of reasons why it would be preferable for biodefence research to be in civilian hands. It would decrease international suspicion that biodefence research is a disguise for offensive weapons research, and reassure both the public in that country and the leaders of other countries that the Biological Weapons Convention was being respected. It would ensure that occupational health and safety standards are enforced, that environmental impact statements are complied with and that laboratory accidents are adequately investigated. It would also allow scientific research to be carried out in an atmosphere in which research results can be freely published, mistakes can be admitted and authority can be questioned. Military structures can discourage such questioning and inhibit peer review. Restrictions on the research which scientists do and on their ability to share their results 'are inimical to the free and unobstructed accumulation of knowledge and should be avoided' (Halvorson 1992: 193–194).

Military researchers argue that they do much research which is not funded by civilian agencies and which has applications in the fight against infectious diseases generally. For



example, the United States Department of Defense has developed vaccines against Venezuelan equine encephalitis, Chikungunya, Junin and Ebola. Military research on botulinum toxin has led to the mainstream medical use of the toxin as a muscle relaxant, for example in the treatment of facial twitches. But research which is directed at the control of naturally occurring diseases is more likely to achieve this end than research which primarily has a military focus. If the military research budget were smaller there would be more funds available for civilian medical research which could prioritise work on illnesses which affect large numbers of the population, not work on hypothetical threats or obscure exotic diseases.

In the United States the Department of Defence budget has grown over the past two decades, while funding for civilian biological research has decreased. Zilinskas and Wilson express concerns that the Department of Defence will increasingly be able to control the priorities for biological research, and these may differ from civilian priorities (Zilinskas and Wilson 1992: xiii). Strauss and King also argue that this shift in funding may add to the suspicions of other governments, or at least give them propaganda material, and may fuel a biological arms race (Strauss and King 1986: 72).

### ***Proposals for international civilian biodefence***

The following measures are all non-military schemes which have been implemented or proposed to strengthen international defence against biological weapons. They could be written into the verification mechanisms of the Biological Weapons Convention (discussed in the next chapter) or could stand alone.

#### **Scorpio**

In preparation for the Gulf War, a rapid-response task force named Scorpio was set up with its base in Switzerland. Scorpio is designed to be able to arrive at the scene of a biological attack within 24 hours, to identify the agent used and the extent of the risk and to determine whether it is safe to send in aid to the area. The task force includes physicians, veterinarians, specialists in communications and logistics, experts in nuclear and chemical defence, and specialists in particular diseases, and its members include volunteers from many Swiss hospitals. Jack Woodall, who came up with the idea for Scorpio, has proposed that regional task forces should be set up containing experts with a mix of nationalities. This would be more acceptable to many countries than an entirely Swiss team. Woodall argues that increased preparedness for a biological attack would not only minimise the number of casualties, it would also make biological attacks less attractive to potential aggressors (Woodall 2000).

#### **Global epidemiological surveillance**

Raymond Zilinskas has proposed a Biological Hazards Early Warning Program. An international agency would be established to investigate unusual outbreaks of diseases to determine whether they have occurred naturally, through accidental release of biological agents or through the deliberate use of a biological weapon. Most of these outbreaks would, presumably, have natural causes, and the program would be of most benefit in those countries which do not have the resources to effectively monitor epidemics. The program would be funded by governments who are committed to biological arms control and would employ medical staff, pathologists and epidemiologists. Zilinskas states that such a program would increase transparency, reduce suspicions about the existence of offensive programs and help to increase confidence in the Biological Weapons Convention (Zilinskas 1992). Such a program



would have to overcome the initial reluctance of many countries to admit international inspection teams. The Program to Monitor Emerging Diseases, initiated by the Federation of American Scientists and run by the International Society of Infectious Disease, has similar aims. It currently includes an email listserv which disseminates up-to-date information on outbreaks of emerging and infectious diseases around the world to the list members.

### **Grant assistance to former Soviet scientists**

Scientists in the former Soviet Union who were previously employed in the biological weapons program and are now either unemployed or underpaid are widely considered to constitute the greatest threat of biological weapons proliferation. They have been sought out by Iran, Iraq, North Korea and Syria and offered up to US\$50 000 a year for their expertise. This amount would obviously be very tempting to a scientist struggling to work with very poor pay and conditions. Those who are reluctant to leave their homes may still be enticed to share their weapons expertise by fax or email. Given this threat, a number of programs have been set up to fund former Soviet scientists to undertake useful civilian research in their own countries.

The Civilian Research and Development Foundation is an American organisation which pairs former Soviet scientists with American scientists to promote collaborative, peaceful research. It channels grant money to the former Soviet scientists (Lawler 1996; Smithson 2000). Initiatives for Proliferation Prevention Program is jointly sponsored by the United States and Russian governments and also pairs scientists from the two countries. Other institutions which offer grants to scientists from the former Soviet Union are the International Science and Technology Center, the Science and Technology Centre in the Ukraine and the European Union scientific grant program.

A substantial amount of money has already been granted to former Soviet scientists through these programs, though not enough to support all of the 10 000 scientists formerly employed in the offensive program and their families. Concerns have been raised that there is no guarantee that the scientists who receive funding will not undertake offensive weapons research, or indeed that the grants will not be used for this purpose. Most of the funding bodies closely monitor how the grants are used, though, and this continues to be an important strategy to prevent biological weapons proliferation (Smithson 2000).

### **Civilian vaccine research**

The American Public Health Association and the Council for Responsible Genetics, among others, have called for civilian control of vaccine research. The idea is that all vaccine research should be performed by civilians, should be entirely transparent and that vaccines should be made available wherever they are needed. Supporters of this plan argue that interest in producing biological weapons would decline if vaccines were widely available, and also that such transparency would increase confidence that countries were complying with the Biological Weapons Convention. Opponents of the proposal argue that making vaccines available to anyone makes the agents available to potential aggressors (Cole 1997: 210–211).

### ***Preventive medicine is the best biodefence***

The best way to protect against biological attack is to strengthen the civilian health system, and in particular measures directed at disease prevention. It is health authorities, not military agencies, which are well-placed to detect unusual outbreaks of



disease, to diagnose these diseases, to instigate appropriate treatment and to gather epidemiological data. Setting up a single, centralised office to respond to bioterrorism is less cost-effective than ensuring that those people who already respond to medical emergencies are aware of the risks. A bottom-up preparedness would be the appropriate response for the most likely biological weapons attacks. As Victor Sidel put it, 'there is no technical solution to the problem of biological weapons. It needs an ethical, human and moral solution if it's going to happen at all. There is no other solution.' (Sidel 1999)

Instead of channelling money into new biodefence measures, that money could be spent on improving hospital services, preventive medicine (including vaccination against diseases which are current problems not ones which are only theoretical threats) and treating existing illnesses. It could also be used to fight infectious diseases around the world. This would need to include the relief of poverty, and especially programs which improve nutrition, housing and education (Sidel 1999).

The American Public Health Association released a policy statement in 1999 called 'Public Health Assessment of US Bioterrorism Initiatives'. It called for a transparent investigation of biodefence research, including whether the defensive program could promote offensive capabilities, the 'implications of the militarization of public health', and the examination of non-military methods of protecting populations against infectious diseases, whether naturally occurring or deliberately induced. It demanded that planning for health emergencies should be under the direction of health authorities, not the military, and opposed the diversion of resources from the health budget to 'excessive military budgets'. The accompanying 'public health impact statement' read:

A thoughtful, science- and public health-based assessment of current plans of the U.S. government to protect against terrorism, including bioterrorism, would help to avoid a reckless and politically driven squandering of precious public resources that could be better targeted to promoting the total health, well-being, and survivability of the domestic and global population, while avoiding the potential significant negative health consequences of mass-inoculations of populations with unproven and inadequately studied technologies. Exploration of other alternatives, such as developing verifiable and accountable forms of global disarmament, would have an obvious positive impact on public health and human survival.

### ***What to do in the event of a biological attack***

If terrorists release a biological weapon they may publicly announce what they have done. In this case the State police would be in charge of the response. They would gather evidence to determine whether a biological agent had in fact been released and which one was used. The fire service and the bomb squad would be called in if necessary. In Australia, for example, the police would probably seek expert advice and assistance from health authorities, public health laboratories, the Defence Science and Technology Organisation and relevant members of the Commonwealth Advisory Panel of Experts.

If the police and emergency services knew about a biological attack as it was happening they would have to consider whether immediate decontamination of the people who may have been exposed would be useful. Decontamination of the skin and clothes of those present is not as important for biological weapons as it is for chemical weapons, which are more commonly active on the skin. Most biological agents are infectious in aerosol form and not so dangerous when they settle on the skin or clothes (unless there are already wounds or abrasions in the skin). But many commentators and health authorities



recommend that those who have been exposed shower and wash their clothes immediately. This sort of decontamination procedure could be reassuring for people who fear that they have been exposed if it is done sensitively. Forcing people to remove their clothes in public, on the other hand, would only add to their distress and does not seem justified. If an agent is released in a building, decontamination of the building will enable people to confidently return to work there, even if it is not strictly necessary to prevent further infection.

Antibiotics could be distributed to those who were present at the scene of the release if they are effective against the agent in question. If plague or smallpox were released then it would be necessary to quarantine the people who may have been exposed, as these organisms are transmissible from person to person. Steps should be taken to make sure these people are placed in comfortable surroundings and have regular contact with their friends and family by phone or email.

If advance warning of a biological attack is given, then gas masks will protect against infection. Distributing large numbers of appropriate types of masks quickly would be a difficult task. This scenario seems unlikely, though. On the other hand, a threat to use a biological weapon might be made by an individual or group who do not in fact possess this capability. This is then entirely a police matter.

The most likely scenario is one in which a biological weapon is used but not recognised until several days later when people begin to present to their general practitioners or to hospital casualty departments. Many of the diseases which are likely to be used are difficult to diagnose at first and can easily be mistaken for a naturally occurring influenza epidemic. The possibility of a biological attack should be considered if the distribution of the disease (geographically or over time) is unusual. Naturally occurring epidemics feature a gradual rise in the incidence of disease. A rapidly rising and falling epidemic curve would suggest a biological attack (or else it could suggest an accidental outbreak of food poisoning). A biological warfare attack should also be suspected if:

- A disease appears which does not occur naturally in that area, or there are unusual combinations of diseases in the same patients.
- There are unusually large numbers of casualties.
- The epidemiological data suggests the outbreak originated at a single source.
- The disease has an unusual apparent route of transmission.
- Morbidity and mortality rates are high.
- The casualties occur within a limited geographical area.
- There are low infection rates among people who work within closed ventilation systems.
- Animals in the area are also succumbing to the disease.
- The disease is normally vector-borne, but the natural vector is not found in the area. (Eitzen 1997: 449)

The usual tests which are run in pathology laboratories may not reveal the presence of agents which are not usually seen in that area. Australian pathologists are not using to



seeing Venezuelan equine encephalitis, for example, and would not routinely test for anthrax. The pathology results would therefore merely state that the test was negative. If a general practitioner or member of hospital staff suspects that an unusual pathogen is present then the pathology staff should be notified. If none of the medical personnel involved make the effort to pursue a difficult diagnosis then the unusual disease outbreak may not be identified, but if both the hospital staff and pathologists are suspicious then they can arrange for further tests to be done. The sample can be sent to a reference laboratory which is known to have expertise with the type of pathogen suspected. In Australia there is an informal Public Health Laboratory Network which includes reference centres for viruses which are not routinely found here. It would be important for clinical and pathology staff to communicate any suspicions, even if the initial results are negative, so that unusual infectious diseases could be identified, whether they were naturally occurring or resulted from a biological weapons attack.

If a patient presents to a medical practitioner with a infectious disease with unusual characteristics that practitioner should remain suspicious and seek advice from an infectious disease specialist rather than dismissing it as a slightly unusual case of influenza. If an unusual infectious disease which might have been caused by a biological attack is diagnosed then the Communicable Disease Control authorities should be consulted. Most countries maintain a list of diseases which must be notified to the Communicable Disease Control center, usually it does not include diseases which would not naturally occur in that nation (eg. in Australia, inhalational anthrax and smallpox). Practitioners should be willing to ring for advice on suspicious or highly unusual diseases which are not listed. Infectious disease consultants at hospitals and pathology staff already communicate fairly regularly with staff of the Communicable Diseases Centers. Both community-based practitioners and hospital staff are likely to be less suspicious of a small-scale outbreak of an infection which might be naturally occurring, such as salmonella. The example of the Rajneeshee cult demonstrates that it is worth reporting even these cases if there is anything at all suspicious about them.

Once it has been confirmed that there has been a biological attack, epidemiological data would be gathered by specialists from the Health Department or Communicable Diseases Center in that State or Nation (with assistance from the relevant hospital staff) to try to identify the source of the attack. This would enable other people who are at risk to be identified so that treatment can be administered if appropriate. The police would also collect and use this data in trying to identify the perpetrators of the attack.

It would be important for health authorities to use the media promptly and carefully to reassure the public. As described in Chapter 1, knowledge of a biological attack would produce a panicked response in many members of the community which could cause more damage than the effects of the agent itself. It would be important to convey to as much of the community as possible information such as whether the agent is contagious, what treatment is appropriate and the fact that there is no significant risk of infection after the initial release of the agent. Diagnosing the agent as quickly as possible would enable accurate information to be given quickly. Media messages should reassure people that it is still safe to eat the food in the shops, to drink the water and to remain living in their homes. Telephone hotlines and public meetings would also allow people to clarify their concerns. This could prevent resentment on the part of people who are not at any risk but who do understand why they are not receiving medical treatment.

Individual medical practitioners, laboratory staff and hospital staff should ensure that they are informed about which agents are likely to be used in a biological attack, and



what the effects of this would be. They will then be suspicious about unusual outbreaks of disease, which will enable an attack to be recognised promptly. They will be more prepared to diagnose diseases which they have never seen before, such as inhalational anthrax, and more confident about discussing their suspicions with the staff of their local public health unit. They will also be able to reassure members of the public if an attack occurs, or is suspected or threatened.

### ***The 1972 smallpox epidemic in Yugoslavia: the importance of prompt recognition of unusual disease outbreaks***

If an infectious disease is released into a country in which the population has little or no natural immunity, it could spread widely if the first cases are not promptly diagnosed. The dangers of failing to diagnose an unexpected infectious disease are illustrated by the example of the reintroduction of smallpox into Yugoslavia in 1972. (For a full account of this epidemic see Fenner et al 1988: 1091–1095.)

In 1972 there had been no cases of smallpox in Yugoslavia for more than 45 years. Then a man from the village of Danjane in Kosovo travelled to Mecca and Medina on a pilgrimage. He stopped in Iraq on the way home, and this is probably where he became infected with smallpox. He returned to his village on 15 February and began to experience fatigue and fever the next day. Despite this, he entertained many friends and relatives over the next few days. He did not admit to having a rash at any stage of his illness. It has been pointed out that he may have been reluctant to give a full account of his symptoms for fear of bringing disrepute to the Islamic faith or pilgrimages, or for fear of reprisals for bringing about a number of deaths in his village (Fenner et al 1988: 1093).

There were eleven first generation cases among the man's relatives and social contacts. None of these cases was suspected of being smallpox. It was not until 14 March that smallpox was diagnosed in a second generation case. 100 people in Kosovo who were friends or relatives of the first generation cases, or who were fellow hospital patients of those cases, contracted smallpox. In all, there were 124 cases in Kosovo, and 26 of these were fatal.

A teacher from Belgrade came in contact with the index case in mid February before returning to his home. He developed a fever on 3 March and a rash on 5 March. He spent time in several medical centres in and near Belgrade with severe haemorrhagic complications before his death on 10 March. Smallpox was not diagnosed in his case. 38 of his fellow hospital patients and nurses contracted the disease from him and 8 of these people died as a result.

Once the diagnosis of smallpox was confirmed in mid-March, drastic measures were taken to stop the spread of the epidemic. The population of Kosovo was vaccinated over the following six weeks, and soon the federal government of Yugoslavia decided to vaccinate the rest of the population. 18 million people were vaccinated in all. Known patients were isolated and their contacts quarantined. Whole villages were placed under surveillance and the inhabitants had their temperature taken regularly. Travel in and out of affected areas was restricted. There were only a few third generation cases among those whose vaccinations were not successful.

Yugoslavia was declared free of smallpox on 9 May 1972. In all there were 175 cases in the epidemic and 35 deaths. Prompt diagnosis of the original case could have restricted the epidemic to his immediate contacts. Almost half of the cases in this epidemic were



through hospital transmission, and most of these would have been avoided if the patients had been diagnosed and isolated sooner. This case study demonstrates the lengths to which health authorities must go if a contagious epidemic is not recognised by general practitioners or hospital staff and not brought under control at the start.



## Chapter 6: Legal control of biological weapons

The use of disease as a weapon has been considered repugnant for thousands of years and was prohibited in ancient legal codes. It was not until the nineteenth century that bacteria and viruses were known to cause infection. The word 'poison' was therefore used to cover a range of substances known to cause distressing physical symptoms, including those we now call biological agents. (The Latin word for poison is in fact 'virus'.)

In ancient Greek and Rome the use of poison in war was believed to be a violation of the law of nations. It was also prohibited in India's Manu Law of 500 BC. The Dutch statesman and international lawyer Hugo Grotius described the prohibition on poisoned and other inhumane weapons in his influential work *The law of war and peace* in 1625. English jurist Robert Ward, writing in the early nineteenth century, stated that 'nothing is more expressly forbidden than the use of poisoned arms' (Cole 1996: 34).

The widespread prohibition against the use of poison in war did not entirely prevent the use of biological weapons, as the examples at the beginning of Chapter 3 demonstrate. But the ban reinforced the idea that poisoned weapons were not an acceptable part of war, and it may have deterred their use in many cases. In the eighteenth and nineteenth century the growth of nationalism and national legal systems, and an emphasis on military necessity over humanitarian considerations, weakened the old prohibitions on inhumane weapons (Cole 1996: 34). It was not until the twentieth century, when many soldiers witnessed the horror of chemical weapons first hand, and when many nations had begun to develop biological weapons, that the prohibition on the use of poisons and diseases as weapons was revived.

### ***Geneva Protocol***

The widespread use of chemical weapons in the First World War prompted many countries to act to prevent their use in the future. On 17 June 1925 they met in Geneva to sign the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare. The Geneva Protocol banned the use of 'bacteriological' weapons (as well as chemical weapons), but not their development or production. Some countries who signed the protocol reserved the right to use biological weapons in retaliation if they were subject to a biological attack.

The Geneva Protocol received widespread support, but was highly controversial within the United States. It was debated at length within the US Congress. President Truman withdrew it from consideration by the Senate in 1947, believing that it had been undermined by developments since the 1920s (Poupard and Miller 1992: 13–14). It was finally ratified in 1975.

### ***Biological Weapons Convention***

By 1970 the United States had destroyed its stocks of biological weapons, the United Kingdom and Germany had long since renounced their offensive programs and the United Nations General Assembly had called for the elimination of all weapons 'adaptable to mass destruction'. Negotiations were underway for a ban on chemical and biological weapons. The chemical weapons ban proved to be too difficult to agree upon at that time. Many countries saw biological weapons, though, as unpredictable and of little strategic use. Some were worried that future developments might enable the creation of



a new generation of biological weapons which had greater military utility. They were eager to prevent that from happening (Goldblat 1997).

On 10 April 1972, 79 countries signed the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. The preamble to the convention affirmed that the parties were 'determined to continue negotiations' to ban chemical weapons as well, but the convention only relates to 'microbial or other biological agents, or toxins'. It was seen as a milestone in arms control measures because it was the first convention to prohibit an entire class of weapons.

The preamble states that the parties are '[d]etermined for the sake of all mankind to exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons' and '[c]onvinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize this risk'. Article I prohibits the parties to 'develop, produce, stockpile or otherwise acquire or retain' biological agents or toxins 'of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes'. It also prohibits 'weapons, equipment of means or delivery designed to use such agents or toxins for hostile purposes or in armed conflict'.

Article II imposes an obligation to destroy existing stocks of agents and delivery systems. Article III bans trade in biological weapons and assistance to countries wishing to acquire them. If a party believes that another party is breaching the convention it can lodge a complaint with the UN Security Council under Article VI, and the Security Council may launch an investigation.

The convention also requires parties to implement a ban on biological weapons in domestic legislation. Australia enacted the Crimes (Biological Weapons) Act in 1976. This Act enacted Article I of the convention virtually word-for-word. Other countries were rather slower to enact their own prohibitions. The Russian Criminal Code was amended to prohibit the production, acquisition, sale or use of biological weapons in 1996.

The Biological Weapons Convention entered into force on 26 March 1975 when 22 countries had ratified it. It has now been signed by 158 countries and ratified by 140 governments.

### ***Strengthening the convention***

The Biological Weapons Convention does not provide any penalties for countries who breach their obligations. It also does not allow for any measures to verify that parties are complying. The provision for lodging complaints with the Security Council has not deterred breaches of the convention. This provision depends on the complaining party being able to gather convincing evidence of a breach, on the Security Council's willingness to initiate an investigation, and on the Permanent Members agreeing not to use their vetoes.

Calls for measures to strengthen the convention have grown in recent years as it has become clear that the Soviet Union and Iraq were secretly developing biological weapons for years despite being parties to the convention. A further impetus has been the signing of the Chemical Weapons Convention on 13 January 1993. Despite much controversy and difficult negotiations, several verification mechanisms were agreed upon, including the establishment of the Organization for the Prohibition of Chemical Weapons to police



the treaty, obligations on parties to make declarations about their production of certain chemicals, and provisions for both routine inspections of chemical facilities and 'challenge inspections' if a party alleges that a breach has occurred (Haines 1993: 46–47).

In 1984 the Australian government initiated the 'Australia Group', an informal forum of governments who were committed to restricting the sale and export of certain biological agents and of technology and equipment which could be used for offensive military purposes. The Australia Group is made up of industrialised countries, and its policies have been unpopular with many developing countries who want more access to the technologies available in the richer countries.

The parties to the Biological Weapons Convention have met every five years to review the convention. The 1986 and 1991 Review Conferences established a series of 'confidence-building measures'. The parties agreed to exchange information on their past offensive or defensive biological research programs, their current biological research facilities and vaccine production facilities, relevant domestic legislation and outbreaks of infectious diseases. These confidence-building measures have no legal force and have been ignored by most parties in practice. Only 11 parties have made annual declarations as required. Almost half of the parties have never made a declaration (Pearson 1997b).

The Third Review Conference in 1991 also set up an Ad Hoc Group of Governmental Experts (known as VEREX) to propose potential verification measures. Its 1993 report suggested 21 verification measures, ranging from surveillance of publications, to gathering information by satellite, to exchange visits, to compulsory inspections of facilities and sampling of biological agents found there. A new Ad Hoc Group was established at a Special Conference in 1994 to negotiate a legally binding protocol to strengthen the convention. A 'rolling text' is currently under negotiation and the Ad Hoc Group aims to have a final text ready for consideration at the 2001 Review Conference.

The protocol will only bind those parties that choose to ratify it. It will probably require parties to submit annual declarations to a supervising organisation concerning their biodefence programs, and facilities conducting biodefence work, producing vaccines, performing research on certain agents or containing maximum biological containment facilities. They may be required to declare any international transfers of certain biological agents and any outbreaks of disease not endemic to their region. More detailed export controls may also be negotiated.

Imposing some controls on the sale and export of biological agents seems sensible. For example, anyone can get hold of anthrax if they are really determined, but it would still be reasonable to restrict sales of anthrax to recognised biomedical research facilities and university departments. Zsolt Harsanyi uses the analogy of a determined burglar, who will get into your home regardless of the security devices you install, and the unsophisticated burglar who will be deterred by an alarm. Biological weapons risks today, he argues, are from 'unsophisticated burglars', that is, terrorist groups and 'renegade nations' (Harsanyi 1992: 229).

The organisation created by the protocol will probably have the power to inspect biological research facilities to verify the declarations or in response to suspicions that the convention has been breached. It will also be able to investigate suspicious outbreaks of disease to discover whether they have been caused by an accident at a weapons manufacturing facility or by the deliberate release of biological agents.



The proposed verification protocol has been strongly supported by Australia and the European Union, but has been more controversial elsewhere. Developing countries are concerned about increased restrictions on the transfer of new technologies in a climate in which the 'technology gap' between rich and poor countries is already rapidly increasing. Some poorer countries have called for biotechnology transfer agreements in return for their support for the protocol. Countries and corporations engaged in lucrative biological research are concerned about the loss of confidential information if site inspections are allowed, and especially if samples of biological agents can be taken off-site for testing. Some corporations also fear that an inspection could cause a stigma or loss of reputation to the company, could be a costly use of staff time, and could lead to false positive conclusions due to inadequate testing standards or the presence of naturally occurring biological agents in the region (Monath and Gordon 1998). Another issue is that the verification regime could cost US\$100 million a year, according to one estimate, and there are concerns about where this money will come from (Butler 1997).

The political will to sign a protocol is growing. There have been proposals to write in guarantees that challenge inspections will not be used for political ends, that the biotechnology industry will not be overly burdened and that commercial intellectual property will be protected. These sorts of compromises may still make the signing of a binding protocol in 2001 a possibility.

Verification mechanisms will not provide an absolute guarantee that no party to the convention will ever develop biological weapons. But it will provide a greater deterrence than currently exists. It will also encourage a culture of openness about biodefence programs and vaccine development. The experience of the UNSCOM inspections in Iraq demonstrates that a country can obstruct investigations and hide evidence of prohibited activities for a time. Repeated inspections and interviews will build up a body of evidence which will indicate whether breaches are continuing, though. And the verification measures will also dispel the unfounded suspicions which have prompted the development of weapons in the past. A verification protocol which has widespread support, in addition to other measures to encourage openness such as exchange of scientific information and cooperation on preventive medicine and other health measures, will help to create a climate in which no country feels it must begin a biological arms race.



## Chapter 7: Scientific research and ethics

There is now widespread agreement within scientific societies and among most western life scientists that the production of biological weapons is unethical. Jonathon King from the Committee for Responsible Genetics writes:

**That the science whose origin was the prevention of disease and the alleviation of human suffering should be transformed into a new technology of human destruction is a tragedy of historic importance.**

(Quoted in MacLean 1992: 101)

Some physicists, chemists and engineers conduct research which enables new weapons and new ways of conducting warfare to be developed, often claiming that their research is somehow 'pure' and separate from its later military applications. Many physicians, microbiologists, immunologists and geneticists have shown more concern about the purpose and uses of the research they do. This may be because the life sciences already have ideals or purposes such as preventing disease and healing the sick and injured. This distinction between applied life sciences research and 'pure' physics may be a 'cultural artifact' (MacLean 1992: 109), but it is one which has had a powerful effect on life scientists, at least in western countries. There is now an increasing tendency, though, for biomedical research to be performed for commercial gain and to be conducted by employees of large corporations which make substantial profits from it. This could weaken the connection between the life sciences and their original purposes and ideals (MacLean 1992).

Why is it that developing biological weapons is seen as unethical? Robert Sprinkle asks whether it would be humane to develop a weapon which gives an opposing army dysentery for a day but does not cause any deaths. Would this be preferable to the use of conventional firearms and explosives which cause death and permanent injury? Sprinkle concludes that 'life scientists should not make weapons' (Sprinkle 1992: 89). Other scientists disagree with his conclusion, arguing that war is just under some circumstances, that being able to defend one's country is important, and that scientists need to work to help achieve these goals. Even these scientists may argue that it is unethical to produce certain weapons systems which are indiscriminate in their effects and difficult to control (eg Kemp 1994). Biological weapons would clearly be such a system.

One of the ethical principles leading some scientists to shun research on weapons is the 'bias for life'. This principle holds that the efforts of scientists should be directed toward sustaining life, and never toward destroying it. A related principle is the prohibition on conducting research which could harm some people on the grounds that it will benefit others. Medical ethical codes prohibit deliberate harm to individuals and do not make room for utilitarian calculations (Lappé 1990: 82). Francis Bacon, philosopher of science as well as Lord High Chancellor of England, argued that science should only be used for the good of humanity, and, he added, this meant all of humanity, not just the people of one nation. John Locke argued that a scientist should be objective, tolerant, universalist and should respect the rights and wishes of each individual (Sprinkle 1992: 91–92). At the Nuremberg Trials in 1947 German scientists were told that it was not acceptable to sacrifice the welfare of the individual to the interests of the nation or the rulers of the time; the rights and interests of individuals must always be respected (Sprinkle 1992: 93). 'For physicians and scientists alike, the duty of beneficence proscribes providing, no



matter how unintentionally, a maleficent power with the capacity to produce harm' (Lappé 1990: 86).

Another principle of scientific ethics is universality, an allegiance which is broader than the interests of the nation or government. Robert Sinsheimer, Professor of Biology at University of California, Santa Barbara writes: 'National boundaries are meaningless to the quest for knowledge. To pit the scientists of one country against those of another is inherently a violation of the scientific ethos' (Sinsheimer 1990: 73). The American Society for Microbiology Code of Ethics states that microbiologists must discourage 'any use of microbiology contrary to the welfare of humankind'.

The principle of universality also leads to the principle that professional ethics should be followed even if they conflict with the interests of the government or the profits of the corporation.

Ethical scientists should also take a long-term perspective when considering the consequences of their research:

We may presume that scientists promoting or pursuing biological warfare research justify their activity either as morally neutral or as a route to national security. In either case, their justification is short-sighted; it does not confront the perilous consequences of the militarization of advanced fields of science and technology and the arms acceleration that inevitably follows. (Sinsheimer 1990: 75)

A number of scientific societies have taken an interest in the conduct of research which promotes the development of biological weapons. In 1942 the National Academy of Sciences formed a Biological Warfare Committee. The committee included leading microbiologists, and its aim was to publicise the dangers of biological weapons and to call for research into vaccines (Halvorson 1992: 191). Soon after this, the American Society for Microbiology formed a War Committee on Bacteriology, and later the Committee on Information Concerning Civil Defense Against Biological Warfare. The latter committee provided advice to those in charge of the American biological weapons program on topics such as peer review and recruitment of scientists. In 1968 the committee recommended its own dissolution because of its lack of influence with the program's commanders. In 1970 the ASM passed a resolution supporting Nixon's decision to end offensive research. Despite some controversy within these societies about the relationship they should have with military agencies and about whether they should support biodefence measures, the unease their members felt about these weapons was widespread.

A conference of the International Association of Microbiological Societies in Mexico in the late 1960s unanimously passed a detailed resolution condemning the production and use of biological weapons. This unanimous vote, and in particular the support of the Soviet microbiologists who were present, was a major boost to the campaign to persuade governments to sign a Biological Weapons Convention (Hedén 1992: 8).

When the United States army was conducting an openly offensive biological weapons program in the 1950s it had difficulty recruiting scientists. It began a public relations campaign in an attempt to convince scientists of the worth of its program. Recruiting people with medical training proved to be even more difficult, as most physicians felt that the program was contrary to medical ethics (Cole 1997: 217–218).



Not all scientists have felt so uneasy about biological weapons research. In Japan in the 1930s dissenters among the staff of the weapons research program were a small minority. Most of the staff believed that they were pursuing new scientific knowledge and also conducting useful work for their country, namely building a strong military capability, and that these were both worthwhile goals. Some of the Japanese scientists would have shared the nationalist and racist sentiments which were common in their country in the 1930s and which were fostered by their political and military leaders. They believed that they were experimenting on members of an inferior race for the benefit of the superior Japanese race and the Japanese nation (Harris 1992: 36–39).

### ***Biodefence research***

There is now agreement among many scientists that the production of biological weapons is unethical, but there is less agreement about biological defence research. Biodefence is considered by some scientists to be highly ethical and by others to be ‘a “gray” ethical area’ (Zilinskas and Wilson 1992: xvi). The main problem is that some of the knowledge which is developed in defensive research could be quickly put to use for offensive purposes.

Scientists usually do not have the opportunity to decide how the results of their research are used. For example, when the American government decided to use atomic bombs in the Second World War no-one stopped to consult the scientists who had worked on their development (Zilinskas and Wilson 1992: xiv). Raymond Zilinskas and Tazewell Wilson, from the Center for Public Issues in Biotechnology, have asked whether life scientists have a moral obligation to become involved in policy debates involving the potential uses of their research results. They suggest, for example, that life scientists should lobby governments to meet their obligations under the Biological Weapons Convention and to support the confidence-building and verification measures (Zilinskas and Wilson 1992).

Marc Lappé argues that research into immunisation, vaccine development and protective equipment ‘are justified when conducted openly as part of a public health effort, but are legally and ethically unacceptable when they enhance the capacity to wage biological warfare, no matter how remote the research from field conditions of use’ (Lappé 1990: 97). He also argues that scientists have a duty to assess the likelihood that the knowledge they create will be misused.

By 1993 more than 2000 biomedical researchers had signed a pledge initiated by the Council for Responsible Genetics, promising to refuse to participate in biological weapons research, including ostensibly defensive military research. The signatories included 29 Nobel Laureates (Gould and Connell 1997: 108). There have also been a number of petitions opposing the use of biological research for military purposes. These pledges and petitions have been the subject of some heated debates within scientific societies, with the membership divided between those who have or haven’t signed.

Another objection to biodefence research is that it has often been controlled by the military which may place restrictions on the exchange or publication of data. Many scientists argue that openness in research is an essential part of scientific work, and that it has the added advantage of ensuring credibility and minimising international suspicions (Zilinskas and Wilson 1992: xiii–xiv). The Code of Ethics of the American Society for Microbiology Code of Ethics states: ‘Microbiologists are expected to communicate knowledge obtained in their research through discussions with their peers and through publications in the scientific literature.’ The society’s resolution in 1970 supporting the end of the American offensive program was accompanied by this



resolution: 'The Council of the American Society for Microbiology affirms that the health of the science is enhanced by non-secret research and free movement of scientists.'

Another controversy in scientific societies relates to whistle-blowing. If a scientist suspects that questionable research is being conducted is it ethical for that scientist to keep quiet in order to remain employed? Or is their a duty to report questionable activities? To whom? Should scientific organisations make an effort to protect whistle-blowers? (Zilinskas and Wilson 1992).

Biodefence research involves work with dangerous organisms. Even the most stringent safety procedures cannot totally eliminate the risk of the accidental release of these pathogens. The research therefore poses some risk to the health of members of the community who live near research establishments, even if there is no deliberate outdoor testing. Another controversial issue, therefore, is whether scientists should avoid conducting research to which there is substantial community opposition.

Individual scientists will come to their own conclusions on the more controversial issues. Scientific societies can still play an important role on questions on which most of their members can agree. They can support measures to strengthen the Biological Weapons Convention, for example. And, even if their members cannot agree about the ethics of some defensive research, they can promote awareness and debate about the issues. For example, they can provide an independent perspective on how much money we can afford to spend on biodefence and on who should make the decisions.



## Appendix 1: Biological weapons convention

### ***Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction.***

*Signed at London, Moscow and Washington on 10 April 1972.*

*Entered into force on 26 March 1975*

*Depositaries: U.K., U.S. and Soviet governments.*

The States Parties to this Convention,

- Determined to act with a view to achieving effective progress towards general and complete disarmament, including the prohibition and elimination of all types of weapons of mass destruction, and convinced that the prohibition of the development, production and stockpiling of chemical and bacteriological (biological) weapons and their elimination, through effective measures, will facilitate the achievement of general and complete disarmament under strict and effective international control,
- Recognizing the important significance of the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925, and conscious also of the contribution which the said Protocol has already made, and continues to make, to mitigating the horrors of war,
- Reaffirming their adherence to the principles and objectives of that Protocol and calling upon all States to comply strictly with them,
- Recalling that the General Assembly of the United Nations has repeatedly condemned all actions contrary to the principles and objectives of the Geneva Protocol of June 17, 1925,
- Desiring to contribute to the strengthening of confidence between peoples and the general improvement of the international atmosphere,
- Desiring also to contribute to the realization of the purposes and principles of the United Nations,
- Convinced of the importance and urgency of eliminating from the arsenals of States, through effective measures, such dangerous weapons of mass destruction as those using chemical or bacteriological (biological) agents,
- Recognizing that an agreement on the prohibition of bacteriological (biological) and toxin weapons represents a first possible step towards the achievement of agreement on effective measures also for the prohibition of the development, production and stockpiling of chemical weapons, and determined to continue negotiations to that end,
- Determined for the sake of all mankind, to exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons,



- Convinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize this risk,

Have agreed as follows:

### ***Article I***

Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:

- 1) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes;
- 2) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

### ***Article II***

Each State Party to this Convention undertakes to destroy, or to divert to peaceful purposes, as soon as possible but not later than nine months after entry into force of the Convention, all agents, toxins, weapons, equipment and means of delivery specified in article I of the Convention, which are in its possession or under its jurisdiction or control. In implementing the provisions of this article all necessary safety precautions shall be observed to protect populations and the environment.

### ***Article III***

Each State Party to this Convention undertakes not to transfer to any recipient whatsoever, directly or indirectly, and not in any way to assist, encourage, or induce any State, group of States or international organizations to manufacture or otherwise acquire any of the agents, toxins, weapons, equipment or means of delivery specified in article I of this Convention.

### ***Article IV***

Each State Party to this Convention shall, in accordance with its constitutional processes, take any necessary measures to prohibit and prevent the development, production, stockpiling, acquisition, or retention of the agents, toxins, weapons, equipment and means of delivery specified in article I of the Convention, within the territory of such State, under its jurisdiction or under its control anywhere.

### ***Article V***

The States Parties to this Convention undertake to consult one another and to cooperate in solving any problems which may arise in relation to the objective of, or in the application of the provisions of, the Convention. Consultation and Cooperation pursuant to this article may also be undertaken through appropriate international procedures within the framework of the United Nations and in accordance with its Charter.

### ***Article VI***

- 1) Any State Party to this convention which finds that any other State Party is acting in breach of obligations deriving from the provisions of the Convention may lodge a complaint with the Security Council of the United Nations. Such a complaint should



include all possible evidence confirming its validity, as well as a request for its consideration by the Security Council.

- 2) Each State Party to this Convention undertakes to cooperate in carrying out any investigation which the Security Council may initiate, in accordance with the provisions of the Charter of the United Nations, on the basis of the complaint received by the Council. The Security Council shall inform the States Parties to the Convention of the results of the investigation.

### ***Article VII***

Each State Party to this Convention undertakes to provide or support assistance, in accordance with the United Nations Charter, to any Party to the Convention which so requests, if the Security Council decides that such Party has been exposed to danger as a result of violation of the Convention.

### ***Article VIII***

Nothing in this Convention shall be interpreted as in any way limiting or detracting from the obligations assumed by any State under the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925.

### ***Article IX***

Each State Party to this Convention affirms the recognized objective of effective prohibition of chemical weapons and, to this end, undertakes to continue negotiations in good faith with a view to reaching early agreement on effective measures for the prohibition of their development, production and stockpiling and for their destruction, and on appropriate measures concerning equipment and means of delivery specifically designed for the production or use of chemical agents for weapons purposes.

### ***Article X***

- 1) The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes. Parties to the Convention in a position to do so shall also cooperate in contributing individually or together with other States or international organizations to the further development and application of scientific discoveries in the field of bacteriology (biology) for prevention of disease, or for other peaceful purposes.
- 2) This Convention shall be implemented in a manner designed to avoid hampering the economic or technological development of States Parties to the Convention or international cooperation in the field of peaceful bacteriological (biological) activities, including the international exchange of bacteriological (biological) and toxins and equipment for the processing, use or production of bacteriological (biological) agents and toxins for peaceful purposes in accordance with the provisions of the Convention.

### ***Article XI***

Any State Party may propose amendments to this Convention. Amendments shall enter into force for each State Party accepting the amendments upon their acceptance by a



majority of the States Parties to the Convention and thereafter for each remaining State Party on the date of acceptance by it.

### ***Article XII***

Five years after the entry into force of this Convention, or earlier if it is requested by a majority of Parties to the Convention by submitting a proposal to this effect to the Depositary Governments, a conference of States Parties to the Convention shall be held at Geneva, Switzerland, to review the operation of the Convention, with a view to assuring that the purposes of the preamble and the provisions of the Convention, including the provisions concerning negotiations on chemical weapons, are being realized. Such review shall take into account any new scientific and technological developments relevant to the Convention.

### ***Article XIII***

- 1) This Convention shall be of unlimited duration.
- 2) Each State Party to this Convention shall in exercising its national sovereignty have the right to withdraw from the Convention if it decides that extraordinary events, related to the subject matter of the Convention, have jeopardized the supreme interests of its country. It shall give notice of such withdrawal to all other States Parties to the Convention and to the United Nations Security Council three months in advance. Such notice shall include a statement of the extraordinary events it regards as having jeopardized its supreme interests.

### ***Article XIV***

- 1) This Convention shall be open to all States for signature. Any State which does not sign the Convention before its entry into force in accordance with paragraph (3) of this Article may accede to it at any time.
- 2) This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.
- 3) This Convention shall enter into force after the deposit of instruments of ratification by twenty-two Governments, including the Governments designated as Depositaries of the Convention.
- 4) For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.
- 5) The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or of accession and the date of entry into force of this Convention, and of the receipt of other notices.
- 6) This Convention shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.



### ***Article XV***

This Convention, the English, Russian, French, Spanish and Chinese texts of which are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of the Convention shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding states.



## Appendix 2: Human pathogens

### ***Viruses***

#### **Poxviridae family**

Variola virus (smallpox)

Monkeypox virus

#### **Orthomyxoviridae family**

Influenza virus

#### **Togaviridae family (Alphavirus genus)**

Venezuelan equine encephalitis virus

Eastern equine encephalitis virus

Western equine encephalitis virus

Chikungunya virus

O'nyong-nyong virus

#### **Flaviviridae family (Flavivirus genus)**

Dengue fever virus

Tick-borne encephalitis virus (Russian spring-summer encephalitis virus)

Japanese B encephalitis virus

St Louis encephalitis

Omsk haemorrhagic fever virus

West Nile fever virus

Yellow fever virus

#### **Bunyaviridae family (various genus)**

Crimean-Congo haemorrhagic fever virus

Rift Valley fever virus

Sin Nombre virus

#### **Filoviridae family**

Ebola virus

Marburg virus

#### **Arenaviridae**

Lassa virus (Lassa fever)



Junin virus (Argentinian haemorrhagic fever)

Machupo virus (Bolivian haemorrhagic fever)

Guanarito virus (Venezuelan haemorrhagic fever)

Sabio virus (Brazilian haemorrhagic fever)

Rotavirus

Echovirus 71

## ***Bacteria***

Bacillus anthracis (anthrax)

Brucella abortus

Brucella melitensis (Malta fever)

Brucella suis

Burkholderia mallei (glanders)

Burkholderia pseudomallei (melioidosis)

Coxiella burnetii (Q fever)

Francisella tularensis (tularemia)

Nocardia species

Yersinia pestis (plague)

Salmonella bacteria (typhoid fever, paratyphoid fever, salmonellosis)

Vibrio cholerae (cholera)

Shigella bacteria

## **Chlamydia**

Chlamydia psittaci

## **Rickettsiae**

Rickettsia prowazekii (typhus)

Rickettsia rickettsii (Rocky Mountain spotted fever)

## ***Fungi***

Blastomyces dermatitidis

Coccidioides immitis (San Joaquin Valley or desert fever)

Cryptococcus neoformans

Histoplasma capsulatum



## ***Animal pathogens***

African swine fever virus

Influenza virus (virulent avian influenza/fowl plague)

Hog cholera virus/Classic swine fever virus

Foot-and-mouth disease virus

Newcastle disease virus

Peste des petits ruminants virus

Rinderpest virus

Teschen disease virus (Porcine enterovirus type 1)

Vesicular stomatitis virus

African horse sickness virus

Bluetongue virus

Cowdria ruminantium (heartwater)

Mycoplasma mycoides (contagious bovine pleuropneumonia)

Aspergillus species

## ***Plant pathogens***

Sugar cane Fiji disease virus

Sugarbeet curly top virus

Tobacco mosaic virus

Colletotrichum coffeanum var. virulans

Dothistroma pini (Scirrhia pini)

Erwinia amylovora

Ralstonia solanacearum

Puccinia graminis (stem rust)

Tilletia indica

Xanthomonas albilineans

Xanthomonas campestris pv citri

Sclerotinia sclerotiorum

Peronospora hyoscyami de bary f.sp. tabacina (Adam) skalicky

Claviceps purpurea



Piricularia oryzae (rice blast)

Phytophthora infestans (potato blight)

## ***Toxins***

### **Derived from bacteria**

Botulinum toxin (botulism)

Clostridium perfringens toxins (gas gangrene)

Staphylococcal enterotoxins

Shiga toxin

Tetanus toxin

Diphtheria toxin

### **Derived from marine organisms**

Anatoxin (from cyanobacteria)

Microcystin (from cyanobacteria)

Ciguatoxin/maitotoxin/palytoxin

Saxitoxin (from shellfish)

Tetrodotoxin (puffer fish poison)

### **Derived from fungi**

Trichothecene mycotoxins

### **Derived from plants**

Abrin

Ricin (from castor beans)

### **Derived from terrestrial animals**

Bungaratoxins (from blue krait)

Batrachotoxin (from the arrow-poison frog)

Textilotoxin (from snakes)

Taipoxin (from snakes)

a-Tityustoxin (from scorpions)



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