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Preface

The BioWeapons Prevention Project presents in this volume the first edition of the BioWeapons Report. This book is a major milestone in the development of the young international non-governmental organization (NGO). Launched on 11 November 2002 as a civil society response to the loss of direction and purpose of multilateral efforts to strengthen the 1972 Biological and Toxin Weapons Convention following the collapse of the negotiation of a legally binding protocol in 2001, the founding NGOs—who had been monitoring the so-called 'Geneva process' for many years—decided on two pillars supporting BWPP action: an annual publication and a global network of civil society organizations. On the one hand, the yearbook and other publications were to serve the goal of raising issue awareness and building capacity among civil society constituencies so that they can participate as full partners in the local, national and global efforts to strengthen the norm against the weaponization of disease. On the other hand, representatives from the BWPP Network member organizations were to be major contributors to the BWPP output.

The first edition of the BioWeapons Report perfectly illustrates the synergy. The chapters will not only inform governments and the diplomatic community of the serious concerns regarding the growing possibility of the misuse of biology and biotechnology for hostile purposes, they will also assist the BWPP outreach activities in a growing number of countries across the world. At the same they will make complex issues accessible to a broad non-specialized, yet interested audience ranging from journalists to academics and students. The authors are either directly involved with the BWPP activities or support its goals. In particular, I would like to thank Malcolm Dando, Neil Davison, Daniel Feakes, Chandré Gould, Iris Hunger, Piers Millett, Kathryn Nixdorff, Julian Perry Robinson, Jonathan Tucker, Mark Wheelis, Simon Whitby and Angela Woodward for their contribution to this first edition of the BioWeapons Report. Their wide range of expertise and personal insights are at the heart of the unique contribution the BWPP can make to your work. The Harvard Sussex Program kindly extracted the extensive chronology in this volume covering the two years between July 2002 and July 2004 from its CBW Events Database. The bulk of the editorial work was carried out by Richard Jones of Exile: Design and Editorial Services (UK). My gratitude also goes out to Liliane Zossou for coordinating the administration of the book production.

In its first two years, the Bioweapons Prevention Project benefited from grants offered by the Governments of Canada, The Netherlands, Norway, Sweden, and the United Kingdom, as well as from the Joseph Rowntree Charitable Trust (UK), the Ploughshares Fund (USA), and the WMD Commission (Sweden).

The first edition of the BioWeapons Report was developed and produced with the financial support from the Government of Finland.

Dr Jean Pascal Zanders
Director

Civil society and the norm against the weaponization of disease: Meeting the challenge

On any given day over two billion people worldwide are estimated to be seriously ill. One-quarter of all deaths and about 50 per cent of all deaths in developing countries are caused by naturally occurring infectious diseases. The World Health Organization (WHO) estimated in 1999 that each year more than 13 million people die from infectious diseases alone.[1]

Biological warfare is the intentional use of disease-causing micro-organisms, or other entities, that can replicate themselves—such as viruses, infectious nucleic acids and prions—against humans, animals or plants for hostile purposes. Biological warfare may also involve the use of toxins, which are poisonous substances produced by living organisms, including micro-organisms (e.g., botulinum toxin), plants (e.g., ricin derived from castor beans) and animals (e.g., snake venom). Synthetically manufactured toxins which are used for hostile purposes are also biological weapons (BW). Biological weapons could cause casualties of the order of magnitude of a nuclear weapon.

The 1972 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (Biological and Toxin Weapons Convention, BTWC) is the most important international tool against the use and development of biological weapons (BW). However, since its entry into force in 1975 there have been confirmed cases in which states have breached the Convention and several unconfirmed allegations of state biological warfare programmes. This has resulted in increased calls to equip the convention with instruments to verify and enforce compliance. To date efforts to strengthen the BTWC by means of a supplementary legally-binding protocol have failed. Nevertheless, as developed in the chapter 'Investigations of alleged non-compliance with the BTWC', there remain several options in the present treaty regime for states parties to address those concerns.

The BTWC regulates the behaviour of states. In the current international security environment many states have come to believe that non-state actors (such as criminal or terrorist groups) pose the greatest threat in terms of biological weapons use, and therefore, argue that the BTWC cannot adequately address their security concerns. However, national implementation of the treaty, which includes adopting legislation to criminalize the use and development of biological weapons, may go some way towards addressing this threat.

The ability of the BTWC to address the security concerns of states is additionally challenged by the rapid developments in the fields of biotechnology and genetic engineering. As explored in the chapter entitled 'Advances in science and technology: Present and future threats', biotechnology and genetic engineering offer many promises to improve the quality of life, but much of this knowledge could easily be converted for hostile

[1] World Health Organization, *Removing Obstacles to Healthy Development*, WHO document WHO/CDS/99.1 (WHO: Geneva, 1999), http://www.who.int/infectious-disease-report/pages/ch1text.html#TopAnchor.

purposes in order to improve the stability and virulence of existing warfare agents, or even to create new agents based only on some components of an organism. While States Parties reaffirm the prohibition in the light of the technological developments during the periodic review conferences of the convention, a consequence of the failure of the 5th Review Conference in 2001 and 2002 meant that the norm has not been updated since the 4th Review Conference in 1996. Failure of the 6th Review Conference in 2006 to address this issue would undermine the relevance of the BTWC. The challenge of the rapid pace of scientific and technological progress is discussed in the chapter on 'Science and technology considerations at the Seventh BTWC Review Conference in 2011'.

The first edition of the BioWeapons Report identifies the major threats to the norm against biological weapons, and through presenting an overview of the threat, calls to action civil society organisations, government representatives, scientists and individuals to work in their spheres to strengthen this norm.

The nature of the BW threat

There are three primary areas of concern with regard to the threat of biological weapons development and use: (i) state biological weapons programmes, (ii) the apparently growing interest of non-state entities in non-conventional weapons, including biological agents, and (iii) the future threat posed by unconstrained developments in science and technology which may enable states, organizations or even individuals to develop stable and controllable agents to cause indiscriminate harm.

State Programmes

After World War II the Soviet Union and the United States (and to a lesser extent the United Kingdom) continued their research into and development and production of biological weapons. The USA formally halted its programme in 1969 and proceeded to destroy existing BW stockpiles. This unilateral gesture helped to pave the way for negotiation of the BTWC. The Soviet Union, however, did not reciprocate and even accelerated its BW armament despite the fact that it was one of the three co-depositories of the BTWC (the other two being the UK and the USA). The Soviet programme survived the 1991 break-up of the Soviet Union essentially intact, and, despite assurances by the Russian leadership, there remain considerable doubts as to whether Russia has terminated all of the activities prohibited under the BTWC. After having confronted Russia with detailed evidence of its prohibited BW programmes the United States, the United Kingdom and Russia agreed in September 1992 to reciprocal visits to certain facilities.[2] These trilateral verification and transparency exercises soon faltered and the lack of access to key facilities increased international suspicion of Russian non-compliance. Meanwhile Russia closed key facilities to foreign researchers, and in August and

[2] Joint Statement on Biological Weapons by the Governments of the United Kingdom, the United States and the Russian Federation, 10–11 September 1992, document available from http://projects.sipri.org/cbw/docs/cbw-trilateralagree.html.

September 2002 a US Congressional delegation was refused access to one of the former Soviet BW facilities, despite the fact that the United States provided Russia with millions of dollars to increase security and retrain Soviet scientists who had been involved in the programme.[3]

Russia is not the only country to have violated the BTWC, however, it is difficult to draw firm conclusions about which countries have chemical or biological warfare programmes because of the secrecy which inevitably shrouds such programmes. Since the terrorist attacks on 11 September 2001 in the United States a few countries have become the focus of concern in relation to the proliferation of biological weapons, these are countries which are believed by Western nations to support terrorism, and which are generally hostile to Western interests. Attempts to isolate these countries from the rest of the international community include the use of terms such as 'rogue state' or 'axis of evil'. However, there remains a great deal of uncertainty about whether these states have offensive BW programmes, and the criteria by which to judge this remain unstated.

Threats posed by non-state actors

During October 2001 letters containing anthrax spores were delivered to members of the US Congress and individual citizens which resulted in the death of five people and infected another 17. The fine quality of the spores suggested that a military laboratory—most likely located inside the USA—was used in their preparation, but the perpetrator or perpetrators remain unknown.

These incidents demonstrated that people who were not normally considered as being at risk from a biological terrorist attack (postal workers, secretaries and members of the public) became the first victims. The extensive and costly clean-up operations were hampered by the lack of consensus about what constitutes a safe environment following decontamination. Military standards to ensure the continuation of operations on the battlefield cannot be applied in a civilian setting.[4]

The mail-delivered anthrax spores also demonstrated the potential of such attacks to cause widespread social and economic disruption. Before the anthrax mailings security analysts were preoccupied by the threat of BW terrorist attacks which had the potential to cause large numbers of casualties. While the likelihood of large-scale biological warfare attacks occurring remains low, due to the technological challenges involved in the development, manufacture and dissemination of biological agents, and the demands these challenges place on the organizational structure of non-state groups, it is now clear that acts of biological terrorism could be directed at creating economic and social disruption.

Attacks on the agricultural sector through the use of plant or animal diseases as a weapon[5] also come easily within reach of single-issue groups, criminals and less-structured organizations. Biological agents arguably offer the prospect of large-scale economic

[3] Warrick, J., 'Russia denies US access on bioweapons', *Washington Post*, 8 September 2002, p. 25

[4] For a detailed overview of the attacks with mail-delivered anthrax spores, see Zanders, J. P., Hart, J. and Kuhlau, F.., 'Chemical and biological weapon developments and arms control', *SIPRI Yearbook 2002: Armament, Disarmament and International Security* (Oxford University Press: Oxford, 2002), pp. 696–703.

[5] See the chapters on 'Anti-animal threats' and 'Anti-plant threats' in the present volume.

disruption as they can be used to infect livestock or destroy crops. The time needed for an animal or plant disease to develop such an attack would invariably stretch over a prolonged period of time and the demand for containment, remediation and compensation would involve authorities at both national and local levels of governance. The economic damage in such a situation would not be limited to the destruction of produce, but would also affect other enterprises that depend on agricultural products and would seriously affect international trade. Countries, regions or communities that depend on monocultures for their livelihood are particularly at risk.

Governments face a multitude of biological terrorism threats, but the most catastrophic scenarios involving mass casualties, though possible, are the least likely to occur. (Catastrophic scenarios involving non-conventional weapons, which feature in many policy debates, are often made plausible by insistence on the existence of a threat posed by state-sponsored terrorism.) Nevertheless, because of the potential consequences for the targeted society of a terrorist attack with BW, governments must be prepared for such an attack. The issue of key importance is thus to devise and execute balanced policies. Overreaction can lead to nationwide anxiety and paranoia. In such an atmosphere, hoaxes may become as efficient in terms of causing disruption as actual attacks with BW.

Scientific and technological developments

Biological warfare is closely related to knowledge of disease. The opportunities for the weaponization of disease began with scientific breakthroughs in the early 1970s. In 1973 the first gene was cloned; three years later the first company to exploit technology based on recombinant DNA was founded in the USA. The revolution has continued along two main lines: genomics and proteomics. Together, they represent powerful experimental and modelling techniques that enable the modification of living organisms and their products in precise and predictable ways. They also enable small molecules to be designed to interact in specific ways with proteins in order to predictably alter their functioning.[6]

Biotechnology has the potential to improve biological warfare capabilities through product and process improvements. Product improvements may involve the genetic modification of pathogens or the creation of novel agents, as well as the development of new equipment for analysis and production. Process improvements relate to the way in which the agents are manufactured. Optimization of production processes, for instance, can lead larger production batches in shorter time frames or to the use of smaller, less conspicuous equipment (such as fermentors), which would make it easier to hide a BW programme in legitimate activities and installations.

Research and Development in the field of biotechnology leads to many ‘enabling technologies’, which lay the foundation for future product and process improvements. Of particular importance today are the automation of sequencing in genome projects; bioinformatics, which contributes greatly to the storage and analysis of research data; and the advances in combinational chemistry and high throughput screening of compounds.

[6] Wheelis, M. and Dando, M., ‘New technology and future developments in biological warfare’, *Disarmament Forum*, no. 4 (2000), p. 44.

Many of these products and processes are being researched and developed for civilian application in medicine, pharmaceuticals, and agriculture, as well as for purposes that are legitimate under the BTWC, such as defence, detection, protection and prophylaxis. However, their investigation also generates considerable knowledge about the potential offensive use of certain substances to interfere with the biological processes in humans, animals and plants. In certain cases, the offensive properties of known or potential biological warfare agents are being actively investigated in order to develop adequate defensive technologies and procedures. Such activities raise the question whether they are permissible under the BTWC. The question may be difficult to answer, because it ultimately depends on the intentions of the state conducting such research and development programmes. Transparency is one of the keys to protecting against the hostile use of new technologies, greater secrecy will make the international community less inclined to accept the benign purpose of these programmes.

The Biological and Toxin Weapons Convention

The BTWC is at the heart of the norm against biological weapons. It was opened for signature on 10 April 1972 and entered into force on 26 March 1975. As of December 2004, 153 states have ratified or acceded to the BTWC and another 16 have signed, but not ratified the convention. The BTWC encompasses a comprehensive prohibition of preparation for biological warfare. According to Article I, states parties cannot acquire or retain BW under any circumstances which serves to implicitly ban the use of biological and toxin weapons. This prohibition was reaffirmed by the Fourth Review Conference of States Parties, held in 1996. For analysis of other treaty obligations, particularly those which must be implemented through national legislation, see the chapter on ‘National implementation legislation for the BTWC’.

By current standards the BTWC is a weak treaty because it lacks effective mechanisms for monitoring and verifying whether or not states parties are complying with their treaty obligations. In particular, the review process has reaffirmed the applicability of the core prohibition of Article I to the rapid developments and discoveries in the field of biotechnology. The review conferences have also attempted to increase the transparency of activities relevant to the convention on a voluntary basis. During the Second Review Conference in 1986 the states parties agreed on annual data exchanges to serve as confidence-building measures (CBMs). However, participation in these confidence and transparency-building measures has been limited and, in most cases, is not systematic. In addition, the parties are only required to provide their declarations in one of the six UN languages and no organization has been designated to administrate, translate, distribute or analyse the submissions. As the chapter on ‘The contribution of CBMs to transparency’ argues, while some states have acted in the interests of transparency by making their CBM declarations publicly available on the internet, most have not. Doing so would be an important step towards engendering public confidence in the BTWC.

Most importantly, the question of verification and compliance enforcement has still not been resolved. Efforts since 1991 to redress this imbalance, culminating in the draft

protocol negotiated by an Ad Hoc Group of states parties to the BTWC,[7] was rejected by the United States in 2001 based on its assessment that the draft protocol would negatively affect its national interests. The 5th Review Conference, which was held between 19 November–7 December 2001, was hastily adjourned until November 2002 following a last minute effort by the United States to terminate the negotiation mandate of the Ad Hoc Group.[8] In 2002, the 5th Review Conference did not finalize its review of the operation of the BTWC, but instead adopted a compromise proposal calling for a 6th Review Conference to be held no later than in 2006 and a series of annual meetings between 2003–2005, which would be preceded by expert group meetings. The meeting only have a limited mandate to discuss five sets of topics and they cannot reach legally-binding agreements.[9] At present the efforts to strengthen the BTWC through a supplementary legally-binding document are stalled.

NGO responses

At times failure is as significant a catalyst for action, as success. When the Protocol negotiations failed in 2001, it served as a strong signal to the community of non-governmental organizations (NGOs) that action needed to be taken to prevent this event and its aftermath from weakening the international norm against biological weapons. During the five years of negotiation (1996–2001) the effectiveness of the proposed protocol had been consistently compromised in an attempt to reach consensus. By 2001 the text was indeed significantly weaker than some states parties and the NGOs monitoring the negotiations would have wished. The fact that they had accepted several key compromises in order to meet US concerns, made the US justification for their pulling out of the negotiation that the proposed agreement would weaken its national interests hard to bear.

The failure was a wake-up call for civil society. It had become painfully clear that there were too few NGOs undertaking research and monitoring activities on biological weapons-related issues to significantly influence the process. Furthermore, the then existing BW NGO community was mostly based in the United States and Europe (particularly in the United Kingdom). In addition, the homogeneity of NGO community meant that the views of civil society were not reflected at an international level. In most parts of the world, the BTWC negotiations had attracted little or no attention. If NGOs were to prevent the failure from casting a shadow over the future of the BTWC it was essential that civil society organisations around the world become aware of the issues and actively press their national governments and the negotiators at an international level to strengthen the treaty. It was believed that civil society had to organize itself better to actively contribute to a positive outcome of future negotiations and to monitor activities

[7] For a summary of the history of the negotiations and the contents of the last version of the draft protocol before the negotiations collapsed, see Zanders, J. P., Hart, J. and Kuhlau, F., 'Biotechnology and the Future of the Biological and Toxin Weapons Convention', *SIPRI Fact Sheet* (Stockholm International Peace Research Institute: Stockholm, November 2001), http://projects.sipri.org/cbw/research/ cbw-papersfactsheets.html.

[8] Zanders, J. P., Hart, J. and Kuhlau, F.., 'Chemical and biological weapon developments and arms control', *op. cit.*, pp. 673–77.

[9] UN Department of Disarmament Affairs, Draft Decision of the Fifth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) Weapons and on Their Destruction, document BWC/CONF.V/CRP.3, 6 November 2002.

inside countries and at international forums in order to ensure that the norm against the weaponization of disease was not undermined.

The success of the International Campaign to Ban Landmines and the international movement to monitor and control small arms use and proliferation were inspirational. The role that civil society had played in bringing about the Ottawa Convention and in informing the negotiations on small arms control provided useful insights for the BW NGO community. In March 2002 the Geneva Forum organized a meeting for civil society organisations and government representatives titled: 'Civil Society monitoring: Comparing experiences, exploring relevance to Biological Weapons'. This meeting provided sufficient impetus for nine NGOs to initiate the process which resulted in the formation of the BioWeapons Prevention Project (BWPP), which was launched 8 months later.

Establishing a global network

The original founding organisations of the BWPP, with one exception, had little experience of working on BW issues outside of north America and Europe. It was, therefore, essential for the BWPP in its early phase, to develop an understanding of the specific issues of concern to organizations, individuals and governments in other parts of the world. In order to broaden and deepen its knowledge of how biological weapons issues are viewed in the developing world, and to establish a strong basis from which to draw conclusions about how a sustainable network may be grown, the BWPP initiated a pilot project in South Africa in 2003.

South Africa was chosen as the location for the initial programmatic development of the BWPP because (i) the South African public and NGO community had been exposed to the consequences of chemical and biological weapons development and use through publication of the details of the apartheid CBW programme[10] and there was consequently an existing interest in the issue and awareness about the need for effective international and national controls, and (ii) the NGO sector in South Africa is well established and has a long history of engagement with disarmament issues.

An important advantage was the involvement of a South African NGO in founding the BWPP. This meant that in developing its networking activities the BWPP could rely on the organizations' experience, knowledge of geography, political dynamics and the relationships between NGOs and government. In addition, the South African government had, since 1994, demonstrated its commitment at an international level to strengthening the BTWC. Had the BWPP initiated its activities in a country that was less well known to its member organisations and staff, the learning curve would have been much steeper and important lessons about the natural constituencies for BWPP activities may have been missed in an effort merely to identify people and organisations with which to work.

Since 2003 the BWPP has held four workshops in South Africa. Besides acquiring

[10] In 1998 the Truth and Reconciliation Commission held a public hearing on the apartheid chemical and biological warfare programme. The hearing was widely covered in the press as was the trial of the former head of the programme which followed a year later.

valuable experience and insights for future networking activities, six new organisations from southern and South Africa have joined the network and this number is likely to increase further in 2005. In 2004 the BWPP gained eight Network members, bringing the number to 32.

Lessons for BWPP from the pilot project

It is clear from the process followed in South Africa that a phased approach to network development can result in the establishment of a sustainable process. For the BWPP sustainablity depends on generating sufficient interest and awareness about the potential harm that can be caused by the misuse of biotechnology for hostile intent. For organizations and individuals at a national level to integrate BW research and advocacy into their programme of activities it is crucial that they identify their stakeholdership in the issue. This is now beginning to happen in South Africa. New network members, having been made aware of the key issues relating to BW control and disarmament, have identified this as an important area of work. Reaching that point required an initial investment of BWPP staff time and resources in a phased programme which evolved over a six month period.

The networking process as developed in South Africa can be broken down into the following phases:[11]

- Initial introductory meeting with NGOs, government agencies and departments and the press;
- Individual meetings with organisations and individuals in the above constituencies;
- Multi-constituency workshops to introduce the issues of concern and to explore national responses and views to the future threats; and
- Engagement with specific communities to develop an approach to dealing with the concerns raised during multi-constituency workshops.

During workshop discussions with NGOs in the early phase of the project it became clear that the BWPP needed to convey a very clear understanding of (i) what biological weapons are, and (ii) why it is important for civil society organisations in the developing world to be concerned about BW issues. Participants in these discussions were clear that two issues were far more important than arguing the need to strengthen the BTWC as a starting point for discussion. This had an impact on the structure of the subsequent workshops, resulting in greater involvement of the participants in discussions.

While the South African public and NGO community were aware of the harm caused by the past CBW programme, there was little awareness about the future threats posed by the possible misuse of new technologies to food and health security, the economy or human rights. Raising these matters during the workshops provided an opportunity for participants from government departments, NGOs and the scientific community to find issues of common concern and identify ways in which they could work together to minimize the risk.

[11] The seminar reports detailing the development of the networking strategy are available from http://www.bwpp.org/publications.html.

BWPP workshops in July and October 2004 (in Johannesburg and Cape Town respectively) brought together NGOs involved in security and disarmament, human rights and environmental issues; people from government departments and agencies; representatives of the scientific and health professional communities and industry representatives. The BWPP workshops were the first opportunity these constituencies had to jointly discuss an issue of common interest and concern. For many participants it provided an opportunity, not only to question what government departments were doing to minimize the risk of the use of biological weapons, but to discuss ways in which they could address the need to minimise the risk in their own communities, and how they could co-operate with government officials to reduce the threat. For government departments the converse was true. It was an opportunity to talk about the steps that government was taking, share issues of concern, including the constraints on the ability of the health infrastructure to cope with an infectious disease outbreak and the challenges faced by prosecuting authorities to undertake investigations into violations of national laws which prohibit the development, use or transfer of pathogens for harmful purposes. The value that can be gained from initiating and facilitating dialogue between these constituencies was an important lesson for the BWPP.

Before undertaking this pilot project the BWPP had identified the NGO community as its primary constituency. Yet, the enthusiasm with which representatives of the scientific and health professionals communities responded to the discussions during the workshops made it clear that the support base for the network is far broader. One of the most practical and positive outcomes of these meetings was the request for assistance by BWPP to develop educational materials and curricula to inform scientists and students about the risk of the misuse of science, the responsibilities of scientists and the international treaties, and national laws and regulations to which they should adhere. The BWPP is currently working with the Health Sciences Faculty of the University of the Witwatersrand to develop a curricula for science students which incorporates these aspects. Other universities represented at our workshop have expressed an interest in introducing such courses too. Through this the BWPP is able to reach a wide range of future scientists to convey the need to act responsibly and to be aware of the harm which can be done through unethical behaviour.

The challenge for the BWPP is to integrate the lessons from this pilot project into an approach which will ensure the sustainable development of issue-awareness and engagement in other countries. It is likely that through the process in South Africa network members will become involved in the process of engaging NGOs in other countries on the African continent. Since biological weapons-related issues are both technically complex and are not a priority concern in many countries the process of building the network will be slow and require extensive capacity building. Through sharing information and experiences between countries and through the development of accessible educational and informational materials, the BWPP believes that strengthening global involvement in preventing the misuse of science and technology will lead to the strengthening of the international norm against the weaponization of disease.

National implementation legislation for the BTWC

The 1972 Biological and Toxin Weapons Convention (BTWC)[12] is at the core of international legal efforts to address the problem of biological and toxin weapons (BW). This international law explicitly bans the development, production, stockpiling, acquisition and retention of biological and toxin weapons, which are defined in Article I using the 'general purpose criterion' (GPC). The prohibition also serves to implicitly outlaw the use of BW.

All states parties, however, need to ensure that these obligations are effectively transformed into a range of national measures, including legislation, to make certain that they are capable of being implemented and enforced—and therefore complied with—in their domestic legal jurisdiction. Specifically, states parties are required by Article IV to adopt any national measures necessary, in accordance with their constitutional processes, to prohibit and prevent the banned activities detailed in Article I. In practice, a wide range of treaty obligations, as well as undertakings that states parties have agreed to at various BTWC Review Conferences, will require implementation in national legislation and other measures.

Without appropriate criminal legislation that details offences and establishes penalties for action prohibited by the treaty—together termed 'penal sanctions'—a state is vulnerable to prohibited activity being carried out on its territory without being able to prosecute and punish transgressors effectively.

On the eve of the thirtieth anniversary of entry into force of the BTWC, in March 2005, it is timely to consider how states parties have addressed the issue of national implementation of their treaty obligations. This chapter details states parties' commitments to adopt national implementation measures and highlights the importance of national legislation, in addition to other national measures, in ensuring compliance with the convention. It describes efforts made since 1975 to monitor the enactment and effectiveness of appropriate legislation and assesses states' transparency over their national measures. The paper concludes by proposing ways to improve the availability of legislative assistance, in order to increase the rate of adoption of effective BTWC implementing measures and laws and thereby enhance states parties' compliance with Article I, as well as to make any such measures that are adopted more accessible.[13]

[12] Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. The treaty was opened for signature in London, Moscow and Washington, DC, on 10 April 1972 and entered into force on 26 March 1975.

[13] Future editions of the *BioWeapons Report* will assess the effectiveness and scope of national implementation legislation and other national measures adopted by states parties to implement and enforce the treaty.

The obligation to adopt national implementation measures

Under Article IV, states parties are mandated to take any national measures necessary to prohibit and prevent the activities that are banned under Article I from occurring on their territory. Proscribed activities include the development, production, stockpiling, acquisition or retention of biological and toxin weapons and related equipment. These are defined in Article I using the general purpose criterion, whereby dual-use agents, materiel and equipment are banned with respect to their intended purpose. This criterion was deliberately chosen to avoid a prescriptive description or an exhaustive list of such items to be outlawed becoming redundant as a result of future products of biotechnology or scientific research being used as weapons.[14] They comprise 'microbial or other biological agents, or toxins whatever their origin or method of production, of types or in quantities that have no justification for prophylactic, protective or other peaceful purposes'[15] and 'weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict'.[16] States also need to ensure that measures to enforce these prohibitions are extended to any other territory under their jurisdiction or control.

The treaty does not prescribe the type of measures that should be adopted, although Article IV provides that such measures must be adopted in accordance with the state's constitutional process, which usually dictate how international law obligations are incorporated into national law:

> '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.'[17]

Differences have emerged with regard to practice between states with a common law tradition and those with a civil law tradition. Common law states require national legislation to transform international obligations into enforceable national law. States parties with a common law tradition have generally determined that the Article IV obligation to put in place national measures to 'prohibit and prevent' violations of the treaty's core prohibitions requires the enactment of legislation and, specifically, penal legislation that details offences and establishes appropriate penalties for activities banned under Article I.

States with a civil law tradition, however, may consider treaties they have joined as 'self-executing', whereby the text of the accord is automatically incorporated into national law when the agreement enters into force—no additional national measures are necessary to

[14] World Health Organization (WHO), *Public health response to biological and chemical weapons: WHO Guidance*, Second Edition, (Geneva: WHO, 2004), p. 111.

[15] Article I (1) of the BTWC. For an authoritative interpretation of 'toxin' in the BTWC, see *Ibid*., pp. 214-216.

[16] Article I (2) of the BTWC.

[17] Article IV of the BTWC.

give it effect. The state's constitution will provide guidance on whether or not a treaty is self-executing, and hence whether further implementation measures are required.[18] The BTWC, though, does not specify criminal offences or define the nature of punishments, such as prison terms or monetary fines, as their determination is the sovereign right of states. Civil law states will not be able to effectively enforce all BTWC obligations in their respective national jurisdictions without specific implementing legislation. While violations of the prohibition against the use of biological and toxin weapons might be capable of prosecution under states' laws against manslaughter or murder, the related offences of development, production, stockpiling and transfer of such weapons might not be available in states' penal codes, leaving the state unable to prosecute and punish alleged offenders. In addition, there may not be sufficient legislative provision to enable those who assist, encourage or induce such offences to be prosecuted.[19] Legislation will also be necessary to establish appropriate import and export controls. Many civil law states parties have reached the conclusion that the BTWC obligations are not self-executing as evidenced by their adoption of specific implementing legislation for the treaty.

Obligations requiring national implementation through legislation

The requirement in Article IV to adopt national measures specifically relates to prohibiting and preventing the activities banned under Article I. However, other treaty articles contain obligations that will likely require national implementation through legislation, in addition to a range of national measures, such as administrative or executive orders, in order for states parties to be able to comply with them. These include Article III commitments not to transfer to any recipient whatsoever the items banned under Article I, or to assist, encourage or induce a state, or group of states, or international organisations to manufacture or otherwise acquire them. This prohibition on the 'transfer' of such items will necessitate the issuance of controlled goods list regulations under national export control legislation. National laws and regulations, as well as administrative and other measures for their enforcement, will also be necessary to ensure the appropriate physical protection of biological agents and toxins, as well as related materials and equipment, that might be diverted for purposes prohibited by Article I. States will also need to include provisions in their criminal legislation that establish offences for action by their citizens that involves assisting, encouraging or inducing activities banned under Article III.

Any state party that possesses items banned under Article I when it joins the treaty will also likely require legislation to comply with the Article II obligation to ensure the destruction or diversion to peaceful uses of such materials within nine months. In addition, the Article II requirement that states parties must ensure that 'all necessary safety precautions [are] observed to protect populations and the environment' in carrying

[18] For further detail of common law and civil law states' obligations to adopt national implementation legislation, see Woodward, A., 'National implementing laws for arms control and disarmament treaties', *Verification Yearbook 2003,* (VERTIC: London, 2003), pp.151-167.

[19] It has been identified that civil law states parties to the 1993 Chemical Weapons Convention require specific implementing legislation on these issues. See Tabassi, L. and Spence, S., 'New directions for improving national implementation of the CWC: the OPCW and its Action Plans', *Verification Yearbook 2004,* (VERTIC: London, forthcoming 2004).

out destruction or diversion tasks may also require implementing legislation.

States parties have also agreed to specific undertakings at BTWC Review Conferences that may require the adoption of national implementing legislation, or other types of national measures.[20] For instance, states may need to enact legislative provisions to facilitate the compilation and submission of information under the confidence-building measure (CBM) data exchanges agreed at the Second and Third Review Conferences in September 1986 and September 1991, respectively.[21] Legislation may be required, for example, to permit government departments and agencies to share data with each other in order to collate relevant information and to complete the agreed reporting forms, as well as to request pertinent information for inclusion and submission from appropriate individuals, organisations and companies in the private sector. Furthermore, states parties may enact legislation relating to the handling of information they have collected for their own CBM data exchange, to facilitate, for instance, the public release of their own CBM declaration—as some states parties have opted to do.[22]

During the Second Review Conference, states parties also noted the importance of 'legislative, administrative and other measures designed effectively to guarantee compliance' with treaty provisions, as well as of 'legislation regarding the physical protection of laboratories and facilities to prevent unauthorised access to and removal of pathogenic or toxic material'.[23] This politically-binding undertaking suggests types of measures necessary to ensure compliance with the treaty's core prohibitions relating to BW. Such measures are specifically outlined in UN Security Council Resolution 1540, adopted on 28 April 2004, with respect to all states—irrespective of their status vis-à-vis the major non-proliferation agreements on weapons of mass destruction (WMD)—and require that they develop and maintain appropriate controls for the physical protection of biological, chemical and nuclear weapons and their means of delivery.[24]

At BTWC Review Conferences, states parties have also considered the scope of national measures and legislation to be adopted, by 'inviting' states parties to consider extending the application of their national measures to 'actions taken anywhere by natural persons possessing its nationality'.[25] Such an extension establishes the state's jurisdiction for activities undertaken by its citizens abroad that constitute an offence under the state's BTWC national implementing legislation, specifically penal legislation.

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[20] For a comprehensive overview of BTWC states parties' consideration of these issues, see Pearson, G. S. and Sims, N. A., *Maximising the benefits of the inter-Review Conference process: I: National implementing legislation*, Briefing Paper No. 6 (Second Series), Department of Peace Studies, University of Bradford, July 2003.

[21] See chapter on 'The contribution of CBMs to transparency' in this volume.

[22] Such as Australia and the US. See chapter on 'The contribution of CBMs to transparency' in this volume.

[23] 'Final Declaration, Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 8–26 September 1986', BWC/CONF.II/13/II.

[24] United Nations Security Council Resolution 1540 (2004), operative paragraph 3(b).

[25] 'Final Declaration, Third Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 9–27 September 1991', BWC/CONF.III/23, Part II, and 'Final Declaration, Fourth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 25 November–6 December 1996', BWC/CONF.IV/9, Part II.

Consideration of national legislation to implement treaty obligations

States parties have collectively considered the importance of the national implementing measures required under Article IV at each BTWC Review Conference. The First Review Conference, in March 1980, requested states parties that had not yet 'taken any necessary measures in accordance with their constitutional processes to do so immediately'.[26] The Second Review Conference 'note[d] the importance' of legislation, as well other types of national measures, in 'guarantee[ing] compliance with the provisions of the Convention' and 'prevent[ing] unauthorised access to and removal of pathogenic or toxic material' through 'the physical protection of laboratories and facilities', when it met in September 1986.[27] These points were reaffirmed at the Third Review Conference[28] and the Fourth Review Conference,[29] held in September 1991 and November–December 1996 respectively. The section on Article IV in the Final Declaration of the Fourth Review Conference also reports that some states parties had adopted penal legislation, inferring that they felt it necessary to adopt legislative measures so as to comply with Article IV.

The annual treaty meetings running between 2003 and 2005 under the 'New Process'[30], which was agreed at the reconvened Fifth Review Conference in November 2002, have been specifically tasked with considering national implementation measures and, notably, the adoption of penal legislation. The first of the five topics scheduled for these meetings requires states parties to 'discuss, and promote common understanding and effective action' on 'the adoption of necessary national measures to implement the prohibitions set forth in the Convention, including the enactment of penal legislation'.[31] This was scheduled for consideration at the Meeting of Experts and the Meeting of States Parties on 18–29 August 2003 and 10–14 November 2003, respectively.

In addition, states parties considered requirements for comprehensive national legislation, as well as a range of other national measures, during their negotiations on a verification protocol for the treaty, under the Ad Hoc Group (AHG) that convened from 1997–2001.[32] Article X of the states parties' negotiated text, or 'Rolling Text',[33] and Article 17 of the

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[26] 'Final Declaration, First Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 3–21 March 1980', BWC/CONF.I/10.

[27] 'Final Declaration, Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 8–26 September 1986', BWC/CONF.II/13/II.

[28] BWC/CONF.III/23, Part II, *op. cit.*

[29] BWC/CONF.IV/9, Part II, *op. cit.*

[30] Annual meetings of experts and Meetings of States Parties are being held between 2003 and 2005 to consider five issues relating to treaty implementation: national implementation measures; national mechanisms for the security and oversight of pathogens and toxins; enhancing international capabilities to respond, investigate and mitigate the effects of alleged use of BW or suspicious disease outbreaks; strengthening disease surveillance, detection and diagnosis mechanisms; and codes of conduct for scientists.

[31] 'Final Document, Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 19 November–7 December 2001, 11–22 November 2002', BWC/CONF.V/17.

[32] The Ad Hoc Group was established in 1995 and switched to negotiation mode in 1997. See Findlay, T., 'Biological Weapons: minding the verification gap', VERTIC Brief, No. 4, February 2004, www.vertic.org.

[33] 'Annex I: Rolling Text of a Protocol to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 1 March 2001', BWC/AD HOC GROUP/55-1, and 'Appendices', BWC/AD HOC GROUP/55-2.

Chairman's 'Composite Text'[34] related to 'National Implementation Measures'.

Transparency of BTWC implementing legislation

States parties have agreed to provide the United Nations Department of Disarmament Affairs (UNDDA) with texts of their measures, which will include any implementing legislation they have adopted, for the purpose of consultation. The Final Declarations of the First and Second Review Conferences merely invited states parties that had adopted national measures to make texts available to the UNDDA.[35] At the Third Review Conference, states parties agreed to inform each other of the existence of implementing measures using Form E of the CBM data exchange. However, Form E does not specifically request substantive detail on measures adopted, as it only asks states to declare whether or not legislation, regulations or other measures have been adopted with regard to three issues:

- development, production, stockpiling, acquisition or retention of microbial or other biological agents, or toxins, weapons, equipment and means of delivery specified in Article I;
- exports of micro-organisms[36] and toxins; and
- imports of micro-organisms[37] and toxins.

States that provided working papers to the 2003 Meeting of Experts

Argentina (one), Australia (six), Austria (one), Bulgaria (one), Brazil (one), Canada (four), China (two), Cuba (two, in Spanish), Finland (one), France (three), Germany (nine), Iran (three), Japan (two), Malaysia (one), Mexico (one in Spanish), Netherlands (one), Poland (two), Russia (three), South Africa (one), South Korea (one), Sweden (one), Thailand (one), Ukraine (four), UK (nine), US (five)

States that supplied working papers to the 2003 Meeting of States Parties

Germany (three), Italy (one), Japan (two), Netherlands (two), Russia (two), Switzerland (one)

These working papers focussed on issues arising with respect to both topics scheduled for discussion in 2003: the adoption of necessary national measures to implement the prohibitions specified in the convention, including the enactment of penal legislation; and national mechanisms to establish and maintain the security of, and oversight over, pathogenic microorganisms and toxins.

(The number of working papers submitted is included in brackets. All were written in English, except where otherwise stated. The budgets for these meetings did not make provision for translation of the working papers into all official UN languages.)

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[34] 'Protocol to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 3 April 2001', BWC/AD HOC GROUP/CRP.8.

[35] The First Review Conference, in 1980, requested that states provide this information to the UN Centre for Disarmament, the predecessor of the UNDDA.

[36] 'Micro-organisms pathogenic to man, animals and plants in accordance with the Convention', CBM Form E, 'Declaration of legislation, regulations and other measures'.

[37] *Ibid.*

In any event, the data exchanges are not made public through the current CBM process, although some states have chosen to release their own.[38]

States and a regional organisation that provided information on national legislation and other measures to the 2003 Meeting of Experts and 2003 Meeting of States Parties

Albania (three), Algeria (one), Argentina (16), Armenia (7), Australia (six), Austria (five), Belarus (11), Belgium (five), Belize (four), Bolivia (one), Brazil (16), Brunei Darussalam (one), Bulgaria (17), Cambodia (three), Canada (five), Chile (two), China (seven), Colombia (11), Croatia (two), Cuba (three), Cyprus (three), Czech Republic (seven), Denmark (one), Dominica (two), Ecuador (six), Estonia (seven), European Union (15), Fiji (three), Finland (eight), Former Yugoslav Republic of Macedonia (six), France (16), Georgia (four), Germany (12), Guatemala (seven), Hungary (three), India (seven), Iran (four), Ireland (four), Italy (seven), Japan (seven), Jordan (one), Latvia (eight), Liechtenstein (six), Lithuania (20), Malaysia (eight), Mexico (two), Mongolia (two), Netherlands (eight), New Zealand (three), Norway (six), Peru (one), Poland (11), Portugal (three), Romania (five), Russia (34), Saint Kitts and Nevis (one), Senegal (one), South Africa (seven), South Korea (seven), Spain (four), Sweden (nine), Switzerland (four), Thailand (two), Turkey (four), Ukraine (21), UK (43), US (25), Uzbekistan (two), Vietnam (three)

Source: *The BWC Information Repository CD-ROM*, Version 3.0, UNDDA, Geneva, 2003.

To aid discussion of national implementing measures at the Meeting of Experts and Meeting of States Parties in 2003, many states parties distributed working papers describing the status and scope of their national legislation and other measures.

In addition, the UNDDA requested states to provide information on their national legislation and measures relating to both topics under consideration at the 2003 treaty meetings, to facilitate their discussions. Sixty-eight states and one regional organization provided such information.

The UNDDA published summaries of the legislation, regulations and other measures that it received, along with states parties' statements, presentations and other contributions made available to the chair,[39] states parties' working papers,[40] official meeting documents,[41] and unofficial documents circulated to aid discussion,[42] on a CD-ROM titled the 'BWC Information Repository'. This has only been made available to states parties. States parties have not tasked the UNDDA with publicly releasing information on legislation collected via this process, despite the fact that, by its very nature, legislation is public information.

The International Committee of the Red Cross (ICRC) also maintains a database of national laws and regulations to implement international humanitarian law and case law

[38] See chapter on 'The contribution of CBMs to transparency' in this volume.

[39] Also published separately as 'Report of the Meeting of Experts (Part II): Statements, presentations and contributions made available to the Chairman, 18 September 2003', BWC/MSP.2003/MX/4.

[40] Also available on the UNDDA website, http://disarmament2.un.org/wmd/bwc/index.html.

[41] *Ibid.*

[42] For example, questions were circulated on different legislative, regulatory and administrative issues relating to topic one.

States parties that provided statements, presentations and other contributions relating to topic one to the Meeting of Experts

Argentina, Australia, Brazil, Bulgaria, Canada, China, Czech Republic, Cuba, Finland, France, Germany, India, Iran, Italy, Japan, Jordan, New Zealand, Poland, Romania, Russia, Saudi Arabia, South Korea, Spain, Turkey, Ukraine, UK, US

Source: 'Report of the Meeting of Experts, (Part II), Annex II, Statements, Presentations and Contributions made available to the Chairman, 18 September 2003', BWC/MSP.2003/MX/4 (Part II).

States parties that provided statements, presentations and other contributions relating to topic one to the Meeting of States Parties

Argentina, Australia, Brazil, Canada, China, Colombia, Cuba, Czech Republic, France, Germany, India, Indonesia, Iraq, Italy, Japan, Jordan, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Philippines, Poland, Russia, Saudi Arabia, South Africa, South Korea, Sudan, Sweden, Switzerland, Tunisia, UK, US

Source: 'Report of the Meeting of States Parties, Volume II, Annex II, Statements, Presentations and Contributions made available to the Chairman, 26 November 2003', BWC/MSP.2003/4 (Vol. II).

Where texts were provided to the chair, these were included in the final reports of the meeting.

where this legislation has been enforced.[43] The database contains information that states have provided to the ICRC on their national measures to implement the prohibitions contained in Article I of the BTWC and can be searched by entering the name of a state and/or key words.

A non-governmental organisation (NGO) and BWPP Global Network member has recently surveyed the status of national legislation to implement and enforce the prohibitions contained in Article I of the treaty. In conducting its survey in 2002 and 2003, the London-based Verification Research, Training and Information Centre (VERTIC):

- distributed a questionnaire, in Arabic, English, French and Spanish;
- contacted national focal points, diplomatic representatives and state officials in capitals to request information;
- liaised with other organisations involved in BTWC implementation; and
- collated open-source data.

Information was obtained on the status of national legislation in 95 of the BTWC's 151 states parties and analytical reports were compiled for the 2003 Meeting of Experts[44] and Meeting of States Parties.[45] Texts of legislation adopted in 70 states parties are available on the VERTIC website.[46]

In 2004, VERTIC launched a new, two-year project to survey the status of all types of

[43] See URL, www.icrc.org/ihl-nat.

[44] *Time to lay down the law: the status of national laws to enforce the BWC* (draft), (London: VERTIC, August 2003), www.vertic.org.

[45] *Time to lay down the law: national legislation to enforce the BWC* (London: VERTIC, October 2003), www.vertic.org/assets/TimeToLayDownTheLaw.pdf.

[46] VERTIC, 'Biological Weapons Convention: Collection of national implementation legislation', www.vertic.org/datasets/bwlegislation.html.

BTWC national implementation measures.[47] The final results will be published in advance of the Sixth Review Conference in 2006, with interim findings and analysis published to coincide with meetings under the New Process.

Monitoring the status and effectiveness of BTWC national implementation legislation

The requirement in Article IV to 'take any necessary measures' to enforce Article I commitments can be viewed as inferring an ongoing obligation on states parties to review regularly the status and effectiveness of their own national measures. States parties have not formally considered the effectiveness of individual states parties' legislation or other measures in treaty meetings, however the 2003 Meeting of Experts and Meeting of States Parties did consider key questions relating to topic one of the New Process on 'national measures to implement the prohibitions set forth in the Convention, including the enactment of penal legislation'. These questions, [48] which were considered during week one of the Meeting of Experts, encompass the range of issues that need to be considered when adopting national measures to effectively implement the treaty obligations. Below is the meeting's provisional programme of work:

States parties agreed to make procedural reports of the Meeting of Experts [49] and Meeting of States Parties.[50] It is likely that they will not consider the issue of national measures to implement the treaty prohibitions again during meetings held under the auspices of the New Process until the Preparatory Committee is convened in advance of the Sixth Review Conference.[51] The latter is tasked, inter alia, with considering the work of the meetings held under the New Process and deciding on any further action.[52]

Members of the BWPP network conduct their own research on the status of national implementing legislation. In *Time to law down the law: national legislation to enforce the*

Regional findings of the VERTIC study

	No information available	In force	Drafting	Status uncertain
Africa	71%	16%	3%	13%
Americas	34%	47%	9%	13%
Asia	42%	37%	11%	18%
Europe	10%	73%	7%	17%
Oceania	25%	75%	–	–

Source: *Time to Lay down the Law: National Legislation to enforce the BWC* (London: VERTIC, October 2003)

[47] See www.vertic.org.

[48] 'Provisional Programme of Work for the Meeting of Experts, 28 July 2003', BWC/MSP.2003/MX/2.

[49] BWC/MSP.2003/MX/4 (Part I), *op. cit.*

[50] BWC/MSP.2003/4 (Part I), *op. cit.*

[51] BWC/CONF.V/17, *op. cit.*

[52] *Ibid.*

BWC,[53] for example, VERTIC provided a comparative analysis of implementation legislation covering issues including: definitions; scope of prohibitions incorporated into national legislation; enforcement powers; export and import controls; external territories; extraterritoriality and universal jurisdiction; divulgence of BW-related information; national focal points; and penal sanctions. On the basis of information collected during the survey, the status of BTWC implementing legislation in states parties is reported as follows: no information available (37 percent); in force (47 percent); drafting (seven percent); or status uncertain (15 percent).

Availability of assistance for national implementation legislation and other measures

There is no treaty secretariat for the BTWC. Such a body would be tasked with providing and coordinating technical and other implementation assistance to states parties and signatory states. During the 2003 Meeting of Experts and Meeting of States Parties, certain states offered to provide aid on request to other states requiring legal and technical assistance to improve their national implementation and to assist in enhancing the security of, and oversight over, pathogens and toxins. The chair of the Meeting of Experts encouraged delegations to 'outline what they may be able to offer in this regard during the 2003 Meeting of States Parties'.[54] Many of the states for which no information on the status of BTWC national implementation legislation is available, as identified in the aforementioned VERTIC report, are likely to require such technical assistance. Many of them, though, did not attend the two meetings and may not know how to locate or take up any assistance that was offered, not least because these offers are only located in lengthy compilations of official meeting reports.[55]

The ICRC provides a Legal Advisory Service on International Humanitarian Law that assists states to implement BTWC prohibitions. This service is tailored to provide specialist assistance to civil law and common law states. States requiring assistance can contact the Geneva headquarters of the ICRC or one of its regional legal advisory offices.

Proposals to improve the adoption rate, effectiveness and transparency of national implementing legislation

States parties meeting under the New Process are not explicitly tasked with negotiating procedures or measures to improve the implementation of BTWC obligations. However they are tasked with promoting 'common understanding' and 'effective action' on each

[53] *Time to lay down the law: national legislation to enforce the BWC, op. cit.*

[54] 'Report of the Meeting of States Parties, 26 November 2003, Chairman's Opening Remarks', BWC/MSP/2003/4 (Vol. II), Annex II, p. 6.

[55] BWC/MSP.2003/4 (Part II), *op. cit.*

issue being discussed under the New Process, which does enable them to reach politically-binding agreement on measures to strengthen the treaty under each of the five issues. To assist states parties to promote common understandings and effective action relating to the two issues under discussion during 2004, the final report of the 2004 Experts Meeting contained a collated summary[56] of the various proposals and perspectives that states parties put forward. While the reports of the 2003 meetings did not contain a comparable collation of such proposals for the 2003 topics, lists of states parties' recommendations and proposals could still be collated and made available as an information or background document. Such a collation would form a useful starting point for further consideration and action on: assessing the legislative approaches taken in different states; facilitating and coordinating technical assistance for national implementation, particularly legislative drafting support; and collating and widely disseminating the texts of legislation, regulations and other national measures adopted by BTWC states parties to implement their treaty obligations.

The Chair of the 2003 treaty meetings noted that states parties had identified three common elements in their national implementing approaches which include: the need for legislation, including penal legislation, which encompasses the full scope of the prohibitions of the Convention; effective regulations or legislation to control and monitor transfers of relevant dual-use technologies; and effective implementation and enforcement to prohibit and prevent violations.[57] States parties are reluctant to make agree procedures for ensuring adherence to the obligation to effectively implement the treaty their respective national jurisdictions. However they did at least not the value of reviewing and updating their national laws, including offences and punishments for activities which are prohibited under the treaty.[58]

While states parties have not yet taken concrete steps to improve the availability of technical assistance, which would improve the adoption rate and effectiveness of national implementing measures, NGOs and other organisations have put forward a range of proposals to improve the coordination and provision of technical implementation assistance, including help in drafting national laws. VERTIC, for example, has outlined some options[59] in this area that may be introduced by states individually or collectively. For instance, establishing an informal network of legal advisors, modelled on the network set up under the auspices of the 1993 Chemical Weapons Convention,[60] which could be tasked with:

- promoting the obligation to adopt appropriate national implementation measures;
- supplying information to assist states in adopting national implementation legislation;

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[56] 'Considerations, lessons, perspectives, recommendations, conclusions and proposals drawn from the presentations, statement, working papers and interventions made by delegations on the topics under discussion at the meeting', BWC/MSP/2004/MX/3 (Annex II), 11 August 2004.

[57] BWC/MSP/2003/4 (Vol. II), *op cit.*, Chairman's closing remarks, p. 149.

[58] BWC/MSP/2003/4 (Vol. I), *op. cit.*, p. 5.

[59] Woodward, A., Time to lay down the law. *op. cit.*, pp.40-45 and Findlay, T. and Woodward, A., *Enhancing BWC Implementation: A modular approach,* Paper No. 23, The Weapons of Mass Destruction Commission, 2004, www.wmdcommission.org.

[60] Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction. The treaty was opened for signature on 13 January 1993 and entered into force on 29 April 1997.

- creating a database of legislation adopted and model legislation suggestions; and
- providing contact details of legal advisers in states parties.

Another proposal is to establish a BTWC technical implementation support unit for the treaty, modelled on the unit created for the 1997 Ottawa Landmine Convention,[61] which could be tasked with coordinating offers of, and requests for, assistance with regard to BTWC implementation.[62]

In cooperation with the ICRC Legal Advisory Service, VERTIC has also prepared a model law for states requiring legislative assistance to implement the prohibitions against biological and toxin weapons in their national jurisdiction. States that adopt these model provisions which are not yet states parties to the BTWC will be encouraged to ratify or accede to it. This model law will be disseminated widely in early 2005 as an advocacy and assistance tool.[63]

The discussions at the 2003 treaty meetings on national implementing laws and other measures are generally regarded by states parties as providing a useful exchange of views on implementation issues and steps that have been taken to implement the BTWC obligations through national measures, including national legislation and penal sanctions. The information provided to other states parties at the 2003 treaty meetings, as well as to the ICRC, VERTIC and others on national measures and laws to implement the BTWC has started an important process which should increase transparency over the status of such measures. Yet it is evident that many states parties still have to enact their treaty obligations, including those relating to the treaty's core prohibitions. Much work remains to be done to rectify this imbalance, including awareness-raising activities and the ongoing provision of technical implementation assistance.

[61] Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction. The treaty was opened for signature on 3 December 1997 and entered into force on 1 March 1999. See the website of the treaty's Implementation Support Unit, hosted by the Geneva International Centre for Humanitarian Demining, at www.gichd.ch/mbc/isu/index.htm.

[62] Findlay, T. and Woodward, A., *op. cit.*

[63] VERTIC and the ICRC, 'A model law: the Biological and Toxin Weapons Crimes Act' (draft). A final version will be available in January 2005 from VERTIC (www.vertic.org) and the ICRC Legal Advisory Service (www.icrc.org).

The contribution of CBMs to transparency

In September 1986, the Stockholm Conference on Confidence and Security Building Measures and Disarmament in Europe—held under the auspices of the Conference on Security and Co-operation in Europe (CSCE)—was coming to a close following more than two years of negotiations. The 35 member states of the CSCE had reached consensus on the 'Stockholm Document', providing for far-reaching confidence- and security-building measures, which were to improve relations between the East and the West dramatically in subsequent years.

At exactly the same moment, states parties to the 1972 Biological and Toxin Weapons Convention (BTWC) were coming together for the Second Review Conference in Geneva, Switzerland, the aim of which was to restore some integrity to the treaty, which was reeling as a result of unresolved non-compliance allegations involving the Soviet Union.[1] The 'Stockholm factor' got the BTWC back on track.[2] One of the most important outcomes of the meeting was the decision of states parties to enhance transparency with respect to treaty implementation by establishing some data exchange arrangements. These later became known as confidence-building measures (CBMs) for the BTWC.[3] Following the Second Review Conference, in April 1987, an Experts Meeting was convened to work out the details.

There are different BTWC mechanisms that concentrate on openness and transparency, including the consultation and cooperation procedures under Article V and the complaint and investigation procedures under Article VI, as well as the statements that countries make on their compliance with the various provisions of the BTWC. The only mechanism that generates treaty-relevant data on a frequent basis, however, is the CBMs.

How the CBMs should work

Every BTWC state party is obliged to file a CBM return each year. The agreement reached at the Second Review Conference provided for exchanges of information on four topics. At the Third Review Conference, in September 1991, it was agreed that this list should be revised and widened. (No revisions or improvements have since been made.) Currently, there are nine topics, each of which has its own reporting form:[4]

[1] See the chapter on 'Investigations of alleged non-compliance with the BTWC' in this volume.

[2] Sims, N. A., 'The Second Review Conference on the Biological Weapons Convention', in Wright, S. (ed), *Preventing a Biological Arms Race*, (Cambridge, MA: MIT Press, 1990), pp. 267–88.

[3] For a detailed account of how the CBMs came into existence, see Sims, N. A., *The Evolution of Biological Disarmament*, SIPRI Chemical and Biological Warfare Studies, No. 19, (Oxford: Oxford University Press, 2001), pp. 61–64.

[4] The forms are available at www.opbw.org.

- A1-exchange of data on research centres and laboratories.
- A2-exchange of information on national biological defence research and development (R&D) programmes.
- B1-background information on outbreaks of reportable infectious diseases.
- B2-information on outbreaks of infectious diseases and similar occurrences that seem to deviate from the normal pattern.
- C-encouragement to publish results and to promote the use of knowledge.
- D-active promotion of contacts between scientists.
- E-declarations on legislation, regulations and other measures.
- F-declarations on past activities with regard to offensive and/or defensive biological R&D programmes.
- G-declarations on vaccine production facilities.

States parties must submit completed CBM forms to the United Nations Department for Disarmament Affairs (UNDDA) by 15 April each year, providing information that covers the previous calendar year. These returns must be in at least one of the official languages of the United Nations (UN). If a state has nothing to report, or there have been no developments since its previous report, it is still obliged to submit a return—using the so-called Form 0—stipulating that it has 'nothing to declare' or 'nothing new to declare'.

The UNDDA collates the CBM returns and distributes them to all states parties, primarily through their permanent missions in New York or elsewhere.

How the CBMs work

States parties gave themselves responsibility for implementing the CBMs.[5] Despite this politically binding obligation, as well as a clear expectation that all states would file information every year, participation in the CBM process has been decidedly patchy. Obviously, a large number of states parties wrongly believes that the CBM reporting process is a voluntary arrangement. Non-participation amounts to 'technical non-compliance' with the BTWC. A whole host of BTWC states parties fall into this category, seriously undermining the biological weapons control regime.

Usually, less than one-third of states parties submits information annually. With 53 returns, participation peaked in 1996—the year of the Fourth Review Conference, when expectations were high that agreement on a verification instrument for the BTWC would soon be reached. Between 1999 and 2003, 22 countries provided information every year (Argentina, Australia, Belarus, Canada, China, Cuba, Czech Republic, Finland, Germany, Italy, Japan, the Netherlands, New Zealand, Norway, Romania, Russia, Switzerland, Slovakia, Spain, South Korea, Turkey and the US). This number fell to eight (Canada, Finland, Germany, Netherlands, Norway, Russia, Spain and the US) between 1987 and

[5] Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 'Final Document', Part II, Final Declaration, BWC/CONF.II/13/II, 1986, Geneva, p. 6.

2003.

Since 1987, 87 states parties have taken part in the process at least once. This means, though, that almost 50% of BTWC member states never submitted any information in the period under review. Among those that have not participated are Algeria, Ethiopia, Indonesia, Kenya, Lebanon, Libya, Malaysia, Morocco, Nigeria, Oman, Pakistan, Singapore, Uruguay, Venezuela, Yemen, Vietnam and Zimbabwe.

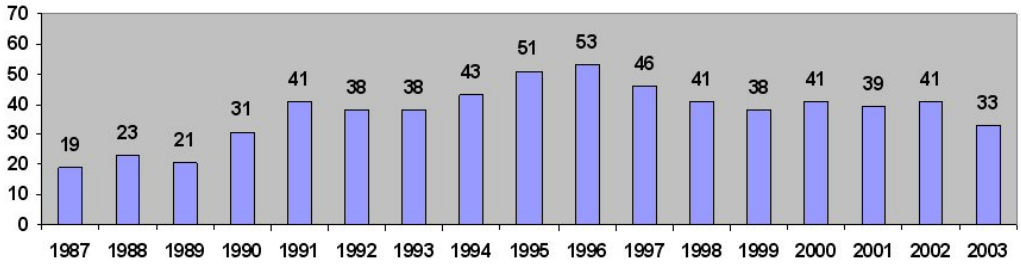

Figure 1: Number of states parties that submitted CBMs, 1987-2003

Eastern European countries and Western states took part much more frequently than members of the Non-Aligned Movement (NAM). Over the past ten years, almost all Western states and 80% of Eastern European countries participated on at least occasion, compared with only one-third of NAM members. The most likely reason for this is that the CBMs were, or are perceived to have been, transplanted from a European context into a global one without proper adaptation.

Publicly available analysis of CBM data is scant. A detailed assessment of the first three exchange rounds was published in 1990.[6] More recent information, however, tends only to be released in an ad hoc fashion.

By 1998, 18 States (Australia, Belarus, Canada, China, Finland, France, Germany, India, Italy, the Netherlands, Norway, Poland, Russian Federation, Spain, Sweden, Switzerland, the UK and the US) had declared national bio-defence programmes, involving between six and 3,325 people. Five states had declared past offensive programmes and their termination dates—Canada (1956), France (1973), Russian Federation (1992), the UK (1957) and the US (1969)—while 17 states had declared past defensive programmes—Australia, Belgium, Canada, China, Czech Republic, France, Germany, India, Iraq, Italy, the Netherlands, Poland, Russian Federation, South Africa, Sweden, the UK and the US.[7]

The quality of information supplied has varied greatly. Lack of consistency and the incomplete nature of many CBM returns were factors criticised in the aforementioned 1990 analysis. Some submissions have been found to contain serious discrepancies when checked against information from other sources. Below are two examples.

In 1992, the Russian Federation filed a CBM Form F, running to five pages, and covering its past offensive and defensive activities. This document has been judged by independent

[6] Geissler, E. (ed), *Strengthening the Biological Weapons Convention by Confidence-Building Measures*, SIPRI Chemical and Biological Warfare Studies, No. 10, (Oxford: Oxford University Press, 1990).

[7] Chevrier, M. I. and Hunger, I., 'Confidence-Building Measures for the BTWC: Performance and Potential', *The Nonproliferation Review*, Fall–Winter 2000, pp. 32–33.

experts as being incomplete and not reflecting the true nature and extent of the Soviet biological weapons programme.[8] Since 1992, the Russian Federation has stated that it has 'nothing new to declare'.

The US, meanwhile, has failed to report some of its more sensitive bio-defence activities: fabrication of a cluster munition to disseminate biological agents; construction of a biological weapons plant using commercially available components; genetic modification of *B. anthracis* to mimic Soviet activities; and production of dried, weaponized anthrax.[9]

Even those states parties that are otherwise very active in ensuring the well-being of the BTWC have experienced lapses in implementing the CBMs, perhaps simply due to administrative oversight. The UK, for example, failed to submit a CBM return in 2001.

The non-existent CBM concept

The disappointing performance of the CBM system makes a look at the underlying CBM concept all the more worthwhile. In general, the application of confidence-building measures has taken precedence over any kind of conceptual exploration.[10] Those concepts that were developed tended to be vague. Most observers agree that CBMs seek to clarify intentions and to resolve misperceptions by providing information and methods of checking whether data are correct, in other words, by increasing the level of openness and transparency. It is equally patent that CBMs are not a substitute for verification measures.

The BTWC CBMs, in particular, have almost no conceptual basis. They were agreed 'in order to prevent or reduce the occurrence of ambiguities, doubts and suspicions, and in order to improve international cooperation in the field of peaceful bacteriological (biological) activities'.[11] Even though transparency building is not mentioned directly in the documents establishing the CBMs, it was widely seen as the most important goal of these measures. In his opening statement to the April 1987 Experts Meeting, the president of the Second Review Conference, Winfried Lang, underlined:

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[8] See Lilja, P., Roffey, R. and Westerdahl, K. S., *Disarmament or Retention. Is the Soviet Biological Weapons Programme Continuing in Russia?*, (Umeå: Defence Research Establishment (FOA), December 1999); Rimmington, A., 'The Soviet Union's Offensive Program. The Implications for Contemporary Arms Control', in Wright, S. (ed), *Biological Warfare and Disarmament. New Problems/New Perspectives*, (Lanham, MD: Rowman & Littlefield Publishers, Inc., 2002), pp. 103–48; and Averre, D., 'From Co-option to Cooperation. Reducing the Threat of Biological Agents and Weapons', in Einhorn, R. J. and Flournoy, M. A. (project directors), *Protecting against the Spread of Nuclear, Biological, and Chemical Weapons. An Action Agenda for the Global Partnership*, Vol. 2, (Washington, DC: Center for Strategic and International Studies, January 2003), pp. 23–52.

[9] Wheelis, M. and Dando, M., 'On the Brink: Biodefence, Biotechnology and the Future of Weapons Control', *The CBW Conventions Bulletin*, No. 58, December 2002, pp. 4–5.

[10] Desjardins, M. F., 'Rethinking Confidence-Building Measures', *Adelphi Paper* 307, (Oxford: Oxford University Press for the International Institute for Strategic Studies, 1996), p. 7.

[11] 'Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction', *op. cit.*, p. 6.

> [T]he widely shared belief that a high degree of transparency, in particular in respect of biological research, would contribute to a build-up of confidence among parties; openness and mutual trust were expected to help to dispel suspicions and misunderstandings which had arisen in the past.[12]

Besides transparency building, states had a number of additional expectations: CBMs would create conditions conducive to strengthening the BTWC verification system; CBMs would act as a test vis-à-vis future declarations; and CBMs would serve to indicate the readiness of states to meet their treaty obligations.

The views of states on the CBM process

In 1990, states described the CBM process as being 'very valuable', 'useful in many ways' and 'helpful'.[13] One year later, during the Third Review Conference, this cautiously positive assessment gave way to complaints about limited participation. The UK expressed its disappointment as follows:

> The response to the Confidence Building Measures elaborated at the Second Review Conference has been unsatisfactory—two-thirds of States Parties have not participated in the information exchange at all and the quality of the data submitted by the remaining one-third has been disappointing.[14]

This situation remained the same in 1994, leading Iran to conclude that: '[C]onfidence-building measures had not helped significantly to clarify matters'.[15]

In a series of interviews with delegates from all regional groups in 2000 and 2001, almost all of them said that CBMs were of little value.[16] No one, though, wanted to abandon the CBM process. CBMs were described as indicators of the interest of states in a functioning BTWC, as a modest contribution to improving transparency, as a first step towards developing a robust verification mechanism, and as one source of information on states'

[12] 'Opening Statement by the President of the Review Conference Ambassador Winfried Lang (Austria)', 31 March 1987, Geneva, p. 2.

[13] Geissler, E., 'The first three rounds of information exchanges', in Geissler, E. (ed), *Strengthening the Biological Weapons Convention by Confidence-Building Measures, op. cit.*, pp. 73–75.

[14] 'Statement by Ambassador Solesby, Leader of the Delegation of the United Kingdom of Great Britain and Northern Ireland to the Third Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction', 11 September 1991, Geneva, p. 3.

[15] Special Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 'Summary Record of the 3rd Meeting held at the Palais des Nations, Geneva, on Tuesday, 20 September 1994, at 10 a.m.', BWC/SPCONF/SR.3, 26 September 1994, Geneva, p. 13.

[16] Hunger, I., 'Ohne Vertrauen keine Kontrolle. Zur Rolle der Vertrauensbildung in der Evolution des Biowaffen-Kontrollregimes', PhD thesis, Technical University Darmstadt, 2003.

compliance. Most delegates emphasised that non-participation in the CBM scheme did not imply non-compliance with treaty obligations.

These interviews appeared to suggest that no state was particularly worried about the level of participation. 'Technical non-compliance' with the political obligation to submit a CBM return was explained by bureaucratic and administrative difficulties, the existence of other priorities ('feeding people is more important'), the 'voluntariness' of the mechanism, the expectation that declarations under a future BTWC verification instrument would take precedence, the perception that CBMs are useless, the dearth of knowledge, and the lack of declarable facilities and activities.

Based on these interviews, it is apparent that states do not translate or analyse systematically the data contained in the CBM returns. Instead, the focus is on particular countries or topics and often depends on the personal interests of the experts involved.

Nature of the CBMs

When agreeing the CBMs, states did not specify that access to data would be restricted. Indeed, confidentiality would obviously run counter to the goal of increasing the level of openness and transparency. It would be wrong, therefore, to accept that the CBM returns are only 'for government use', as some state representatives have claimed.

Some states are models of openness when it comes to CBM submissions. Australia, for instance, posted its CBM return for 2002 on the internet; the US followed suit in 2004.[17] At least one state (Germany) has provided a non-governmental organisation (NGO) with access to its CBM submission on request. Canada has made parts of its 2003 CBM submission public in order to illustrate how to complete the CBM forms. But it underlines that, '[d]ue to confidentiality requirements, actual Canadian data cannot be presented [publicly]'.[18]

A limited amount of public information can be gleaned from the CBM reports that the UNDDA prepares for BTWC Review Conferences. These documents utilise a yes–no format in order to identify the CBM forms that states have or have not submitted, but they do not contain any analysis of the data.[19]

Today, NGOs cannot obtain copies of CBM documents from the UNDDA. But this was different in the late 1980s, when the Stockholm International Peace Research Institute (SIPRI) was afforded access to CBM submissions (for the study on the first three rounds of data exchanges).[20]

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[17] See URL <www.dfat.gov.au/security/statements/bwc_cbm_return_2002.pdf> (30 June 2004) and URL <www.state.gov/documents/organization/32486.pdf> (30 June 2004) respectively.

[18] See URL <www.opbw.org/cbms/Guide_files/frame.htm> (30 June 2004).

[19] Documents produced for the Fifth Review Conference are BWC/CONF.V/2, BWC/CONF.V/2/Corr.1, BWC/CONF.V/2/Corr.2, BWC/CONF.V/2/Corr.3, BWC/CONF.V/2/Add.1 and BWC/CONF.V/2/Add.1/Corr.1. They can all be found at URL <www.opbw.org>.

[20] Geissler, E. (ed), *Strengthening the Biological Weapons Convention by Confidence-Building Measures*, *op. cit.*, preface.

Examples from other arms control regimes also highlight the fact that making such data public is the norm—keeping such information confidential requires specific provisions. In the case of the 1997 Ottawa Landmine Convention, Article 7, entitled 'transparency measures', stipulates that states parties must submit an initial report to the UN Secretary-General within 180 days of joining the treaty, and annual reports thereafter, detailing their implementation of specific treaty requirements.[21] These include the adoption of national criminal laws to enforce the treaty, the destruction of stockpiles and clearance of mined areas, as well as measures taken to provide warnings about mined areas.[22] At the First Meeting of States Parties, the treaty members adopted a standard reporting format and requested the UN Secretary-General to make these reports publicly available online for reasons of efficiency and transparency.[23]

A reporting system similar to the BTWC CBMs—aimed at building confidence and engendering security through increased openness and transparency—was set up in 1991 for major conventional weapons systems, known as the United Nations Register for Conventional Arms. UN resolution A/RES/46/36 L calls on states to provide annually data on imports and exports of arms and invites them to supply (to the UN Secretary-General) background information on their military holdings, procurement through national production means and relevant policies. All of the information can be accessed via the internet.[24]

Data provided by states parties to the 1993 Chemical Weapons Convention (CWC) are generally kept confidential. CWC states parties have a legal obligation to provide initial and annual declarations. The Organisation for the Prohibition of Chemical Weapons, which handles the declarations, has been instructed to release information only under exceptional circumstances. States parties are explicitly required to 'treat as confidential and afford special handling to information and data that [they] receive in confidence from the Organization in connection with the implementation of this Convention'.[25] The CWC's confidentiality provisions run to five pages.

Looking to the future

During the second half of the 1990s, while negotiations on a BTWC verification instrument were continuing, interest in CBMs, including any attempt to improve or expand data

[21] 1997 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction.

[22] Article 7 lists nine topics that states must report on. Further topics, relating to the provision of assistance to mine victims and the actual use of mines retained for training in accordance with Article 3, have been designated for voluntary reporting.

[23] 'Final Report, First Meeting of the States Parties to the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Landmines and on Their Destruction', Annex III, President's Paper: Circulation of Article 7 Reports, APLC/MSP.1/1999/1, URL <www.gichd.ch/pdf/mbc/1msp/Presidents_paper_Art7_reports-en.pdf> (17 September 2004). The reports are available at URL <http://disarmament2.un.org/MineBan.nsf> (12 July 2004).

[24] See URL <http://disarmament.un.org:8080/cab/register.html> (12 July 2004).

[25] See Confidentiality Annex A 2(c) and Article VII (6) of the Chemical Weapons Convention, accessible via URL <www.opcw.org/html/db/cwc/eng/cwc_frameset.html> (12 July 2004).

reporting, was almost zero. Everyone assumed that the CBMs would soon be superseded by legally binding declarations. Due to the failure of the negotiations on a verification instrument, and the fact that there is little political momentum behind the follow-up process, interest in CBMs has been revitalised. While this is a welcome development, one should not assume that a perfectly functioning CBM regime constitutes the ultimate goal. CBMs under the BTWC are a stepping stone towards an effective convention, one that is universal and has a robust verification system.

Since CBMs are the only frequent data exchange measure that has been agreed under the BTWC, and a multilateral verification system is not on the horizon, it is vital that states make best use of them. To do so, the current system's shortcomings have to be addressed. There are several problems here that have to be noted: limited participation; lack of clarity with respect to individual CBMs; the selectivity of topics; and the shortage of follow-up and analysis.

Patchy participation is a key obstacle to ensuring the effectiveness of the CBM system. States have issued demarches in the past to raise the visibility of the mechanism, but they have met with limited success. More successful would probably be a series of consultations and workshops designed to help those states that do not take part in the process because they lack appropriate knowledge and experience. Canada took a step in this direction when it prepared, in 2004, a guide entitled *The Biological and Toxin Weapons Convention Confidence Building Measures: A Guide to their Completion.*[26] A group of states parties to the Ottawa Landmine Convention holds bilateral discussions to assist states with transparency reporting, in part by utilising a widely used reporting guide developed by NGOs, which was accepted as an Information Document at the Third Meeting of States Parties and has been translated into all UN languages.[27]

The existing CBMs and the respective forms need to be more precise and logical. The best example to demonstrate the need for improvement is Form F. The latter is misleading because it asks for the declaration of 'past activities in offensive and/or defensive biological research and development programmes' but the form that states have to fill in asks for information on 'production, test and evaluation, weaponization, stockpiling of biological agents, [and] the destruction programme of such agents and weapons'.[28] Considerable improvements to the CBM process were made during the BWC Ad Hoc Group's negotiations on declarations under the envisaged legally-binding protocol, including expanding the range of issues to be reported and the streamlining of the reporting forms and the submission process. Large parts of the negotiated protocol text on declarations were considered not to be contentious and should serve as the basis for enhancing the CBM process. South Africa made a proposal along these lines during the Fifth Review Conference.[29]

Whether the topics set out under the CBM mechanisms are the most relevant is open to

[26] This guide can be found at URL <www.opbw.org/cbms/Guide_files/frame.htm> (13 July 2004).

[27] *Guide to Reporting under Article 7 of the Ottawa Convention*, (London: Verification Research Training and Information Centre (VERTIC) (in cooperation with Landmine Action UK), 2001).

[28] Third Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 'Final Document', BWC/CONF.III/23, 1992, Geneva, pp. 15 and 45.

[29] Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, BWC/CONF.V/COW/CRP.1, 30 November 2001, Geneva, pp. 46–48.

debate. Almost since the CBMs came into being, proposals on how to expand the number of topics have been issued. Besides the changes made during the Third Review Conference in 1991, other amendments were suggested at that time, including declarations on the release of biological agents in the open air and military vaccination programmes, as well as the opening up of declared facilities.[30] In 2001, even more proposals were made for new and expanded CBMs, such as declarations on animal vaccine and plant inoculant production and outbreaks of animal and plant disease.[31] Proposals to terminate data exchanges on selected subjects have been rare.

The CBM system would profit most, though, from an increase in the level of institutional support. In 1991 a proposal to create a small secretariat unit was seriously considered, but, ultimately, it was rejected.[32] In 2001, the European Union recommended the following institutional arrangements: the setting up by the UN Secretary-General of an easy-to-use database containing the annual declarations; the establishment by states of a national entity responsible for CBM implementation and follow-up; and the implementation of consultation procedures to consider matters connected to CBM returns, including information exchanges and bilateral and multilateral visits.[33] NGOs have consistently pressed for institutional arrangements.[34]

Civil society can contribute to remedying all of the problems associated with the BTWC CBM process. Political pressure could be put on states to take their commitments seriously by checking, for instance, whether the data provided (or not) are consistent with that available in the public domain. A precondition for such projects is that the CBM returns are publicly available and easy to obtain. Such projects would likely increase the rate of participation, as well as improve the quality of the data provided (in terms of consistency and comprehensiveness). They are, of course, much easier in states where openness and transparency are already well established principles. A significant amount of relevant information, however, can also be procured in less open societies.

A well functioning CBM system, besides increasing the degree of cooperation among BTWC states parties and thereby strengthening the treaty itself, will provide states parties, as well as civil society bodies, with a starting point for checking states' compliance with the international norm against biological weapons.

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[30] Sims, N. A., *The Evolution of Biological Disarmament*, *op. cit.*, pp. 68–69.

[31] Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, BWC/CONF.V/COW/CRP.1, *op. cit.*, pp. 44–48.

[32] Sims, N. A., *The Evolution of Biological Disarmament*, *op. cit.*, p. 174.

[33] Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, BWC/CONF.V/COW/CRP.1, *op. cit.*, pp. 44–46.

[34] See: Royal Society Study Group, *Scientific Aspects of Control of Biological Weapons. Report of a Royal Society Study Group*, (London: The Royal Society, 1994), p. 21; and Sims, N. A., 'The Case for a BWC Committee of Oversight: Draft Mandate and Commentary', *Disarmament Diplomacy*, No. 60, September 2001, pp. 13–19.

Investigations of alleged non-compliance with the BTWC

When the Biological and Toxin Weapons Convention (BTWC) was negotiated in the early 1970s, few states were prepared to accept the highly intrusive on-site inspections (OSIs) needed to monitor compliance with a reasonable degree of confidence. As a result, the treaty entered into force in 1975 with no formal verification provisions. Over the past three decades, numerous allegations of non-compliance with the BTWC have come to light in the following ways:

- official government statements regarding illicit biological weapons (BW) programmes (for example, past allegations by the United States against Cuba, Libya, Iran, Iraq, North Korea and the Soviet Union);
- official government allegations of accidental or deliberate release of BW agents (for instance, US claims in the early 1980s about the outbreak of human anthrax in the Soviet city of Sverdlovsk and the alleged use of trichothecene mycotoxins ('yellow rain') in Southeast Asia and Afghanistan, as well as multiple assertions by Cuba that it has been the victim of US biological attacks);
- the release of historical documents and testimony on a clandestine BW programme in the aftermath of a change in government (such as revelations about Project Coast, the chemical and biological weapons programme of apartheid South Africa, which emerged during the hearings of the Truth and Reconciliation Commission and the trial of Dr. Wouter Basson[1]);
- information provided by senior scientists who have defected from national BW programmes (such as the Soviet defectors Vladimir Pasechnik in 1989 and Kanatjan Alibekov in 1992[2]);
- the carrying out of international inspections after a country has lost a war (Iraq) or a government has taken the unilateral decision to disarm; and
- information obtained from unofficial sources, including intelligence leaks to the press, allegations by rebel groups, investigations by human rights organisations, and observations by biotechnology industry representatives.

Because of the BTWC's lack of compliance machinery, many of these allegations have continued to fester without being either refuted or confirmed, undermining confidence in the convention. In the aftermath of the failed attempt between 1995 and 2001 to negotiate a compliance protocol for the BTWC, states parties are considering alternative ways of

[1] Gould, C. and Burger, M., *Secrets and Lies: Wouter Basson and South Africa's Chemical and Biological Warfare Programme* (Cape Town: Struik Publishers, 2003).

[2] Alibek, K. with Handelman, S., *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World-Told from the Inside by the Man Who Ran It* (New York: Random House, 1999).

strengthening the biological disarmament regime at a time when the threats of bio-warfare and bio-terrorism appear to be increasing. This chapter reviews a variety of approaches to investigating BTWC compliance, both inside and outside of the treaty framework, and assesses their effectiveness.

Investigative mechanisms within the BTWC

Although the BTWC does not have a formal system of declarations or inspections for monitoring compliance, it does include procedures for consultation and investigation, some of which have been utilised in the past with limited success.

Consultations under Article V

Article V of the BTWC provides that states parties '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'. The BTWC does not specify how such consultations are to be conducted, nor is there any requirement that the party seeking the consultation establish that a treaty violation has occurred. Article V merely establishes a general obligation to consult and cooperate in order to address compliance concerns—either within a bilateral or a multilateral framework—in response to a reasonable request by another state party.

Bilateral consultations

Under Article V, BTWC states parties that have concerns about compliance by other states parties may request a clarification on a bilateral basis. For example, after an outbreak of human anthrax occurred in April 1979 in the Soviet city of Sverdlovsk, the US intelligence community suspected that the cause of the incident had been an accidental release of anthrax spores from a nearby military microbiological facility. Washington made three official attempts to obtain a clarification from the Soviet Ministry of Foreign Affairs: in March and June 1980 (during the administration of President Jimmy Carter) and in August 1981 (during the administration of President Ronald Reagan). Each time, Moscow denied any wrongdoing and asserted that the outbreak was of natural origin, resulting from the ingestion of contaminated meat.[3]

Although the Soviets claimed to have fulfilled their treaty obligation under Article V, many US questions about the Sverdlovsk outbreak remained unanswered. Accordingly, the government of the United Kingdom judged that the Soviet response had 'fallen short of the cooperative attitude that seems necessary if the consultative provisions of Article V are to have practical meaning'.[4] Despite the unsatisfactory outcome of the bilateral consultations, the US did not request a review of the evidence at the multilateral level. Instead, after Moscow failed to respond to the third American démarche in August 1981,

[3] Sims, N. A., *The Diplomacy of Biological Disarmament: Vicissitudes of a Treaty in Force, 1975–85*, (London: Macmillan, 1988), pp. 155–163 and 226–252.

[4] *Ibid.*, p. 235.

Reagan administration officials began referring to the Sverdlovsk incident as a proven violation of the BTWC and repeatedly denounced Soviet misbehaviour, while casting doubt on the value of arms control.[5] Several years later, a forensic investigation of the Sverdlovsk incident uncovered evidence suggestive of an accidental release into the atmosphere of weaponised anthrax spores from a military facility, as the US government had alleged.[6]

Multilateral consultations

Article V also provides that cooperation and consultation on BTWC compliance issues may occur on a multilateral basis, or 'through appropriate international procedures within the framework of the United Nations and in accordance with its Charter'. In 1980, the First BTWC Review Conference agreed that the Article V procedures 'include, *inter alia*, the right of any State Party subsequently to request that a consultative meeting open to all States Parties be convened at [the] expert level'.[7] The First Review Conference provided no guidelines, however, on how such a meeting would be convened and organised, and whether it would attempt to reach a judgment on the evidence or charges.[8]

The next three BTWC Review Conferences elaborated and refined the details of the multilateral consultative mechanism. The Second Review Conference (1986) specified that, in response to a request by a state party, the consultative meeting would be convened promptly and with broad terms of reference. The Third Review Conference (1991) determined that the request should be addressed to one or more of the three depositary states—the Soviet Union (now the Russian Federation), the United Kingdom and the United States—which would immediately inform all states parties and convene a procedural meeting within 30 days and a formal consultative meeting within 60 days. The Fourth Review Conference (1996) added an explicit fact-finding mandate, obliging the country in question to cooperate in resolving the compliance concern, as well as decision-making rules and time lines.[9]

Seventeen years after the multilateral consultative mechanism was proposed, it was invoked for the first time to address an allegation by Cuba that a US government aircraft had deliberately released a crop-destroying insect pest over the island in an attempt to damage its agricultural sector. After first attempting without success to resolve the issue with the United States on a bilateral basis, Cuba approached the Russian Federation, one of the BTWC depositary states, on 30 June 1997 and requested a formal consultative meeting of states parties to consider its claim.

The facts of the case are as follows. On 21 October 1996, an S2R crop-dusting plane operated by the US Department of State overflew Cuba through the Giron air corridor on an approved flight path from Florida to Grand Cayman Island. The plane was en route to Colombia to participate in a coca crop eradication campaign. As the US aircraft passed

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[5] *Ibid.*, p. 240.

[6] Meselson, Matthew, Guillemin, Jeanne, Hugh-Jones, Martin, Langmuir, Alexander, Popova, Ilona, Shelokov, Alexis and Yampolskaya, Olga, 'The Sverdlovsk Anthrax Outbreak of 1979', *Science*, Vol. 266 (18 November 1994), pp. 1202–1208.

[7] United Nations, 'First Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction: Final Document', BWC/CONF.1/9, 20 March 1980.

[8] Sims, N. A., *The Evolution of Biological Disarmament*, (Oxford: Oxford University Press for the Stockholm International Peace Research Institute, 2001), p. 32.

[9] *Ibid.*, pp. 31–36.

over Matanzas Province, the pilot of a nearby Cuban plane saw it release a cloud of unknown material. Three months later, on 18 December 1996, the Cuban agricultural authorities first detected the crop-destroying insect *Thrips palmi* in Matanzas Province, and the pest subsequently spread throughout western Cuba. The Cuban government alleged that a deliberate release of *Thrips* from the US aircraft was responsible for the infestation. After receiving the Cuban complaint, Russia consulted with the other two depositaries and called an informal meeting of BTWC states parties on 31 July 1997 to decide on procedures and to set a date for the formal consultative meeting.

The multilateral consultations under Article V were held in Geneva, Switzerland, on 25–27 August 1997. Chaired by British Ambassador Ian Soutar, the meeting was attended by 74 BTWC states parties and three signatory states (Egypt, Myanmar and Syria). During the first plenary session, the participating countries elected six vice-chairs from Brazil, Canada, Iran, the Netherlands, Nigeria and Russia, who henceforth constituted the 'Bureau of the Formal Consultative Meeting'. During the three-day session, the Cuban government presented its case for a causal connection between the US overflight of the island and the subsequent infestation of *Thrips palmi*. In rebuttal, the US argued that the insect pest could have been transported naturally to Cuba on the wind or through the importation of goods from neighbouring islands, having spread over the previous decade throughout most of the Caribbean, including the Dominican Republic, Haiti and Jamaica. As for the material emitted by the transiting aircraft, the US representative claimed that the pilot had used an on-board smoke generator to emit several puffs of smoke in order to warn an approaching Cuban plane of its presence and thereby avoid a mid-air collision, and that the US aircraft did not have the equipment needed to discharge anything else.[10]

Following the formal presentations by Cuba and the US, Ambassador Soutar declared that any states parties that wished to do so should submit their 'observations' on the case, including analyses by national technical experts, by a deadline of 27 September 1997. The chair and the six vice-chairs would consider these submissions and attempt to clarify and resolve any outstanding issues related to the Cuban allegation and issue a final report by 31 December.[11] Thirteen states parties filed written comments. Eleven countries stated that they were not persuaded of a causal link between the US overflight and the *Thrips* infestation, and believed that the US should be fully exonerated. But China, North Korea and Vietnam argued that the technical complexity of the issue and the lack of detailed information made it impossible to reach a clear verdict. As a result, the Bureau was divided and the 'finding of fact' section of its report concluded that 'it has not proved possible to reach a definitive conclusion with regard to the concerns raised by the Government of Cuba'.[12]

Despite the lack of an unequivocal judgment in its favour, Cuba was reasonably satisfied with the outcome of the formal consultative meeting and did not pursue its concerns outside of the BTWC framework, for example, by appealing to the United Nations (UN) General Assembly. Thus, the multilateral consultative mechanism under Article V proved

[10] Zilinskas, R. A., 'Cuban Allegations of Biological Warfare by the United States: Assessing the Evidence', *Critical Reviews in Microbiology*, Vol. 25, No. 3 (1999), pp. 206–217.

[11] 'Report of the Formal Consultative Meeting of States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction', Geneva, 27 August 1997, p. 2.

[12] Ambassador S.I. Soutar, Permanent Representative of the United Kingdom to the Conference on Disarmament, Geneva, 'letter addressed to All States Parties to the Biological and Toxin Weapons Convention', 15 December 1997, paragraph 7.

its usefulness as a vehicle for addressing BTWC compliance concerns, if not necessarily for resolving them definitively given the uncertainties associated with most cases of alleged BW use. It should be noted, however, that the Cuban allegation was not particularly credible. As one analyst has observed, 'If there were to be a biological attack by the US, why would it be carried out in broad daylight under conditions of unlimited visibility and when Cubans were observing it? It just does not make sense'.[13]

Investigations under Article VI

Potentially the most robust provision in the BTWC for addressing allegations of non-compliance is Article VI, which provides that any party '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 …'. Unlike Article V, the language of Article VI indicates that a state invoking this mechanism must make a formal allegation. Although the Article VI procedure has no rules regarding evidence or burden of proof, it is likely that a complainant would at least be expected to present clear and convincing information in support of a charge. Article VI also requires each state party to cooperate in any investigation that the UN Security Council may choose to initiate.

Under Article 27 of the United Nations' Charter, Security Council decisions on non-procedural matters must have the support of nine of the 15 members, but can be vetoed by any of the five permanent members. During the negotiation of the BTWC in 1971, the UK attempted to structure Article VI so that a permanent member of the Security Council could not veto an investigation of non-compliance. The British draft convention specified, for example, that investigations of alleged use of biological weapons (as distinct from other prohibited activities) would be carried out under the auspices of the UN Secretary-General, making them exempt from the veto. In the course of the BTWC negotiations, however, both the prohibition on use and the mention of the Secretary-General were dropped from the draft text.[14] The final language of Article VI preserved the right of a permanent member of the Security Council to veto an investigation of an alleged BTWC violation. As a result, the implicit threat of a Soviet veto later deterred the UK and the US from requesting that the Security Council launch an inquiry into the Sverdlovsk incident.

Confidence-building measures

In an attempt to increase transparency and to build confidence in compliance, the BTWC Review Conferences in 1986 and 1991 developed Confidence-Building Measure (CBM) declaration formats to allow states parties to exchange data on an annual basis on their vaccine production facilities, bio-defence programmes, unusual outbreaks of infectious disease, and other categories relevant to the convention. Since the requirement to submit CBM reports is not legally binding, however, only a minority of BTWC states parties has

[13] Zilinskas, R. A., *op. cit.*, p. 215.

[14] Sims, N. A., The Evolution of Biological Disarmament, *op. cit.*, p. 53.

participated in the annual data exchanges on a consistent basis. The current status of the CBMs is reviewed elsewhere.[15]

Investigative mechanisms outside of the BTWC

Allegations of non-compliance with the BTWC can be raised and pursued in international forums outside of the treaty framework itself. Four such mechanisms have been developed over the past 30 years:

- field investigations of alleged use under the auspices of the UN Secretary-General;
- the disarmament and monitoring regime in Iraq created by UN Security Council resolutions;
- ad hoc inspection regimes established by individual states on a bilateral or trilateral basis, such as the Russia–UK–US Trilateral Agreement and the UK–US inspections in Libya; and
- 'societal verification' initiatives by non-governmental organisations (NGOs) and members of the scientific community.

Each of these mechanisms is discussed below.

UN Secretary-General investigations

The UN Secretary-General's authority, under Article 99 of the United Nations' Charter, to bring matters that may constitute a threat to international peace and security to the attention of the Security Council allows him/her to engage in fact-finding with respect to such issues. In addition, pursuant to a series of resolutions approved by the UN General Assembly, any member state can bring an allegation of biological or toxin weapons use to the attention of the Secretary-General and request that he/she initiate an investigation and make recommendations to correct the situation.

This mechanism came into existence in 1980, after the US had alleged that Soviet-allied governments in Laos and Vietnam were employing unspecified chemical weapon (CW) agents against two groups of insurgents: H'mong villagers in Laos who had fought on the side of the US during the Vietnam War; and Khmer Rouge guerrillas in Cambodia (then known as Democratic Kampuchea). Soon after the Soviet invasion of Afghanistan in December 1979, reports of chemical attacks also began to filter out of that country.

In response to political pressure from the US, the UN General Assembly adopted Resolution 35/144 C in December 1980, requesting that the UN Secretary-General investigate alleged cases of chemical warfare in Southeast Asia and Afghanistan. The relevant paragraphs of the resolution stated that the General Assembly:

[15] See the chapter on 'The contribution of CBMs to transparency' in this volume.

> 1. 'Decides to carry out an impartial investigation to ascertain the facts pertaining to these reports regarding the alleged use of chemical weapons and to assess the extent of damage caused by the use of chemical weapons'; and
> 2. 'Requests the Secretary-General to carry out such an investigation, inter alia, taking into account proposals advanced by the States on whose territories the use of chemical weapons has been reported, with the assistance of qualified medical and technical experts'.[16]

UN Secretary-General Kurt Waldheim duly organised and dispatched a Group of Experts from Egypt, Kenya, Peru and the Philippines, which conducted field investigations in Southeast Asia and Afghanistan between April and November 1981. This team was unable to reach a definitive judgment for three reasons: the long delay between the alleged attacks and the launch of the investigations; the refusal by the accused governments to cooperate with the team by granting its members access to the alleged attack sites; and the unreliable and conflicting testimony of purported eyewitnesses.[17] The report of the Group of Experts concluded: '[I]n the opinion of the Group, this report is inconclusive. Any investigation designed to lead to definitive conclusions regarding the alleged use of chemical weapons … would require timely access to the areas of alleged use of chemical warfare agents in order to establish the true facts. Such an exercise has so far not been possible'.[18]

Dissatisfied with this outcome, the General Assembly asked UN Secretary-General Javier Pérez de Cuéllar to launch a follow-on investigation, which he did in early 1982. In the meantime, on 13 September 1981, the US government identified the mysterious CW agent being used in Southeast Asia and Afghanistan as a mixture of fungal toxins known as trichothecene mycotoxins, which the press dubbed yellow rain.[19] Like the first UN Group of Experts, the second team was denied access to the alleged attack sites in Afghanistan, Cambodia and Laos and had to rely on indirect evidence, such as interviews with refugees at camps in Pakistan and Thailand. Because of the length of time that had elapsed between the purported toxic exposures and medical examinations of the victims, and the fact that the most severely affected individuals had reportedly died in remote areas or en route to the refugee camps, the UN experts could not identify characteristic signs and symptoms of exposure to particular chemical or toxin agents. Moreover, although the investigators obtained samples of yellow rain that had supposedly been collected in attack zones, the material was of uncertain provenance and chemical analyses failed to produce clear-cut results. Hence, the report of the second UN Group of Experts was as inconclusive as that of the first: 'While the Group could not state that these allegations had been proven, nevertheless it could not disregard the circumstantial evidence suggestive of the possible use of some sort of toxic chemical substance in some

[16] United Nations, General Assembly, 35th Session, 94th Plenary Meeting, Resolutions Adopted on the Reports of the First Committee, Resolution 35/144 C, 'Chemical and Bacteriological (Biological) Weapons', 12 December 1980.

[17] United Nations, General Assembly, 36th Session, 'Report of the Group of Experts to Investigate Reports on the Alleged Use of Chemical Weapons', A/36/613, Annex, 20 November 1981, p. 32.

[18] Ibid., p. 35.

[19] Tucker, Jonathan B., 'The "Yellow Rain" Controversy: Lessons for Arms Control Compliance', Nonproliferation Review, Vol. 8, No. 1 (Spring 2001), pp. 25–42.

instances'.[20]

The failure to reach a definitive technical judgment in the case of the yellow rain allegations highlighted the need to carry out a UN field investigation as soon as possible after an alleged attack while the forensic evidence was still fresh, to gain unrestricted access to the site of the incident, and to conduct medical examinations of the dead and injured. Accordingly, the General Assembly adopted Resolution 37/98 D in December 1982, broadening the mandate of the Secretary-General to launch field investigations. According to the relevant paragraph of this resolution, the General Assembly: 'Requests the Secretary-General to investigate, with the assistance of qualified experts, information that might be brought to his attention by any Member State concerning activities that might constitute a violation of the Geneva Protocol or of the relevant rules of customary international law in order to ascertain thereby the facts of the matter, and promptly to report the results of any such investigation to all Member States and to the General Assembly'.[21] Because the General Assembly's Rules of Procedure do not cover standards of evidence or burden of proof, any member state requesting an investigation of alleged use may base its appeal on whatever evidence it deems suitable.

The reference in General Assembly Resolution 37/98 D to the 1925 Geneva Protocol provided additional legal justification for the Secretary-General, acting pursuant to his fact-finding authority under the UN Charter, to investigate allegations of the use of biological and toxin agents in warfare, as well as chemical agents. Most international lawyers agree that the prohibitions enshrined in the Geneva Protocol have become part of the customary international law of armed conflict as a result of general adherence to the treaty and the declarations of international organisations. For that reason, the ban on the use of biological and toxin weapons in armed conflict applies to all states, regardless of whether or not they are party to the Geneva Protocol, and whether or not the country with which they are engaged in hostilities is a party.

Resolution 37/98 D also called on the UN Secretary-General to compile and maintain lists of qualified experts to conduct field investigations and of reference laboratories capable of analysing environmental and bio-medical samples, and to prepare a handbook detailing investigation procedures. To perform these tasks, the Secretary-General appointed a Group of Consultant Experts, which met in Geneva in April and September 1983 and in New York in August 1984.[22] Its 80-page report provided criteria to help the Secretary-General decide when to investigate an incident of alleged use, along with detailed guidelines for the conduct of such missions, including procedures for collecting and analysing environmental and bio-medical samples.[23] Three years later, this document was revised. Pursuant to General Assembly Resolution 42/37 C of 30 November 1987, a Group of Qualified Experts was requested to update the lists and the investigation

[20] United Nations, General Assembly, 37th Session, 'Report of the Group of Experts to Investigate Reports on the Alleged Use of Chemical Weapons', A/37/259, 1 December 1982, p. 50.

[21] United Nations, General Assembly, 37th Session, 'Chemical and Bacteriological (Biological) Weapons: Provisional Procedures to Uphold the Authority of the 1925 Geneva Protocol', Resolution 37/98 D, 13 December 1982.

[22] The Group of Consultant Experts met twice in 1983 but failed to complete its tasks under Resolution 37/98 D (see report A/35/435 of 19 October 1983). Consequently, the UN General Assembly adopted Resolution 38/187 C of 20 December 1983, calling on the Secretary-General to complete this work in 1984.

[23] United Nations, General Assembly, 39th Session, 'Chemical and Bacteriological (Biological) Weapons: Report of the Secretary-General', A/39/488, 2 October 1984.

guidelines.[24] This group met three times in 1988 and 1989 and issued the revised guidelines in October 1989.[25]

Following the inconclusive yellow rain investigations, three subsequent investigations of alleged CW use were conducted under the UN Secretary-General mechanism. In November 1983, in response to a complaint lodged by the Iranian government, the Security Council asked the Secretary-General to investigate the allegation that Iraqi forces had staged chemical attacks against Iranian troops during the ongoing Iran–Iraq War. In March 1984, Secretary-General Pérez de Cuéllar dispatched a Group of Experts to Iran. The Iranian government granted the UN team unrestricted access to the alleged attack sites and to soldiers suffering from chemical injuries. In their report, the experts concluded that Iranian troops had been attacked at various times with bombs or artillery shells loaded with mustard gas, nerve agents (tabun and sarin) and unknown pulmonary irritants.[26] Additional UN expert teams travelled to Iran in 1985, 1986 and 1988 to investigate subsequent Iranian allegations of Iraqi chemical attacks and confirmed the earlier findings. Yet despite the unequivocal evidence that Iraq was systematically violating the Geneva Protocol, the international community failed to impose any political or economic sanctions on Baghdad because national foreign policy priorities (such as preventing an Iranian victory) took precedence over the enforcement of international law. During the late 1980s, resolutions passed by the General Assembly (in 1987[27]) and the Security Council (in 1988[28]) confirmed the right of the UN Secretary-General to launch a field investigation on his/her own authority, rather than at the request of a member state.

Twice during 1992, Secretary-General Boutros Boutros-Ghali dispatched expert teams to investigate alleged chemical attacks. In January 1992, the government of Mozambique sent a letter to the Secretary-General alleging that the Mozambican National Resistance (RENAMO), a rebel organisation supported by the apartheid government of South Africa, had attacked its forces with chemical weapons. Mozambique requested an investigation of the incident, and on 18 March, Boutros-Ghali appointed a group of three experts from Sweden, Switzerland and the UK, who visited the country on 23–27 March. The UN team conducted interviews with purported victims, visited the alleged attack site and collected bio-medical and environmental samples for analysis. In their report, the experts concluded that the victims' signs and symptoms were 'consistent with the use of an atropine-like chemical' but could also have been caused by severe heat stress. Analyses of the environmental samples were negative for 20 common chemical warfare agents, although the extended lapse of time between the alleged attack and the collection of samples raised the possibility that chemical agents could have degraded to the point that they were no longer detectable. The UN team's negative findings appeared to be sufficiently compel-

[24] United Nations, General Assembly, 42nd Session, 'Chemical and Bacteriological (Biological) Weapons: Measures to Uphold the Authority of the 1925 Geneva Protocol and to Support the Conclusion of a Chemical Weapons Convention', Resolution 42/37 C, 30 November 1987.

[25] United Nations, General Assembly, 44th Session, 'Report of the Group of Qualified Experts Established in Pursuance of General Assembly Resolution 42/37 C', A/44/561, Annex I, 4 October 1989, pp. 11–43.

[26] United Nations, 'Report of the Specialists Appointed by the Secretary-General to Investigate Allegations by the Islamic Republic of Iran Concerning the Use of Chemical Weapons: Note by the Secretary-General', S/16433, 26 March 1984.

[27] United Nations, General Assembly, 42nd Session, Resolution 42/37 C, op. cit.

[28] United Nations, Security Council, Resolution 620, S/Res/620, 26 August 1988.

ling to lay the allegations to rest.[29] Nevertheless, some outside analysts have argued that political factors interfered with the objectivity of the Mozambique mission.[30]

Later in 1992, the Secretary-General launched another investigation of alleged CW use, this time in Azerbaijan. After the break up of the Soviet Union, Azerbaijan and Armenia had become embroiled in a dispute over Nagorno-Karabakh, an enclave within Azerbaijan populated mainly by Armenians. In April and May 1992, Armenian irregular forces attacked the Azerbaijani army, and the government of Azerbaijan sent a letter to the president of the Security Council alleging that the Armenians had used chemical weapons. Armenia denied the allegation and requested a UN field investigation to clear its name. On 19 June, the Secretary-General appointed three experts from Belgium, Sweden and Switzerland, who conducted an investigation in Azerbaijan on 5–8 July. They visited two alleged attack sites, interviewed purported victims and consulted with Azerbaijani and Armenian officials, but collected no samples. In their report, the UN experts wrote that they had found no evidence of chemical weapons use and that environmental contaminants suggestive of chemical warfare, such as cyanide, were probably by-products of conventional weapons. These negative findings were sufficiently convincing to end further charges against Armenia.[31]

Since 1992, no further cases of alleged CW or BW use have been pursued under the UN Secretary-General mechanism. The reason for this situation is two-fold. First, field investigations of the alleged use of chemical and toxin agents are now subsumed under the 1993 Chemical Weapons Convention (CWC), except for those UN member states that are not parties to the treaty. With respect to allegations of BW use, the draft compliance protocol to the BTWC, which was negotiated between 1995 and 2001 but failed to be adopted, included detailed provisions for the conduct of field investigations. As a result of these parallel efforts, the UN Secretary-General mechanism was allowed to atrophy and no effort was made to update the list of experts or to revise the 1989 inspection guidelines.

In the wake of the collapse of the BTWC protocol negotiations in 2001, member countries have discussed how best to revive and strengthen the UN Secretary-General mechanism in order to investigate allegations of biological and toxin weapons use. For example, the UK government proposed in July 2004 that the Secretary-General mechanism be strengthened by updating the roster of scientific specialists who can be called up at short notice, designating reference laboratories to support the investigations, and revising the 1989 manual of field investigation procedures to take account of recent experiences and improvements in analytical science and technology.[32] Some non-governmental experts have also suggested the creation of a standing UN verification body, which would be equipped with inspection equipment and personal protective gear, and might also have a dedicated aircraft at its disposal to ferry inspectors rapidly to the

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[29] Tucker, Jonathan B. and Zilinskas, Raymond A., 'UN Field Investigations: The Historical Record' (sidebar), in 'Assessing U.S. Proposals to Strengthen the Biological Weapons Convention', Arms Control Today, Vol. 32, no. 3 (April 2002), pp. 12–13, www.armscontrol.org/act/2002_04/tuczilapril02.asp.

[30] McCreight, Robert E. and Weigert, Stephen L., 'Up in Smoke: Political Realities and Chemical Weapons Use Allegations during Mozambique's Civil War', International Politics, Vol. 38, No. 2 (June 2001), pp. 253–272.

[31] Tucker, Jonathan B., and Zilinskas, Raymond A., op. cit.

[32] United Kingdom, 'Enhancing International Capabilities for Responding to, Investigating and Mitigating the Effects of Cases of Alleged Use of Biological or Toxin Weapons or Suspicious Outbreaks of Disease', BWC/MSP/2004/MX/WP.56, Meeting of Experts, Geneva, Switzerland, 23 July 2004.

site of an alleged attack.[33]

Other experts have explored the possible role of the World Health Organization (WHO) in investigating unusual outbreaks of infectious disease, which might be associated with the deliberate release of biological threat agents. In recent years, WHO has stated that public health preparedness for biological warfare and bio-terrorism are within its institutional mandate[34] and that it plans to work with the World Organization for Animal Health (OIE) and the Food and Agriculture Organization (FAO) to establish a Global Early Warning System to detect outbreaks of infectious disease whose origins may be either natural or deliberate.[35] At the same time, WHO is deeply wary of jeopardising its political neutrality, which could interfere with its ability to gain access to member countries and fulfil its primary mission of investigating and responding to epidemics. Accordingly, WHO plans to base its outbreak investigations exclusively on public health concerns, while avoiding politically sensitive judgments related to BTWC compliance.

Country-specific multilateral inspections

Following Iraq's defeat in the 1990–91 Gulf War, the UN Security Council passed Resolution 687 imposing a ceasefire, on the condition that the country declare and eliminate (or render harmless) all of its nuclear, chemical and biological weapons, and its ballistic missiles with a range of greater than 100 kilometres.[36] To verify the disarmament process, the Security Council established the United Nations Special Commission (UNSCOM), which operated in Iraq for the next seven years. Throughout this period, Iraq engaged in persistent efforts at obstruction, deception and denial to impede the work of the UN inspectors. In response, the Special Commission, backed by the political authority of the Security Council, set a new standard for intrusiveness with regard to suspect-site investigations and the ongoing monitoring and verification (OMV) of dual-use facilities.[37] In 1998, however, a series of escalating confrontations with the Iraqi regime over access to 'presidential' sites led to the withdrawal of the UNSCOM inspectors in December, shortly before the UK and the US launched a punitive bombing campaign called Operation Desert Fox. After the attack, Iraq refused to allow the UN inspectors back into the country.

In retrospect, the UNSCOM process was successful at ferreting out the clandestine Iraqi BW programme in the face of the regime's persistent efforts at deception and denial. UN analysts undertook a 'systems' approach to investigations that involved piecing together a

[33] Rosenberg, Barbara Hatch, 'WMD Investigations by the UN', unpublished paper, 15 July 2004.

[34] 55th World Health Assembly, Agenda Item 13.15, 'Global public health response to natural occurrence, accidental release or deliberate use of biological and chemical agents or radionuclear material that affect health', WHA55.16, Geneva, Switzerland, 18 May 2002.

[35] 'Mechanisms being Implemented for Response to Outbreaks of Disease by Intergovernmental Organizations (World Health Organization (WHO), Food and Agricultural Organization (FAO), World Organization for Animal Health /Office International des Epizooties (OIE)): Background paper prepared by the Secretariat', BWC/MSP/2004/MX/INF.2/Summary, Meeting of Experts, Geneva, Switzerland, 18 June 2004, p. 2.

[36] United Nations, Security Council, Resolution 687, S/Res/687, 3 April 1991.

[37] Tucker, Jonathan B., 'Monitoring and Verification in a Noncooperative Environment: Lessons from the U.N. Experience in Iraq', Nonproliferation Review, Vol. 3, No. 3 (Spring–Summer 1996), pp. 1–14, www.cns.miis.edu/pubs/npr/vol03/33/tucker33.pdf.

mosaic of information from a wide variety of sources, including official documents, interviews with Iraqi officials, on-site inspections, and forensic accounting, such as calculating the 'mass balance' between the quantity of a dual-use material purchased by Iraq and the amount consumed. In 1995, for example, UN analysts identified a 17-tonne discrepancy between Iraq's known imports of bacterial culture media from foreign suppliers and the documented use of the material for legitimate purposes, including clinical diagnosis and commercial production. This huge imbalance suggested that the missing media had been diverted for the large-scale cultivation of BW agents.[38] By summer 1995, UNSCOM's persistent detective work had exposed the broad outlines of the Iraqi BW programme despite Baghdad's determined efforts at concealment.

On 1 July 1995, Iraqi officials finally admitted to having mass-produced anthrax bacteria, botulinum toxin and aflatoxin, but they continued to deny that these agents had been loaded into munitions. On 7 August 1995, General Hussein Kamel, the mastermind behind the Iraqi BW programme, defected to Jordan. This event prompted Iraq to release to UNSCOM a vast collection of previously hidden documents related to proscribed weapons activities and to revise its earlier declarations. In addition, during an interview in Amman, Jordan, with UNSCOM Executive Chairman Rolf Ekéus, General Kamel revealed that, shortly before the 1990–91 Gulf War, the Iraqis had filled R-400 aerial bombs and Scud missile warheads with biological agents. UNSCOM also identified Iraq's main BW agent production facility, the Al Hakam Factory, which the Iraqi authorities had claimed was a commercial plant for producing bio-pesticide and single-cell protein (an animal-feed supplement). In July 1996, the UN inspectors razed Al Hakam to the ground. As a result, UNSCOM not only exposed the Iraqi BW programme but eliminated most of its production capacity. These actions, combined with economic sanctions and import controls, impeded the reconstitution of the programme even after the UN inspectors withdrew from the country in December 1998.

Although UNSCOM was a technical success, it lost political credibility during 1998 because of the perception that it was too close to the United States, including evidence that the Central Intelligence Agency (CIA) was conducting intelligence operations against the Iraqi regime under the cover of UNSCOM. Accordingly, the Special Commission was disbanded, and a successor organisation with a new legal mandate was established in December 1999 under Security Council Resolution 1284.[39] The new organisation was called the United Nations Monitoring, Verification and Inspection Commission (UNMOVIC), and it spent the first three years of its existence preparing for inspections in Iraq. It was not until November 2002, when war clouds were gathering on the horizon, that Baghdad finally allowed UNMOVIC to begin in-country operations. But the UN inspectors were buffeted by political pressures, including harsh criticism of their competency by senior US government officials, and they had only three months to do their work before American and British forces invaded Iraq on 20 March 2003.

In the months following the war in Iraq, the US failed to discover biological weapons (or any other prohibited arms), suggesting that the UN inspections and OMV had been far more effective at eliminating and preventing the reconstitution of the Iraqi BW programme than had been believed at the time. Although the CIA-led Iraq Survey Group

[38] Black, Stephen, 'UNSCOM and the Iraqi Biological Weapons Program: Technical Success, Political Failure', in Wright, Susan (ed), Biological Warfare and Disarmament: New Problems/New Perspectives, (Lanham, MD: Rowman & Littlefield Publishers, 2002), pp. 285–309.

[39] United Nations, Security Council, Resolution 1284, S/Res/1284, 17 December 1999.

uncovered evidence of ongoing BW research and development, it found no indication of renewed production or weaponisation. Given the apparent success of the UN weapons inspections in disarming Iraq, some analysts have proposed that UNMOVIC be preserved as a permanent subsidiary body of the Security Council—or that at least its expertise and experience in the fields of biological and missile verification be retained.[40]

Bilateral or trilateral inspection agreements

A few countries have established ad hoc inspection mechanisms for the purposes of either verification or confidence-building. In 1989 and 1992, senior Soviet biological scientists defected to the UK and the US and revealed the existence of a massive, clandestine Soviet bio-warfare programme that was in flagrant breach of the BTWC. On 14 September 1992, less than a year after the break up of the Soviet Union, the Russian Federation, the United Kingdom and the United States signed a Trilateral Agreement that sought to dispel the fog of secrecy shrouding the former Soviet BW programme and to verify that its illicit activities had come to an end.[41] Under this agreement, Russian President Boris Yeltsin agreed to allow visits by UK and US experts to any non-military biological site on the territory of Russia in order to resolve outstanding questions about BTWC compliance. To save face, however, Moscow insisted on the right to conduct reciprocal inspections at sites of its choosing in the UK and the US.

In 1993 and 1994, the UK–US inspection team visited four former Soviet BW facilities at Berdsk, Obolensk, Omutninsk and Pokrov, and obtained compelling evidence that the Soviet Union had violated the BTWC from 1975 until its demise in December 1991. The Russians, for their part, conducted reciprocal inspections in the US at two Pfizer pharmaceutical facilities and the Department of Agriculture's Plum Island Animal Disease Center, and in the UK at Evans Medical Limited, a drug company based in Liverpool. After completion of the site visits, Moscow tried to offset the evidence of its own non-compliance by levelling false charges that the UK and the US were retaining 'mothballed' BW production facilities. The Russian government also rejected American and British requests to extend the inspections to secret microbiological facilities under the control of the Russian Ministry of Defence.

On the positive side of the ledger, the Trilateral Agreement demonstrated that despite limited access to facilities and a lack of cooperation from the host country, OSIs could still detect 'signatures' of an offensive BW programme. On the negative side, Moscow passed up an opportunity to demonstrate its current compliance with the BTWC, and its lack of transparency and political will brought the inspections process to an end without resolving serious UK and US concerns. According to the late British bio-weapons expert David C. Kelly, 'The Trilateral Agreement failed dramatically, as Russia proved unwilling to acknowledge and fully account for either the former Soviet programme or the BW activities that it had inherited and continued to engage in. This included refusing access

[40] Findlay, Trevor, 'Preserving UNMOVIC: The Institutional Possibilities', Disarmament Diplomacy, No. 76 (March–April 2004), pp. 26–30.

[41] 'Joint Statement on Biological Weapons by the Governments of the United Kingdom, the United States, and the Russian Federation', 10–11 September 1992, http://projects.sipri.se/cbw/docs/cbw-trilateralagree.html.

by American and British inspectors to its military biological sites'.[42]

More recently, in December 2003, Libyan leader Muammar Gaddafi declared his intention to renounce his nuclear, chemical and biological weapons programmes in exchange for the lifting of economic sanctions. Although the Libyan government admitted the existence of a past BW research and development programme, it denied having ever produced or stockpiled actual weapons. On 18 January 2004, the first of several teams of American and British experts travelled to Libya to inspect its biological laboratories and to interview key bio-medical scientists.[43] The investigators were granted broad access and reportedly found no concrete evidence of an ongoing BW programme.[44]

Civil society monitoring

Another approach to BTWC compliance monitoring and clarification is 'civil society monitoring', including the conduct of independent inspections and the analysis of open-source information by NGOs and private individuals.[45] For example, after a senior US government official alleged in May 2002 that Cuba had an ongoing BW development programme,[46] the Washington-based Center for Defense Information (CDI) requested and obtained permission from the Cuban government to visit nine biotechnology facilities on the island that émigrés and other sources had implicated in illicit activities. On 6–9 October 2002, the CDI sent a ten-person delegation to Cuba, including two scientists, a former UN weapons inspector, a Cuba specialist and a retired general. These experts were granted unrestricted access to all nine biotechnology facilities and found no evidence to support the US government's allegations.[47] Although this visit was not as rigorous as a true weapons inspection, it served a useful confidence-building function. Since then, the CDI has conducted two follow-on trips to Cuba and visited four additional biotechnology facilities.

Of course, cursory site visits are not sufficient for BTWC compliance monitoring, which requires an ongoing effort to verify that a country's capabilities and activities on the ground match what it has declared and to assess its level of cooperation with the inspections process.[48] Even so, the Cuban government's efforts at transparency may have had a

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[42] Kelly, David C., 'The Trilateral Agreement: Lessons for biological weapons verification', in Findlay, Trevor and Meier, Oliver (eds.), Verification Yearbook 2002, (London: Verification Research, Training and Information Centre, 2002), p. 93.

[43] Warrick, Joby and Slevin, Peter, 'Libya's Disclosures Put Weapons in New Light', Washington Post, 2 March 2004, p. A01.

[44] Shoham, Dany, 'Libya: The First Real Case of Deproliferation in the Middle East?', Disarmament Diplomacy, No. 77 (May–June 2004), p. 41.

[45] Meier, Oliver and Tenner, Clare, 'Non-governmental monitoring of international agreements', in Findlay, Trevor and Meier, Oliver (eds), Verification Yearbook 2001, (London: Verification Research, Training and Information Centre, 2001), pp. 207–227.

[46] Bolton, John R., Under Secretary of State for Arms Control and International Security, 'Beyond the Axis of Evil: Additional Threats from Weapons of Mass Destruction', speech to the Heritage Foundation, Washington, DC, 6 May 2002.

[47] Baker, Glenn (ed), Cuban Biotechnology: A First-Hand Report, (Washington, DC: Center for Defense Information, May 2003).

[48] Ifft, Edward, 'Iraq and the Value of On-Site Inspections', Arms Control Today, Vol. 34, No. 9 (November 2004), pp. 21–28, www.armscontrol.org/act/2004_11/Ifft.asp.

positive effect. In September 2004, the New York Times reported that the US intelligence community, using more stringent standards adopted after the failure to find prohibited weapons in Iraq, was backing away from its earlier assessment of Cuba's BW activities and had now 'concluded that it was no longer clear that Cuba has an active, offensive bio-weapons program'.[49]

The crucial role of scientists in the development of biological weapons has led to proposals calling for professional codes of conduct for biologists, similar to the Hippocratic Oath for physicians.[50] In addition, some universities and NGOs are preparing educational products to raise the awareness of graduate students and professional researchers about the potential misuse of new discoveries in microbiology, molecular biology and related fields. The Federation of American Scientists (FAS), for instance, is developing an interactive teaching module to promote awareness of bio-security issues among researchers in the life sciences.[51] Individual scientists have also been encouraged to 'blow the whistle' if they detect activities related to offensive biological warfare. One analyst contends that the scientific community could perform a function analogous to a 'global immune system' to detect and expose illicit BW development projects.[52]

Conclusion

At present, the BTWC compliance regime consists of a patchwork of ad hoc mechanisms, operating both inside and outside of the framework of the convention itself. Although these measures have been employed at various times to look into alleged violations or to build confidence in treaty compliance, none has been particularly effective. Regrettably, the six-year effort to negotiate a BTWC protocol that would have established a more formal and coherent verification system ended in failure in 2001, a débâcle attributable both to a flawed negotiating mandate and to resistance to intrusive inspections on the part of some key member states.[53] The Fifth Review Conference of the BTWC, which concluded in 2002, sought to fill the void created by the collapse of the protocol negotiations by agreeing that states parties would meet twice yearly until the next Review Conference in 2006 'to discuss, and promote common understanding and effective action on' five specific topics related to implementation of the BTWC. This 'new process' has focussed on voluntary national measures, such as bio-security regulations, penal legislation, disease surveillance and scientific codes of conduct.[54] Although the current effort is modest and time-limited, it is to be hoped that the 2006 Review Conference will launch a

[49] Steven R. Weisman, 'In Stricter Study, U.S. Scales Back Claim on Cuba Arms', New York Times, 18 September 2004, p. A7.

[50] For example, see Rappert, Brian, 'Towards a life sciences code: Countering the threats from biological weapons', Briefing Paper No. 13 (Second Series), Bradford Project on Strengthening the Biological Weapons Convention, September 2004, www.brad.ac.uk/acad/sbtwc/briefing/BP_13_2ndseries.pdf.

[51] Federation of American Scientists (FAS), 'Biosecurity Education for Biological Researchers', www.fas.org/main/content.jsp?formAction=297&contentId=150.

[52] This concept was developed by Joshua Epstein of the Brookings Institution in Washington, DC.

[53] Ward, Kenneth D., 'The BWC Protocol: Mandate for Failure', Nonproliferation Review, Vol. 11, No. 2 (Summer 2004), pp. 183–99, www.cns.miis.edu/pubs/npr/vol11/112/112ward.pdf.

[54] Tucker, Jonathan B., 'The BWC New Process: A Preliminary Assessment', Nonproliferation Review, Vol. 11, No. 1 (Spring 2004), pp. 26–39, www.cns.miis.edu/pubs/npr/vol11/111/111tucker.pdf.

more sustainable and effective multilateral process to enhance BTWC compliance and deter violations.[55]

[55] For one approach, see Tucker, Jonathan B., 'Strengthening the BWC: A Way Forward', Disarmament Diplomacy, No. 78 (July–August 2004), pp. 24–30, www.acronym.org.uk/dd/dd78/78jbt.htm.

Advances in science and technology: Present and future threats[1]

Some biologists have expressed concern about the potential impact of genetic engineering on the prospects for biological warfare almost from the time that the former became possible.[2] Since the mid-1990s, an increasing number of such warnings have been issued from official sources[3] and by microbiologists.[4] The medical profession, in particular, has demonstrated mounting concern about the kinds of agents that may be developed and employed for hostile purposes.[5]

The recent warnings have made it clear that the world could well see a broader range of biological agents being utilised by terrorists and parties to conflicts in coming decades. George Poste,[6] for example, has emphasised the need to think 'beyond bugs', and, more generally, Mathew Meselson has argued convincingly that, as the years pass, more and more of life's fundamental processes will become open to benign and malign manipulation.[7]

As a starting point, a paper written in 2003 by three US Department of Defense analysts[8]—perhaps the most systematic assessment available in the public domain—is used to develop a framework for thinking about future trends. The three authors consider the evolution of biological warfare in three phases.

- As there are only a limited number of traditional biological warfare agents suitable for use they suggest that the defence will eventually be able to counter all of them.
- Moreover, as there are only a limited number of ways in which traditional agents may be effectively modified, the defence will also eventually be able to counter all of them.

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[1] Parts of this report are taken from a paper commissioned by the Controlling Dangerous Pathogens Project, Center for International Security Studies, School of Public Affairs, University of Maryland, US, August 2004, www.brad.ac.uk/acad/sbtwc.

[2] Geissler, E., 'A new generation of biological weapons', in Geissler, E. (ed), *Biological and Toxin Weapons Today*, (Oxford: Oxford University Press, 1986), pp. 21–35.

[3] Cohen. W., *Proliferation: Threat and Response*, (Washington, DC: Department of Defense, 1997).

[4] Nixdorff, K., Brauburger, J. and Hahlbohm. D., 'The biotechnology revolution: the science and applications', in Dando, M., Pearson, G. and Tóth, T. (eds), *Verification of the Biological and Toxin Weapons Convention*, (Dordrecht: Kluwer Academic Publishers, 1997), pp. 77–124.

[5] Nathanson, V., Darvell, M. and Dando, M.R., *Biotechnology, Weapons and Humanity*, (London: Harwood Academic Publishers (for the British Medical Association), 1999). Also see International Committee of the Red Cross (ICRC), *Biotechnology, weapons and humanity: summary report of an informal meeting of government and independent experts*, Montreux, Switzerland, 23–24 September, (Geneva: ICRC, 2002).

[6] Poste, G., *Advances in biotechnology: promise or peril*, 2002, www.hopkins-defense.org/sympost/trans-cripts/trans/post.html.

[7] Meselson, M., *The problem of biological weapons*, presentation at the eighteenth slated meeting of the American Academy of Arts and Sciences, Cambridge, MA, 13 January 1999.

[8] Petro, J. B., Plasse, T.R. and McNulty, J. A., 'Biotechnology: impact on biological warfare and biodefense', *Biosecurity and Bioterrorism: Biodefense Strategy, Practice and Science*, Vol. 2, 2003, pp. 161–168.

- However, as Meselson asserts, as the twenty-first century unfolds, a growing number of targets will become available for which specific advanced biological warfare agents may be designed.

Preventive arms control criteria emphasises the need for monitoring research in areas relevant to biological weapons (BW), to provide possible early warning of potentially dangerous developments.[9] The following section of the BioWeapons Report (BWR) thus presents an analysis of developments in research in microbiology, immunology, the nervous system, animal diseases and plant diseases. In each area a current cause of concern is set out in an introduction, followed by a look at the possible modification of traditional agents, and finally, a discussion of possible advanced biological warfare agents as well as other advances.

Immunology: vulnerability of the immune system to modulation

The immune system plays a crucial role in protecting against infectious diseases. This is clearly demonstrated in the case of individuals with genetic defects in certain immune mechanisms, which frequently result in death, despite the use of antibiotics or other chemotherapeutic agents. Indeed, the pathogenicity of a microorganism can only rightly be defined within the scope of its interaction with the immune system.

In this age of rapid biomedical and biotechnological advances, far-reaching manipulation of microorganisms is now possible that can change their properties drastically. Experiments to manipulate microorganisms are being carried out daily, with peaceful aims in mind for the most part, such as elucidation of the pathogenic mechanisms of an infectious agent, which, in turn, could point the way to the development of better prophylactic and therapeutic measures to counter infections more successfully.

It has become evident, though, that these experiments can lead to the creation of particularly dangerous microorganisms that can evade the responses of the immune system in devastating ways. A prime example is the inadvertent creation of a killer mousepox virus by researchers trying to develop a contraceptive vaccine to control the rodent population of Australia.[10] Particularly disturbing is the fact that another scientist, Professor Mark Buller of St. Louis University, has picked up on these experiments and taken them forward by increasing the lethality of the mousepox virus and by proposing to carry out similar manipulations with respect to the cowpox virus.[11]

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[9] Nixdorff, K., Hotz, M., Schilling, D. and Dando, M., *Biotechnology and the Biological Weapons Convention*, (Münster: Agenda Verlag, 2003).

[10] Nowak, R., 'Disaster in the making. An engineered mouse virus leaves us one step away from the ultimate bioweapon', *New Scientist*, 13 January 2001, pp. 4–5. Also see Jackson, R.J., Ramsay, A.J., Christensen, C., Beaton, S., Hall, D.F.R. and Ramshaw, I.A., 'Expression of mouse interleukin-4 by a recombinant ectromelia virus suppresses cytolytic lymphocyte responses and overcomes genetic resistance to mousepox', *Journal of Virology*, Vol. 75, 2001, pp. 1205–1210.

[11] Buller, M., 'The potential use of genetic engineering to enhance orthopoxviruses as bioweapons', presentation at the international conference on 'Smallpox Biosecurity. Preventing the Unthinkable', Geneva, Switzerland, 21–22 October 2003. Also see Steinbruner, J.D. and Harris, E.D., 'When science breeds nightmares', *International Herald Tribune*, 3 December 2003, p. 8., and MacKenzie, D., 'US develops lethal new viruses', *New Scientist*, Vol. 180, 2003, p. 6.

To date, the focus has primarily been on concerns about the possibilities of manipulating the properties of microorganisms to make them more robust and pathogenic. It is evident from the example cited above that the real target is the immune system, and how vulnerable it is to evasion mechanisms, which naturally potentiate the pathogenicity of the infective agents. This represents a change of focus from the microorganism to the target of systems biology and how it might be misused. The situation is accentuated by the fact that the National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH), USA, has expanded its programme significantly in order to attract scientists to the area of biodefence research.[12] Within this programme, immunology, as it relates to biodefence, is afforded special attention. In this report (reference 13), it was stated that NIAID has awarded a multi-component grant to create an 'encyclopedia' of innate immunity, a comprehensive and detailed picture of the type of immunity that represents the essential first line of defence against infectious diseases. The stated goal is to gain knowledge that could lead to the development of treatments for infectious diseases. At the same time, though, this information could provide a blueprint for malign attack of the immune system.

In order to appreciate the dilemma of dual use and the possibilities for misuse in this area, a brief description of scientific and technological aspects underlying research activities in this field, including elements of the innate and acquired immune systems, will be provided. In addition, the immune evasion mechanisms utilised by some microorganisms will be outlined. With this background, examples of research in which microorganisms have been created that evade immune defences will be presented, along with analysis of the dual use aspects involved. Finally, there is an examination of possible future threats pertaining to the vulnerability of the immune system.

Scientific and technological background

Mammalian immune systems

The hallmark of the immune system is its ability to respond to an invasion of the body by microorganisms or toxic components in ways that afford protection against the detrimental effects that could occur. The responses of the immune system include both specific (adaptive immune system) and non-specific (innate immune system) components. These components react in different ways to antigens, which are substances that are foreign to the host. Elements of innate and adaptive immunity are listed in Table 1.

The innate immune system includes components that are present and ready for action even before an antigen challenge is encountered. These are cellular and molecular components that are less specific than those of the adaptive system. That is, they are not specific for a particular antigen, but, rather, react to classes of antigenic substances from microorganisms called pathogen-associated molecular patterns (PAMPs). Several components of the innate immune system must be activated by agonists like PAMPs, although this activation can occur within minutes or hours as opposed to days. Therefore, innate responses are quicker, but the immunity they afford may not be as effective over as long a period as adaptive immunity. Nevertheless, the innate immune system represents the all-important first line of defence against pathogens and is essential for keeping an

[12] National Institutes of Health (NIH), 'NIAID biodefense research agenda for CDC category A agents. Progress Report', August 2003, www.niaid.nih.gov/biodefense/research/bioresearchagenda.pdf.

infection in check before adaptive immunity can be induced. If innate immunity is attacked malignly, the battle against infections is lost from the start.

Table 1: Features of Innate and Adaptive (Specific) Immunity*

Feature	Innate Immunity	Adaptive Immunity
Characteristics		
Specificity for microorganisms	Relatively low (PAMPs)a	High (specific antigens)
Diversity	Limited	Large
Specialization	Relatively stereotypic	Highly specialised
Memory	No	Yes
Components		
Physical and chemical barriers	Skin, mucosal epithelia; anti-microbial chemicals e.g. defensins	Cutaneous and mucosal immune systems; secreted antibodies
Blood proteins	Complement	Antibodies
Cells	Phagocytes (macrophages, neutrophils), Natural killer cells	Lymphocytes (B cells that produce antibodies; T cells that carry out cell-mediated reactions

Notes: a = PAMPs are pathogen-associated molecular patterns.
Receptors for PAMPS are Toll-like receptors (TLRs)

* Abbas, A.K., Lichtman, A.H. and Pober, J.S., *Cellular and Molecular Immunology*, Third Edition, (Philadelphia, PA: W.B. Saunders Company, 1997).

The specific components form the basis of adaptive immune responses, which involve the actions of B and T lymphocytes. These are the so-called immunocompetent cells of the immune system, because they are able to react to an antigen challenge with a high degree of specificity, resulting in an immune response. Activation of lymphocytes occurs through the binding of specific antigens to their specific receptors that are found on the surface of the cells. In the case of B cells, these receptors are membrane-bound antibodies. The antigen receptors of T cells are called the T cell receptor (TCR). T cells are further subdivided into T helper cells (Th) and cytotoxic T cells (CTL or Tc). When receptors on the cell surface of lymphocytes bind to specific antigens, this initiates a signal that is carried over to the inner part of the cell, which leads in the end to its activation to a stage that enables it to carry out its function. The function of B lymphocytes is to produce antibodies while the function of T lymphocytes is to help regulate immune responses (in the case of T helper cells) or to initiate the death of infected cells (in the case of cytotoxic T cells).

Prominent signal cascades operating in cells of the immune system are presented in Figure 1. This activation of lymphocytes to effector cells (cells able to carry out their function) usually takes between five and six days, resulting in the production of antibod-

ies by the B lymphocytes and other effector molecules by the T lymphocytes. In the course of activation, so-called memory cells of both B and T lymphocytes are developed, which can respond more quickly to antigen during a secondary or later challenge. Thus, adaptive immunity affords a high degree of protection, but it takes time to be induced.

Macrophages occupy a central position in the immune system, being active both in innate and adaptive immune responses. In innate immunity, macrophages are activated through engagement of receptors on the cell surface by substances called agonists. Most prominent among receptors on the macrophage surface are the Toll-like receptors (TLRs). The latter derive their name from the similarity with the transmembrane receptor protein Toll in the fruit fly *Drosophila*, which is involved in the development of the flies and in

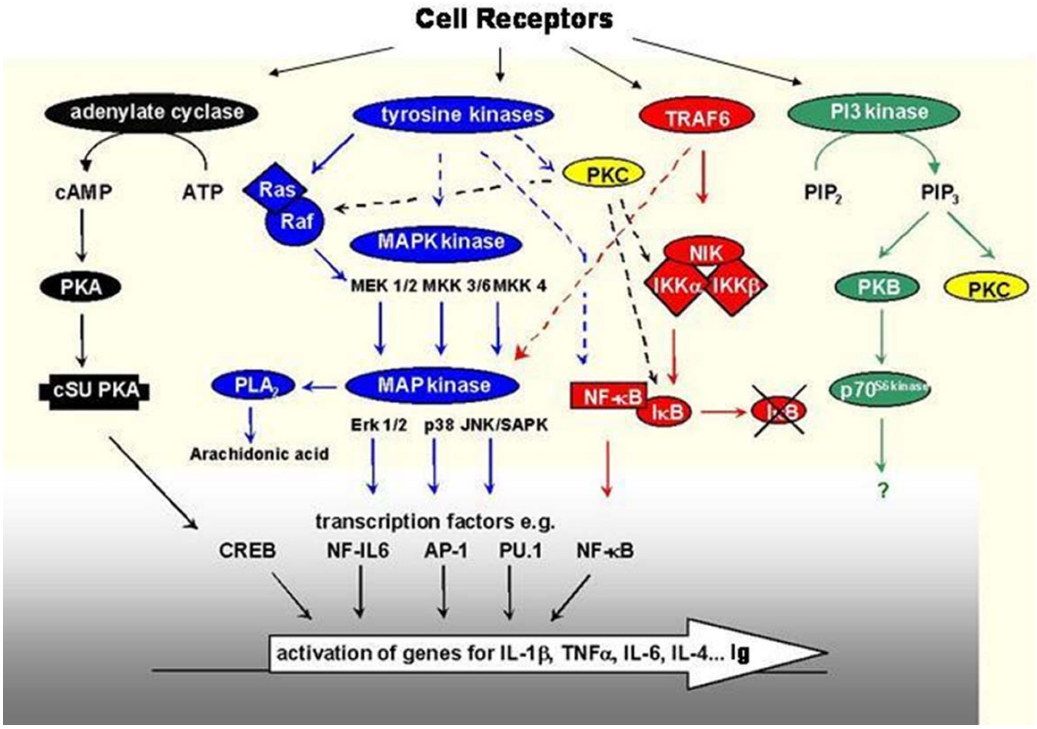

Figure 1: Prominent Signal Transduction Pathways in Cells of the Immune System*

Substances that can activate cells (agonists) bind to receptors for those agonists on the surface of the cells. This induces a reaction that is transferred from the receptors to the inner part of the cells, inducing the activation of kinases, which are enzymes that transduce the signal further. This starts a cascade of subsequent biochemical reactions, leading to the activation of transcription factors (such as CREB, NF-IL-6, AP-1, PU.1, NF-κB) that induce the expression of genes that control the synthesis of biologically active substances like the cytokines interleukin (IL)-1β, IL-6, IL-4, tumour necrosis factor alpha (TNF α) or antibodies (Ig).

* Schilling, D., *Untersuchungen zur differenzierten Regulation der Produktion proinflammatorischer Cytokine und Charakterisierung der negativen Regulation von Interleukin-1 in Lipopolysacccharid-aktivierten Makrophagen*, [Studies on the Differential Regulation of the Production of Proinflammatory Cytokines and Characterization of the Negative Regulation of Interleukin 1 in Lipopolysaccharide-activated Macrophages], Doctoral Dissertation, (Darmstadt: TU Darmstadt, 2000)

protecting them against fungal infections. This has been termed ‘an ancient system of

host defense'.[13]

Up to now, ten different TLRs (TLR1–TLR10) in humans have been described. These molecules contain a characteristic leucine-rich extracellular domain (LLR), which recognises the conserved structures of the PAMPs and leads in the end through a signalling cascade to the activation of genes that control the production of inflammatory cytokines,[14] as depicted in Figure 1.

Macrophages produce type I interferons (a and b), which are cytokines that are essential for successful defence against many viral infections. They are also potent producers of inflammatory cytokines, including interleukin 1 beta (IL-1β), IL-6 and tumour necrosis factor alpha (TNFα), which mediate reactions designed to combat infections. When these cytokines are produced in moderate amounts, they contribute greatly to defence mechanisms directed against pathogens and to the healing process in general. If they are produced in particularly large amounts or continually during chronic illness, this can lead to various disorders like coronary insufficiency, thrombus formation, hypoglycemia, and, in some cases, even to shock and death.[15] This makes these activities particularly vulnerable to malign modulation, such as by targeting the TLRs to induce hyper-responses, or by inhibiting key components in signalling cascades that would upset the balance. It is interesting to note in this regard that IL-1 was reported to be effective in aerosol form in pulmonary absorption studies carried out by the US Army under its medical research programme.[16]

Innate immunity of plants

Plants also exhibit a type of innate immunity, revealed by their resistance to certain pathogens.[17] Essentially, two kinds of reactions are recognised. One is cultivar-specific, and involves complementary pairs of pathogen-encoded avirulence genes (AVR) and plant-encoded resistance (R) genes. The interaction of AVR proteins with plant R proteins elicits plant defence reactions. The other kind of reaction involves a large variety of microbe-associated products, resembling the PAMPs described above, for mammalian systems. The vast majority of plant R proteins that have been characterised resemble modular structures of the LRR-containing Toll-like receptors or the more recently discovered intracellular nucleotide-binding oligomerization domain (Nod)-LRR proteins also implicated in PAMP recognition in humans.[18]

Similar to the macrophages discussed above, plants may be attacked through their innate

[13] Medzhitov, R. and Janeway, C.A., Jr., 'An ancient system of host defense', *Current Opinion in Immunology*, Vol. 10, 1998, pp. 12–15.

[14] Medzhitov, R., Preston-Hurlburt, P. and Janeway, C.A., Jr., 'A human homologue of the Drosophila Toll protein signals activation of adaptive immunity', *Nature*, Vol. 388, 1997, pp. 394–397. Also see Akira, S. 'Mammalian Toll-like receptors', *Current Opinion in Immunology*, Vol. 15, 2003, pp. 5–11, and Triantafilou, M. and Triantafilou, K., 'Lipopolysaccharide recognition: CD14, TLRs and the LPS-activation cluster', *Trends in Immunology*, Vol. 23, 2002, pp. 301–304.

[15] Rietschel, E.T. and Brade, H., 'Bacterial endotoxins', *Scientific American*, Vol. 267, 1992, pp. 54–61.

[16] Rosenberg, B. and Burck, G., 'Verification of compliance with the Biological Weapons Convention', in Wright, S. (ed), *Preventing a Biological Arms Race*, (Cambridge, MA: The MIT Press, 1990), pp. 301–329.

[17] Parker, J.E., 'Plant recognition of microbial patterns', *Trends in Plant Science*, 8(6), 2002, pp. 245–247. Also see Nürnberger, T. and Brunner, F., 'Innate immunity in plants and animals: emerging parallels between the recognition of general elicitors and pathogen-associated molecular patterns', *Current Opinion in Plant Biology*, Vol. 5, 2002, pp. 318–324.

[18] Inohara, N. and Nunez, G., 'Nods: intracellular proteins involved in inflammation and apoptosis', *Nature Reviews Immunology*, Vol. 3, 2003, pp. 371–382.

immune systems, for example by targeting either the receptors of signalling cascades, or by inhibiting or producing an over-reaction in a signalling cascade via the use of inhibitors of key components in that cascade.

Immune evasion by microorganisms

Antigenic variation
There are numerous reports in the scientific literature documenting the fact that some microorganisms frequently vary their antigenic composition through mutation of antigen genes and are thus able to circumvent or evade immune defence mechanisms. Indeed, the mutation rate of antigen genes in these microorganisms is much higher than normal.

Apart from antigenic variation due to intrinsic high mutation rates, variants may be selected as a result of pressures applied by the immune system. Those antigens that elicit the strongest immune response will be subject to the greatest immune selection pressures, favouring the emergence (selection) of microorganisms with changed antigenic composition.[19]

Additional immune evasion mechanisms
In addition to antigenic variation, viruses in particular have devised a whole array of mechanisms that allow them to evade immune defences. The large DNA viruses are most successful in this respect.[20]

One of the most important mechanisms in innate immunity is the complement system. This is a group of serum proteins consisting of approximately 30 factors that circulate in the serum in an inactive state. The complement system can be activated by a variety of specific and non-specific immunologic mechanisms.[21] The vital role of the complement system in immune defence can be seen in individuals with a genetic defect in component C3, a central protein in the complement cascade. This condition has been described as being virtually 'incompatible with life'.[22] However, unrestrained complement activation would cause severe damage to bystander cells, so that complement activity is held in check by a host of membrane-bound and soluble regulatory factors, designated regulators of complement activation (RCA). Members of the poxvirus, herpesvirus and retrovirus families produce homologues that mimic RCA proteins and are thus able to thwart a complement attack.[23]

Cytokines and chemokines are soluble substances of relatively small molecular weight produced by cells of the immune system, which act as messengers to regulate and direct a

[19] Gupta, S., Ferguson, N. and Anderson, R., 'Chaos, persistence, and evolution of strain structure in antigenically diverse infectious agents', *Science*, Vol. 280, 1998, pp. 912–915.

[20] Alcami, A. and Koszinowski, U.H., 'Viral mechanisms of immune evasion', *Trends in Microbiology*, Vol. 8, 2000, pp. 410–418.

[21] Turner, M.W., 'Mannose binding lectin: the pluripotent molecule of the innate immune system', *Immunology Today*, Vol. 17, 1996, pp. 532–536.

[22] Unanue, E.R., *Innate immunity in bacterial infections. Immunology of Infectious Diseases*, (Washington, DC: ASM Press, 2002), pp. 93–103.

[23] Alcami, A. and Koszinowski, U.H., 'Viral mechanisms of immune evasion', *op. cit.* Also see Tortorella, D., Gewurz, B.E., Furman, M.H., Schust, D.J. and Ploegh, H., 'Viral subversion of the immune system', Annual Review of Immunology, Vol. 18, 2000, pp. 861–926.

range of essential steps in immune responses. The activities of the proinflammatory cytokines interleukin 1 beta (IL-1β), tumour necrosis factor alpha (TNF) and interleukin 6 (IL-6) have been referred to above. Other cytokines, such as interleukin (IL)-10, IL-12, IL-4 and IL-2, are essential in directing the activities of different branches of the immune system, such as humoral versus cell-mediated responses. One of the most interesting mechanisms identified in recent years is the mimicry of cytokines and cytokine receptors by large DNA viruses (herpesviruses and poxviruses).[24] Chemokines are small proteins that play a key role in the recruitment of immune defence cells into areas of injury or infection during an inflammatory response. Poxviruses employ essentially three strategies to modulate chemokine functions: through the production of virus-encoded chemokine-receptor homologs; through the production of virus-encoded chemokine homologs; and through the production of virus-encoded chemokine-binding proteins.[25]

A further immune evasion strategy involves the production of a variety of viral inhibitors of apoptosis (cell death), which is also referred to as programmed cell death. In addition, cytotoxic T cells recognise a cell that has been infected by a virus through the presentation by that cell of fragments of viral proteins bound to major histocompatibility complex (MHC) molecules of class I on the surface of the infected cell. This recognition leads to the activation of cytotoxic T lymphocytes, which attack and kill the cell through the induction of apoptosis. Among other things, viruses can cause the suppression of the production of MHC I molecules. This would mean that viral antigens would not be bound to MHC molecules and could not be recognized by T cells. The cell and therefore the virus production factory would be protected from cytotoxic T lymphocyte destruction.[26]

Alternatively, viruses such as cytomegalovirus induce the expression of a certain type of non-typical MHC molecule that can bind a receptor on the surface of natural killer cells, inducing suppression of the activity of these cells that are normally an important component of innate immunity.[27]

Dual-use aspects of biomedical research

There are four categories of manipulations or modifications of microorganisms and their products that have been the subject of debate since the onset of the development of genetic engineering.

- The transfer of antibiotic resistance to microorganisms.
- The modification of the antigenic properties of microorganisms.
- The modification of the stability of the microorganism towards unfavourable conditions in the environment.

[24] Alcami, A. and Koszinowski, U.H., 'Viral mechanisms of immune evasion', *op. cit.*

[25] Mahalingam, S. and Karupiah, G., 'Modulation of chemokines by poxvirus infections', *Current Opinion in Immunology*, Vol. 12, 2000, pp. 409–412.

[26] Alcami, A. and Koszinowski, U.H., 'Viral mechanisms of immune evasion', *op. cit.*

[27] Carayannopoulos, L.N. and Yokoyama, W.M., 'Recognition of infected cells by natural killer cells', *Current Opinion in Immunology*, Vol. 16, 2004, pp. 26–33.

- The transfer of pathogenic properties to microorganisms.[28]

All four types of manipulations are being carried out daily in research programmes with legitimate and basically peaceful aims, such as elucidation of the mechanisms of microbial pathogenesis. This research is essential for developing better means of combatting infectious diseases. At the same time, these techniques can be misused to create new types of biological agents that could be used for producing weapons. In order to focus more directly on the dangers involved, two specific examples of work from the recent literature that have produced dangerous microorganisms that are able to evade vital immune mechanisms will be examined.

Accidental creation of a 'killer' mousepox virus

The potential dangers that may be associated with biological research are particularly evident in recent studies in the area of immunology. A headline in the *New Scientist* proclaimed a 'Disaster in the making. An engineered mouse virus leaves us one step away from the ultimate bioweapon'.[29] The report was about experiments conducted by Australian researchers who tried to make mice infertile, as a model for controlling rodent populations.[30] The experimental strategy was to incorporate a gene for the production of a protein that is found on the surface of the mouse's egg cells into the genome of a mousepox virus, against which the mice used in the experiment were resistant. When the mice were infected with the recombinant virus, the egg cell protein was over-produced, and an antibody response to that protein was mounted, which was supposed to cause infertility in the mice. Indeed, the expected antibody response occurred, but it was short-lived.[31] In order to boost these antibody responses and to prolong their effects, another gene was introduced into the mousepox virus genome. This gene was to direct the production of a cytokine called IL-4, which is known to enhance antibody-type immune responses. IL-4, though, also suppresses the activation and expansion of another type of T-lymphocyte (Th1) that provides essential help to cytotoxic T-lymphocytes (CTLs) needed to fight viral infections. When mice were infected with the recombinant virus, the IL-4 produced did enhance antibody responses to the mouse egg protein, but at the same time it also suppressed the activation of CTLs. As a result, the majority of the mice (60%) died, even though they were supposed to be resistant to the virus.[32]

The mousepox virus is not infective for humans. There is some concern, however, that a similar manipulation might be performed on a pox virus that does infect humans, making that virus even more deadly than it already is.

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[28] Nathanson, V., Darvell, M. and Dando, M.R., Biotechnology, *Weapons and Humanity*, *op. cit.*, pp. 33–51. Also see Nixdorff, K., Hotz, M., Schilling, D. and Dando, M., *Biotechnology and the Biological Weapons Convention*, *op. cit.*

[29] Nowak, R., 'Disaster in the making. An engineered mouse virus leaves us one step away from the ultimate bioweapon', *op. cit.*

[30] Jackson, R.J., Maguire, D.J., Hinds, L.A. and Ramshaw, I.A., 'Infertility in mice induced by a recombinant ectromelia virus expressing mouse zona pellucida glycoprotein', *Biology of Reproduction*, Vol. 58, 1998, pp. 152–159. Also see Jackson, R.J., Ramsay, A.J., Christensen, C., Beaton, S., Hall, D.F.R. and Ramshaw, I.A., 'Expression of mouse interleukin-4 by a recombinant ectromelia virus suppresses cytolytic lymphocyte responses and overcomes genetic resistance to mousepox', *op. cit.*

[31] Jackson, R.J., Maguire, D.J., Hinds, L.A. and Ramshaw, I.A., 'Infertility in mice induced by a recombinant ectromelia virus expressing mouse zona pellucida glycoprotein', *op. cit.*

[32] Jackson, R.J., Ramsay, A.J., Christensen, C., Beaton, S., Hall, D.F.R. and Ramshaw, I.A., 'Expression of mouse interleukin-4 by a recombinant ectromelia virus suppresses cytolytic lymphocyte responses and overcomes genetic resistance to mousepox', *op. cit*.

This work has been continued by Professor Mark Buller at St. Louis University in the US. Buller constructed a recombinant mousepox virus containing the IL-4 gene that was even more deadly than the one produced by the team of Australian researchers. By placing the IL-4 gene in a region of the virus genome that was not needed for any function and by optimising its expression, 100% mortality of the resistant mice was achieved with the recombinant virus construct. Buller's stated motivation was to explore possible prophylactic and therapeutic defences against such an agent. Yet, vaccination or treatment of mice with the antiviral substance cidofovir plus antibodies against IL-4 still did not protect them adequately against a challenge posed by the highly virulent mousepox constructs.[33] Now he has apparently gone one step further in proposing to alter the cowpox virus—which can infect humans—in a similar way.[34] Buller asserted, however, that this virus would only be lethal in mice and not in humans, because he planned to use the mouse IL-4 gene, which is specific only to the mouse immune system. The head of the Australian research team, Ian Ramshaw, maintains that there was no reason to do the cowpox experiments, cautioning that, while viruses containing the mouse IL-4 gene should not be lethal in humans, recombinant viruses can have unexpected effects. Indeed, it has been pointed out that these experiments fall into several categories of concern highlighted in a 2003 report by the National Research Council of the National Academies in the US.[35]

Potentiation of the virulence of vaccinia virus

The smallpox virus *Variola major* causes a serious, virulent infection in humans, while the virus that is used for vaccination against smallpox, vaccinia virus, usually causes only a very mild or even unapparent infection, at least in individuals with an intact immune system. A probable virulence factor for the smallpox virus is the smallpox inhibitor of complement enzymes (SPICE). This component has the ability to inactivate human C3b, one of the key complement components that serve to induce phagocytosis, thus attacking innate immunity in a vital area. Vaccinia virus also has a complement regulatory protein called vaccinia virus complement control protein (VCP), which is, however, much less effective (100-fold) than SPICE. In a recent (2002) report,[36] researchers mutated the VCP gene of vaccinia virus to give it the same nucleotide sequence as the SPICE gene. The recombinant mutant VCP proved to be much more efficient than normal VCP in inactivating complement, when this experiment was performed in vitro (in a test tube). Although the researchers did not actually outfit vaccinia virus with this mutated gene, the work was only one step away from this procedure. Presumably, vaccinia virus outfitted with the mutated gene would be much more pathogenic.

In this context, the employment of modern molecular biology and biotechnology techniques to create viruses that have been the subject of recent reports is a matter of particular concern—for instance, the creation of the polio virus from scratch[37] or the

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[33] Buller, M., 'The potential use of genetic engineering to enhance orthopoxviruses as bioweapons', *op. cit.*

[34] MacKenzie, D., 'US develops lethal new viruses', *op. cit.*

[35] Steinbruner, J.D. and Harris, E.D., 'When science breeds nightmares', *op. cit.*; National Research Council of the National Academies, *Biotechnology Research in an Age of Terrorism: Confronting the Dual Use Dilemma*, (Washington, DC: The National Academies Press, 2003).

[36] Rosengard, A.M., Liu, Y., Nie, Z. and Jimenez, R., 'Variola virus immune evasion design: expression of a highly efficient inhibitor of human complement', *Proceedings of the National Academy of Sciences USA*, Vol. 99, 2002, pp. 8808–8813.

[37] Cello, J., Paul, A.V. and Wimmer, E., 'Chemical synthesis of poliovirus cDNA: generation of infectious virus in the absence of natural template', *Science*, Vol. 297, 2002, pp. 1016–1018.

generation of a bacterial virus within two weeks using synthetic oligonucleotides.[38] These viruses, though, are simple in composition in comparison to most viruses of BW relevance, such as the poxviruses. Poxviruses have genomes that are composed of linear double-stranded DNA molecules that are resolved from transient head-to-head or tail-to-tail structures called concatemers during replication. The introduction of new genes into the vaccinia virus genome, for example, is usually carried out by homologous recombination in mammalian cells, a process that is rather inefficient. Also, time-consuming selection procedures are required. The ability to manipulate the poxvirus genome in the form of a continuous molecule in a plasmid (circular DNA molecule that can be replicated in bacteria) would greatly facilitate genetic studies. Specifically, a method of cloning the entire genome of vaccinia virus (VAC) with an intact concatemer junction sequence as a bacterial artificial chromosome (BAC) has been accomplished.[39] This VAC–BAC construct could be stably propagated in the bacterium *Escherichia coli* and subsequently converted into infectious virus in mammalian cells.

These experiments illustrate the absolute dual use dilemma of confronting researchers in the biotechnology sector. While such experiments create microorganisms that potentially pose a greater risk than do normal ones, and the advisability of undertaking them is certainly open to question, there may at the same time be benefits to be derived from such research. In this respect, the report of the National Research Council of the National Academies states that 'even experiments that have the greatest potential for diversion to offensive applications or terrorist purposes may also have potentially beneficial uses for public health promotion and defense'.[40] This highlights the difficulty in imposing blanket prohibitions on certain research activities from the start, but clearly underscores the need for oversight of research of BW relevance.

Future threats

Targeted delivery systems: gene vectors and immunotoxins

Targeted delivery systems are components that allow an activity to be targeted to a particular site in the body where that activity is desired. An example of such a system is viruses that are used as vectors to transfect a foreign gene into cells for the purpose of immunisation or for gene therapy. The gene would become active in infected cells, leading to the production of the gene product. Vaccinia virus has been investigated for these purposes because of its large genome, which can carry several foreign genes at once, and its effectiveness as a vaccine.[41] A great deal of work has been done in recent years on the possibility of using adenoviruses as gene vectors. These viruses can be produced at high titers (up to 10^{10} per millilitre) and they also have a carrying capacity of

[38] Smith, H.O., Hutchison, C.A. III. , Pfannkoch, C. and Venter, J.C., 'Generating a synthetic genome by whole genome assembly: fX174 bacteriophage from synthetic oligonucleotides', *Proceedings of the National Academy of Sciences USA*, Vol. 100, 2003, pp. 15440–15445.

[39] Domi, A. and Moss, B., 'Cloning the vaccinia virus genome as a bacterial artificial chromosome in Escherichia coli and recovery of infectious virus in mammalian cells', *Proceedings of the National Academy of Sciences USA*, Vol. 99, op. cit., pp. 12415–12420.

[40] National Research Council of the National Academies, *Biotechnology Research in an Age of Terrorism: Confronting the Dual Use Dilemma, op. cit.*

[41] Moss, B., 'Vaccinia virus expression vector: a new tool for immunologists', *Immunology Today*, Vol. 6, 1985, pp. 243–245. Also see Carter, B.J., 'The promise of adeno-associated virus vectors', *Nature Biotechnology*, Vol. 14, 1996, pp. 1725–1726.

up to 40 kb of insert DNA.[42] Alternatively, the development of adeno-associated viruses as vectors for gene delivery seems promising, as these viruses are defective by nature and have thus never been shown to have any pathogenic effects in humans.[43] However, latest investigations have shown that these viruses do indeed integrate into the host genome more frequently than presumed, which might lead to detrimental mutations, including the induction of cancerous states.[44] So there are still serious safety concerns about the use of these vectors. It is conceivable that the immune system could be attacked by viruses which have been outfitted with specificities for immune cells (for instance, the genes for the envelope proteins of the HIV virus that are specific for binding with and uptake in T helper cells and macrophages) plus toxin genes. That cytokines can be successfully delivered to the body by viruses carrying a cytokine gene has been well demonstrated in the mousepox experiment alluded to above.[45]

Another prime example of a targeted delivery system is immunotoxins. These are molecules that contain a toxin coupled to an antibody that can bind specific antigens on the surface of particular cells. The aim is to redirect or limit the toxin activity to specified cells, such as tumour cells; in this case, the antibody specificity is directed against tumour cell antigens.[46] An example of an immunotoxin that employs ricin as the toxic component is shown in Figure 2.[47] New strategies to reduce immune reactions against the immunotoxins have been developed.[48] Alternatively, molecules can be engineered to contain the toxic portion of a toxin linked to an antigen specific for a particular cell receptor. This antigen would direct the toxin to cells having that receptor. Such engineered molecules are called *fusion proteins.*

It should be mentioned that aerosolization of vectors carrying foreign genes could represent an effective delivery system, especially if the vector is a virulent microorganism, as most infections begin at the mucosa. If the vector is not a microorganism, such as in the case of fusion proteins or immunotoxins, successful delivery by the aerosol route would depend to a great extent on the physical and chemical properties of that vector. In its medical research work on endogenous bioregulators, the US Army has, for instance, reported that the hormone insulin and the cytokine interleukin-1 were effective in aerosol form in basic pulmonary absorption studies.[49]

Targeted delivery systems have to be characterised as being strongly dual purpose. While

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[42] Morsy, M.A. and Caskey, C.T., 'Safe gene vectors made simpler', *Nature Biotechnology*, Vol. 15, 1997, p. 17. Also see Kochanek, S., Clemens, P.R., Mitani, K., Chen, H.H., Chan, S. and Caskey, C.T., 'A new adenoviral vector: Replacement of all viral coding sequences with 28 kb of DNA independently expressing both full-length dystrophin and b-galactosidase', *Proceedings of the National Academy of Sciences USA* Vol. 93, 1996, pp. 5731–5736.

[43] Carter, B.J., 'The promise of adeno-associated virus vectors', *op. cit.*

[44] Check, E., 'Harmful potential of viral vectors fuels doubts over gene therapy', *Nature*, Vol. 423, 2003, pp. 573–574.

[45] Jackson, R.J., Maguire, D.J., Hinds, L.A. and Ramshaw, I.A., 'Infertility in mice induced by a recombinant ectromelia virus expressing mouse zona pellucida glycoprotein', *op. cit.*

[46] Kreitman, R.J., 'Immunotoxins in cancer therapy', *Current Opinion in Immunology*, Vol. 11, 1999, pp. 570–578.

[47] Poncelet, P., Blythman, H.E., Carrier, D., Casellas, P., Dussossoy, D., Gros, O., Gros, P., Jansen, F.K., Laurent, J.C., Liance, M.C., Vidal, H. and Voisin, G.A., 'Present potential of immunotoxins', *Behring Institute Mitteilungen*, Vol. 74, 1984, pp. 94–100.

[48] Hayden, M.S., Gilliland, L.K. and Ledbetter, J.A., 'Antibody engineering', *Current Opinion in Immunology*, Vol. 9, 1997, pp. 201–212.

[49] Rosenberg, B. and Burck, G., 'Verification of compliance with the Biological Weapons Convention', *op. cit.*

they may be potentially very useful in vaccine and gene therapy, they can also serve as delivery vehicles for toxins or bioregulators in a negative way.

Immunization with plant foods

At present there is a great deal of interest in developing vaccines in the form of plant foods. This involves the transfer of a gene encoding the antigen of interest into the genome of plants, with subsequent activation of that gene, which would lead to the biosynthesis of the antigen in the plant tissues. Eating the plant tissues would then deliver the antigen to the gut, where it would be taken up by special epithelial cells of the small intestine (M cells) and transferred to the underlying lymphoid tissues, resulting in an immune response to that antigen. There would be several advantages of inducing an immune response in this way, including increased safety, economy of production and stability of the vaccine, as well as the prospect of inducing mucosal immunity (to localise

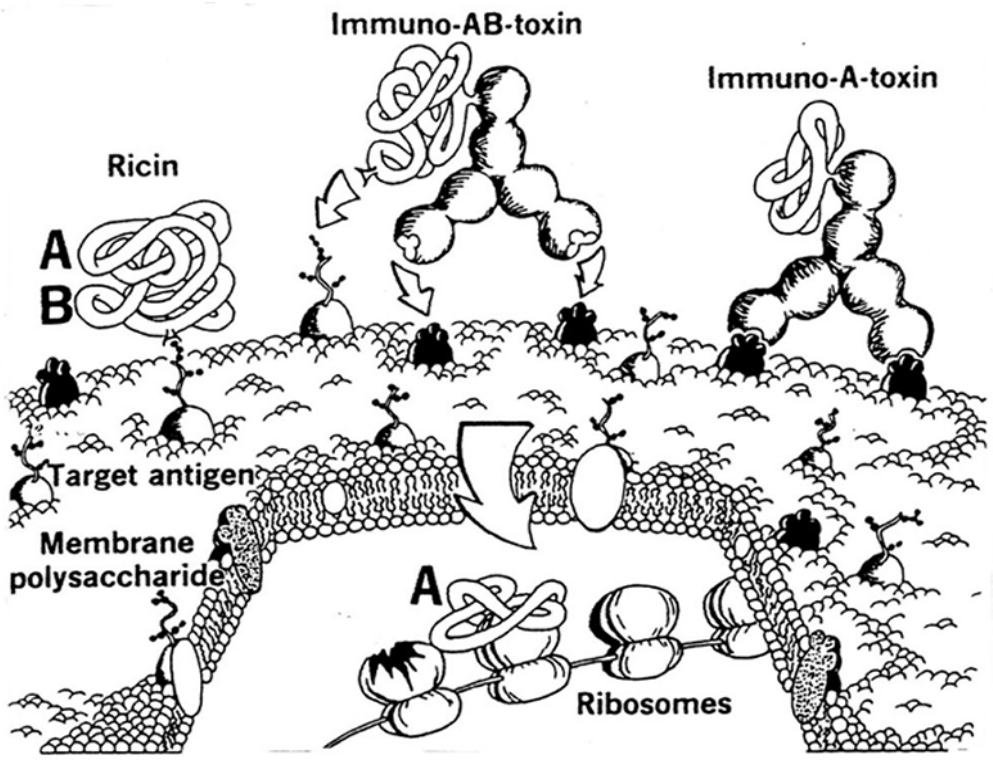

Figure 2: Schematic Representation of Ricin Immunotoxins*

Ricin is composed of an A chain that is the toxic part of the molecule and a B chain that binds to a specific receptor on the cell surface (left part of the figure). An immunotoxin consisting of the AB-toxin bound to the antibody is shown in the middle of the figure. The antibody binds specifically with particular receptors on the cell surface (dark structures). The A chain alone is non-toxic, because it cannot bind to the cell. When coupled to the antibody by a chemical reaction (Immuno-A-toxin), the A chain can be targeted to the cell surface via the antibody and taken up by the cell. It can subsequently interact with ribosomes, the protein synthesising factories of the cell (bottom part of the figure), to inhibit protein synthesis.

* Poncelet, P., Blythman, H.E., Carrier, D., Casellas, P., Dussossoy, D., Gros, O., Gros, P., Jansen, F.K., Laurent, J.C., Liance, M.C., Vidal, H. and Voisin, G.A., 'Present potential of immunotoxins', *op. cit*. Figure used with the kind permission of Hoechst AG.

immunity at mucous membrane sites, where most infections begin).[50]

There are, however, numerous technical and immunological hurdles that have to be overcome in order for plant vaccines to be practical. One of the first is avoidance of degradation of the antigen in the digestive tract. Even if the antigen survived this degradation, oral tolerance mechanisms would have to be side-stepped**,** preventing immune responses to the microorganisms residing in the intestine or to protein antigens acquired continually through food. Furthermore, oral immunisation usually requires multiple doses in larger amounts than antigen administered in vaccines over other routes (for example by injection); responses are weak, unreliable and also shorter-lived.[51] Indeed, results to date show that immunisation with plant foods is in some cases possible, but that the responses are usually modest and appear only after more than one dose.

This discussion serves to illustrate that immunisation with plant foods is by no means readily achievable. It is unlikely, therefore, that it will be possible to employ these techniques successfully in malign ways in the very near future, such as for the vaccination of unaware populations, thus forcing upon them an involuntary immunity or marking them as possible targets (see below). Nevertheless, there is great interest in developing such vaccines for peaceful purposes and improvements are actively being sought.[52] Developments in this area are of concern for the future and should be closely monitored.

Vulnerability of the immune system to modulation after immunization

Activation of the immune system in response to an infection is a vital step in countering the threat posed by the causative agent. Nevertheless, activation of components of the immune system is invariably associated with the enhanced production or exposition of predictable markers that could serve as targets for the delivery of a biological weapon to those sites.

B and T lymphocytes are produced during development to yield an enormous number of clones, each expressing a unique receptor (membrane-bound antibodies in the case of B cells and the TCR in the case of T cells) recognising a particular antigen configuration (epitope).[53] Initially, only a small subset of these clones (estimated at around 0.1%) is able to recognise any one particular antigen.[54] To generate effective immunity, these naive or resting B cells and T cells must undergo clonal expansion in response to an antigen challenge in order to amass the numbers required to counter an infection. This represents a considerable expansion of antigen-specific lymphocytes in response to

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[50] Nossal, G.J.V., 'Vaccines', in Paul, W.E. (ed), *Fundamental Immunology*, Fifth Edition, (Philadelphia, PA: Lippencott Williams & Wilkins, 2003), pp. 1319–1369. Also see Streatfield, S.J., Jilka, J.M., Hood, E.E., Turner, D.D., Bailey, M.R., Mayor, J.M., Woodard, S.L., Beifuss, K.K., Horn, M.E., Delaney, D.E., Tizard, I.R. and Howard, J.A., 'Plant-based vaccines: unique advantages', *Vaccine*, Vol. 19, 2001, pp. 2742–2748.

[51] Nossal, G.J.V., op. cit. Also see Marquet-Blouin, E., Bouche, F.B., Steinmetz, A. and Muller, C.P., 'Neutralizing immunogenicity of transgenic carrot (Daucus carota L.)-derived measles virus hemagglutinin', *Plant Molecular Biology*, Vol. 51, 2003, pp. 459–469.

[52] Marquet-Blouin, E., Bouche, F.B., Steinmetz, A. and Muller, C.P., 'Neutralizing immunogenicity of transgenic carrot (Daucus carota L.)-derived measles virus hemagglutinin', *op. cit.* Also see Streatfield, S.J., Lane, J.R., Brooks, C.A., Barker, D.K., Poage, M.L., Mayor, J.M., Lamphear, B.J., Drees, C.F., Jilka, J.M., Hood, E.E. and Howard, J.A., 'Corn as a production system for human and animal vaccines', *Vaccine*, Vol. 21, 2003, pp. 812–815.

[53] Carayannopoulos, L.N. and Yokoyama, W.M., 'Recognition of infected cells by natural killer cells', *op. cit.*

[54] Silverman, G.J., Nayak, J.V., Warnatz, K., Jajjar, F.F., Cary, S., Tighe, H. and Curtiss, V.E., 'The dual phases of the response to a neonatal exposure to a VH family-restricted staphylococcal B cell superantigen', *Journal of Immunology*, Vol. 161, 1998, pp. 5720–5732.

immunisation, especially when a vaccine is given in several doses over a period of time.

These expanded clones of B and T lymphocytes are vulnerable, for example, to being targeted with constructed toxins, as discussed earlier (targeted delivery systems). For delivery to B cells, a delivery system might be a fusion protein consisting of the specific antigen (against which the B cells are directed) fused to the toxic chain of a toxin molecule (such as the A chain of ricin or diphtheria toxin). Since B cells release antibodies to the antigen, however, the construct might be neutralised and cleared by these antibodies before it can do much damage. T cells might be a more vulnerable target, as they do not secrete their antigen receptors. The delivery system containing the toxin, though, would have to be constructed in such a way as to include the specific antigen fragment bound to MHC molecule epitopes in order for it to be recognised and engaged by the T cell. This would be a tall order at present, especially in view of the fact that T cells must recognize self MHC molecules. However, new studies are providing greater insight into the fine points of the recognition of an antigen presented by MHC molecules to T cells,[55] which could make this approach of more concern in future.

In addition to the expansion of specific antigen receptors, immunisation also induces an enhanced exposition of a variety of molecules on the surface of lymphocytes and macrophages. Prominent ones include MHC molecules on lymphocytes and macrophages, CD40 on B cells and macrophages, and CD28 and CD40L on T cells. All of these would be vulnerable to attack, for example, with immunotoxins consisting of antibodies to these surface components bound to the toxic portion of a toxin molecule.

Whereas most protein antigens are recognised only by a small fraction of lymphocytes (0.1 %), a number of proteins have been described that can react with a significantly greater proportion of T cells (up to 5% of the T cell population)[56] and others are known that can bind with up to 50% of the B cell population.[57] Through binding of these so-called superantigens, the cells suffer an increased rate of apoptosis or cell death. The possibilities for misuse here are intricately connected to dual use aspects of targeted delivery systems.

Conclusions

In its report on biotechnology research in an age of terrorism, the Fink Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology recommended that seven categories of experiments should be subject to review.[58] However, it clearly believed that these categories were only the initial ones in a develop-

[55] Stewart-Jones, G.B.E., McMichael, A.J., Bell, J.I., Stewart, D.I. and Jones, E.Y., 'A structural basis for immunodominant human T cell receptor recognition', *Nature Immunology*, Vol. 4, 2003, pp. 657–663.

[56] Goldsby, R.A., Kindt, T.J., Osborne, B.A. and Kuby J., *Immunology*, Fifth Edition, (New York: W.H. Freeman and Company, 2003).

[57] Goodyear, C.S. and Silverman, G.J., 'Death by a B cell superantigen: in vivo VH-targeted apoptotic supraclonal B cell deletion by a staphylococcal toxin', *Journal of Experimental Medicine*, Vol. 197, 2003, pp. 1125–1139.

[58] National Research Council of the National Academies, *Biotechnology Research in an Age of Terrorism: Confronting the Dual Use Dilemma, op. cit.*

ing system of review, stating that: ‘The system proposed in this report is intended as a first step in what will be a long and continuously evolving process to maintain an optimal balance of risks and rewards’.

The kinds of threats discussed above clearly demonstrate the correctness of this view. The possibility of the production of novel agents is, and will remain, a matter of concern, as underlined in all sections of this report. Modern molecular biology techniques, including genomics and proteomics, will promote the elucidation of the mechanisms of pathogenicity, particularly the interaction of agents with cell receptors. These activities are essential in instigating a more effective battle against disease, but, at the same time, they exacerbate the dual-use dilemma, in that the information gained can more easily be employed for malign purposes.

In this chapter, the dual-use dilemma of modern biotechnology has been viewed within a broader scope of consequences by focussing on interacting biological systems as the target of potential malign intent. In this respect, the perturbation of one system by bioregulators will profoundly affect another. This can be seen most clearly in the interactions of the immune system with the neuroendocrine systems of humans and animals and highlights the need to come to grips with bioregulators in an extremely complex arena. Plants are also acutely affected by systems biology through their own innate immune system, as well as other systems that interact with pathogenic agents. Attacks on the neuroendocrine and immune systems are intimately related to developments in targeting technology. The possibility of immune evasion is of particular concern, and any research that would involve a microorganism evading the immune system must be considered to have the potential to be extremely dangerous. Modulation of the immune system using bioregulators would fall into this category.

In all areas discussed in this paper, the directed evolution of natural agents, as well as developments in bioinformatics, are seen as further areas that will be of increasing concern in future. How proposals designed to ‘maintain an optimal balance of risks and rewards’ can be applied to the threats delineated here is a matter requiring further discussion. The report emphasises the need for oversight of research in BW relevant areas.

Anti-Animal Threats

This section of the BioWeapons Report will address the threat of anti-animal biological warfare. The 2001 foot-and-mouth disease (FMD) epidemic in the UK provides a contemporary example of the continuing impact of animal disease outbreaks. A brief history of anti-animal biological warfare is provided to establish the precedent of the deliberate instigation of animal diseases. General themes, drawn from this history, enable a discussion of the impact of advances in the biological sciences and their implication for the anti-animal threat. This is highlighted by an examination of the potential role of prions in anti-animal biological warfare. The section concludes with an assessment of the potential future threat from this form of warfare, with particular attention being paid to the role of bioinformatics.

The 2001 FMD epidemic in the UK

On 20 February 2001, the presence of FMD was confirmed in Essex, marking the start of the 2001 epidemic in the UK. The disease spread rapidly, the number of confirmed cases rose almost exponentially in the first five weeks.[59] The rate at which new cases emerged then peaked and began to decline (see Figure 1). The disease remained prevalent in the UK for an extended period, demonstrating the difficulties involved in eradicating highly infectious animal diseases.

Thirty-three counties were involved during the first 15 weeks of the outbreak (see Figure 2), which included 1,697 confirmed cases, involving 1,012,242 animals. The epidemic eventually resulted in over 3.5 million animals being slaughtered, 2.3 million of

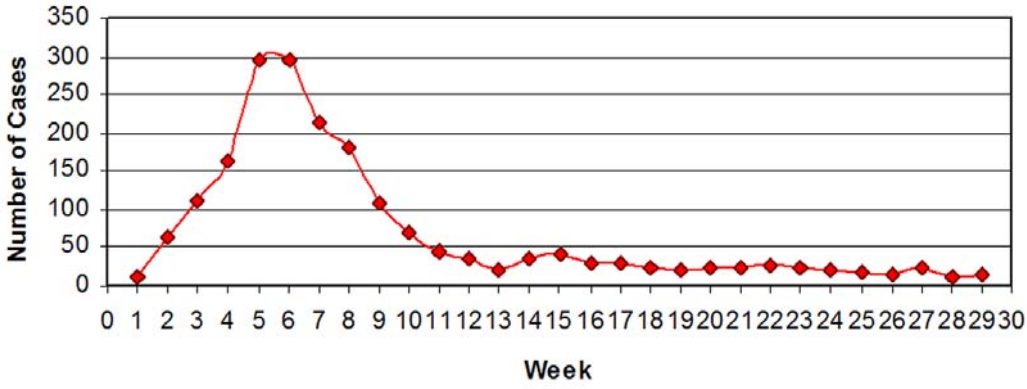

Figure 1: 2001 FMD outbreak in the UK: Number of weekly confirmed cases during the first 29 weeks

[59] A case represents the confirmation of the presence of the virus in at least one animal at a given facility (such as a farm, slaughter house or market).

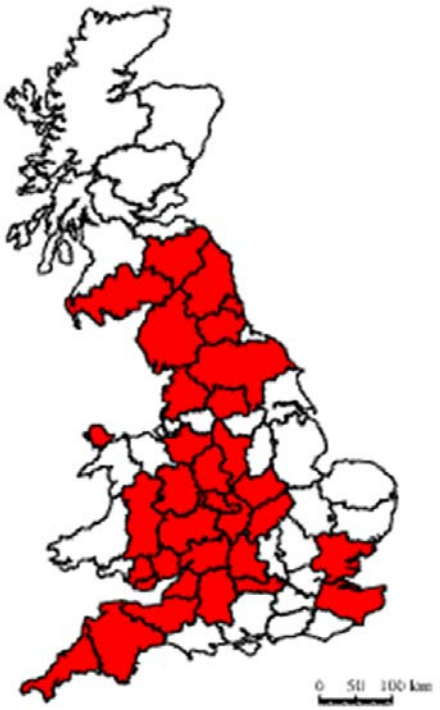

Figure 2: Counties in the UK affected by the FMD outbreak

which were culled for preventative purposes—clearly demonstrating that responses to outbreaks of highly infectious animal diseases can prove more costly than the infections themselves. Other indirect effects worthy of note include the suicides of farmers, the postponement of the general election, fears about air and water pollution connected to the disposal of carcases, and the withdrawal of UK forces from North Atlantic Treaty Organisation (NATO) exercises to prevent the spread of disease. It was estimated that the cost of the epidemic would surpass £40 billion.

Historical precedents of the anti-animal threat

Mark Wheelis established that anti-animal biological sabotage operations were carried out by Germany in at least five countries during the First World War.[60] It would appear that France was also engaged in similar activities, and surviving intelligence archives in the UK point to the fact that a number of other European countries, including Belgium, the Netherlands and the Republic of Ireland, had indicated their interest in pursuing this form of biological warfare.[61]

During the Second World War, several other countries became interested in anti-animal biological sabotage. Project Vegetarian, involving the construction of anthrax-laced cattle cakes by the UK, has been well documented.[62] The Japanese developed tactical munitions designed to infect a variety of targets, including animals.[63] Simultaneously, Unit 100—the Kwantung Army Anti-Epizootic Protection of Horses Unit—conducted research into *'the*

[60] Wheelis, M., 'Biological sabotage in World War 1', in Geissler, E. and van Courtland Moon, J.E., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, SIPRI Chemical and Biological Warfare Studies No. 18, (Oxford: Oxford University Press, 1999), pp. 35–62.

[61] Joint Intelligence Sub-Committee (JIC), *Present State of Progress in BW in Foreign Countries*, Chiefs of Staff Committee, Joint Intelligence Sub-Committee, JIC (47) 22 (0), DEFE 55/135, (London: Public Records Office, 25 April 1947).

[62] Balmer, B., *Britain and BW: Expert Advice and Science Policy, 1930–65*, (London: Palgrave, 2001). Also see Carter, G.B., *Chemical and Biological Defence at Porton Down*, (London: The Stationary Office, 2000).

[63] Unknown, *Notes on Japanese Photostats 57 and 97*, Rev. Moule, WO188/690, (London: Public Records Office, 26 March 1945).

mass extermination of animals'.[64] It also appears that Germany was close to obtaining an anti-animal capability by 1945.[65]

After the Second World War, and throughout the Cold War, the US engaged, with varying degrees of conviction, in a range of anti-animal biological warfare projects, producing strategic, tactical and sabotage weapons. The UK appears to have redirected its efforts to focus on offensive FMD research.[66] Little is known about the anti-animal biological warfare components of the programme of the former Soviet Union, but Ken Alibek has alleged that 'A special division was established to research and manufacture anti-livestock and anti-crop weapons'.[67]

Since the end of the Cold War, other programmes have come to light. It also appears that the United Nations Special Commission (UNSCOM) did not investigate the existence of anti-animal biological warfare activities in Iraq.[68] It is unclear whether the United Nations Monitoring, Verification and Inspection Commission (UNMOVIC) or the Iraq Survey Group have looked into such a possibility.

Modern advances and their implication for the anti-animal threat

A number of general themes can be derived from this history. Elucidating these 'rules of thumb' may provide an insight into the nature of the threat posed by these weapons in future and the possible effect of the revolution in the biological sciences. These themes include, firstly, two separate methodological approaches to this form of warfare.

- 'Military' anti-animal biological warfare programmes—these involved the mass production of the agent, the creation of delivery devices, and required a degree of control over the resulting disease outbreak. Such programmes saw the development of strategic, tactical and point-source weapons.
- 'Clandestine' anti-animal biological warfare programmes—these were designed to induce outbreaks through anti-animal biological sabotage. These programmes relied heavily on the characteristics of the agents, allowing more rudimentary agent production and requiring minimal dispersal technology. They often saw the initiation of epidemics and/or the creation of endemic status as desirable outcomes and more closely resembled a 'bioterrorist' threat.

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[64] IB Dong, Z., Y., 'Kwantung Army Number 100', in *Historical Material on Jilin History*, Peoples Press, Changchun, 1987, as quoted by Harris, S., 'The Japanese BW programme: an overview', in Geissler, E., and van Courtland Moon, J.E., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, *op. cit.*, p. 149.

[65] Millett, P., *Anti-Animal Biological Warfare: Past, Present and Future, and the Revolution in the Biological Sciences*, Doctoral Thesis, University of Bradford, UK (forthcoming).

[66] Millett, P., 'Anti-Animal Bioweapons', in Dando, M. and Wheelis, M. (eds), *Bioweapons Research, Development and Use from 1945 to the Present*, (Harvard, MA: Harvard University Press, forthcoming).

[67] Alibek, K., *Biohazard*, (London: Arrow Books, 2000), pp. 37–38.

[68] Author interview with a former UNSCOM chief weapons inspector.

In addition, anti-animal biological warfare has been targeted tactically (to impede military utility), socially (to disrupt food production) and economically (to induce financial burdens).[69] Situations may exist in the world where each targeting approach is still desirable.

Third, there are desirable characteristics for 'military' and 'clandestine' biological weapons. Some indicative characteristics are listed in Table 1.

Table 1: Some desirable characteristics of military and clandestine anti-animal biological weapons

Military Programmes	Clandestine Programmes
An agent should produce a known effect consistently	An agent should produce a known effect consistently
The dose needed to produce the effect should be low	An agent should be highly infectious
There should be a short predictable incubation period	There should be a long sub-clinical infectious period
The target population should have little or no immunity	An agent should pose a significant threat to livestock production (or associated industries)
Treatment for the disease should not be easily available to the target population	The dose needed to produce the effect should be low
The user should have the means to protect his/her own animals	The disease should not be zoonotic
The disease should not be zoonotic	The disease should be epidemiologically explainable
It should be possible to mass-produce the agent	It should be possible to store the agent for short periods of time
It should be possible to disseminate the agent efficiently	
It should be stable in storage and in munitions	

Finally, the innate properties of the pathogens have been utilised in attempts to achieve the desirable characteristics. These include:

- infectivity—in 'military' programmes minimal lateral transmission facilitated control over the resulting outbreak, and in the 'clandestine' programmes there were a number of 'transmissible diseases which have the potential for very serious or rapid spread, irrespective of national borders'[70];
- lethality—agents were produced representing a spectrum of effects, ranging from the lethal (i.e. death) to incapacitant (such as loss of milk production, inability to enter produce into the foodchain or non-lethal physical distress); and
- the ability to be disguised as natural events—animal diseases emerge periodically in unusual geographical circumstances and differentiation between natural and unnatural origins may be more complex than with

[69] Millett, P., Anti-Animal Bioweapons, *op. cit.*

[70] The Office International des Epizooties (OIE)'s definition of such diseases continues: 'which are of socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products'. 'OIE Classification of Diseases', www.oie.int/eng/maladies/en_classification.htm.

other forms of BW.[71] This is especially true of 'clandestine' programmes that may intentionally mimic natural events.

The revolution in the biological sciences should facilitate developments that have implications for both the advancement and prevention of anti-animal biological warfare. Such developments can be characterised as either offensive or defensive. Possible offensive and defensive developments are listed in Table 2.

Analysis appears to indicate that defensive developments designed to counter a 'military' threat (such as the establishment of novel prophylactic and therapeutic protocols or improved epidemiological surveillance) could be manifest in the short term.[72] More extensive defensive developments (such as improved hand-held/transportable sensor technologies) may be more realistic goals in the medium term.

Offensive developments for military programmes (such as enhanced agent stability and environmental resistance or the creation of novel agents) could be attainable in developed countries in the short-to-medium term. However, access to the scientific and technological resources required for advanced military programmes may not be rapidly available to those states who may be most interested in developing such capabilities. Hence, such developments may be more realistically considered as being likely to occur in the medium term.

Offensive developments for clandestine programmes are unlikely to manifest themselves in anything less than the long term. Although certain improvements (such as the directed evolution of natural agents or the development of techniques to enhance the characteristics of non-traditional agents) will become scientifically possible, it is likely that these manipulations could be detected using technology currently under development or likely to be developed in the future. This would reduce the possibility of disguising an outbreak as a natural event. Identifying such manipulations might also provide clues as to the origin of the outbreak.

One aspect of the revolution in the biological sciences that has been linked to the future threat of BW is proteomics. Although protein-based weapons might pose a future threat in the anti-personnel or anti-crop fields, it is more of a contemporary issue for anti-animal biological warfare, especially following the discovery of prions.

Prions have been described as:

> 'novel infectious pathogens that cause a group of fatal neurodegenerative disorders termed transmissible spongiform encephalopathies'.[73]

They are protein-based agents that appear to lack any genetic material. Although not

[71] Hugh-Jones, M., 'Distinguishing Natural and Unnatural Outbreaks of Animal Diseases', in Dando, M., Preason, G. and Kriz, B., *Scientific and Technical Means of Distinguishing Between Natural and Other Outbreaks of Disease*, NATO Science Series, Disarmament Technologies, Vol. 35, (London: Kluwer Academic Publishers, 1998), pp. 63–73.

[72] Millett, P., *Anti-Animal Biological Warfare: Past, Present and Future, and the Revolution in the Biological Sciences, op. cit*.

[73] Hur, K., Kim, J.I., Choi, S.I., Eun-Kyoung, C., Carp, R.I. and Yong-Sun, K., 'The Pathogenic Mechanisms of Prion Diseases', *Mechanisms of Aging and Development*, Vol. 123, 2002, pp. 1637–1647.

experimentally proven, the favoured hypothesis suggests that prions are replicating, altered forms of important neurological proteins.[74] They are already responsible for a number of important animal diseases, including scrapie in sheep and goats, bovine spongiform encephalopathy (BSE) in cattle, transmissible mink encephalopathy (TME) in mink, chronic wasting disease (CWD) in deer and elk, and exotic ungulate encephalopathy in various exotic ungulates.

These prion diseases demonstrate a number of unusual properties, including:

- an extremely long incubation period, from a few months to several years;
- no inflammation and no disease-specific immune responses, and
- three different manifestations that are unlikely to be related: infectious transmission, inherited infection and sporadic disorders.

Such properties lend themselves to use as an anti-animal biological sabotage agent (see Table 1).

A future anti-animal threat

Of the biological advances yet to come of age, bioinformatics may prove to be particularly relevant to anti-animal biological warfare. Bioinformatics can be considered as the digitisation of biology, covering all aspects of the biology/digital technology interface, ranging from electronically stored experimental data to high-throughput laboratory equipment.

Bioinformatics may prove crucial in both promoting and combatting the ability to disguise anti-animal biological sabotage as a natural event. Next generation automated sensors may well not only be able to detect biological agents but they may also be able to monitor for tell-tale signs of human involvement in the origin of an outbreak, such as genetic manipulation or highly unusual epidemiological characteristics.[75] It may also prove possible to misuse advances in sensor technology. Increasing levels of automation and reduced levels of human interaction with detection and diagnostic processes may facilitate malign manipulation in at least two ways:

- adding a new desirable characteristic to the desirability of anti-animal biological warfare agents—its ability to bypass detection equipment; or
- increasing the efficiency of hoaxes—allowing the development of agents specifically designed to trigger false alarms (minimising the risk of an epidemic spreading out of control).

It is to be hoped that the ultimate manifestation of sensor technology will be a system that can analyse genotype, phenotype and possibly proteotype in real time and one that can use global epidemiological databases to conduct simple analysis of the nature of an

[74] Prusiner, S.B., 'Molecular Biology of Prion Diseases', *Science*, Vol. 252, 1991, pp. 1515–1522.

[75] This might include, for example, disease events involving agents connected to specific seasonal vectors that emerge when natural transmission mechanisms are not present.

outbreak. Many bioinformatic sub-disciplines will be crucial in the development of such sensor technology.

The move towards storing biological data electronically has implications for biological warfare. Those tasked with preventing the proliferation and use of biological weapons should benefit from having faster access to more information. A prime example of such a development has occurred in the USA, where new biosecurity legislation has been formulated that should decrease the potential for biological agents or dual-use technology to be diverted from their intended use. This legislation has led to the production of databases detailing the location of and security measures taken to protect select agents. These databases could prove important tools for enhancing domestic biosecurity. If the data are not properly digitally secured, however, such information may actually facilitate the efforts of potential proliferators. For instance, if the locations and security measures relating to Select Agents were accessed for malign purposes, such information could become a 'shopping list' of raw materials for a BW program. Although it appears that measures are in place to minimise such an eventuality, it is to be hoped that equal attention will be given to animal-related capabilities.

The potential for the future misuse of bioinformatics has already begun to be seen. The creation of a polio virus from its electronically stored genome using high-throughput digital machines in 2002 demonstrates the need to ensure that bioinformatic resources are used in a responsible manner.[76] It is hoped that early attention to such issues can ensure this and that other important biological advances are only used for the benefit of human-kind.

[76] Cello, J., Paul, A.V. and Wimmer, E., 'Chemical synthesis of poliovirus cDNA: generation of infectious virus in the absence of natural template', *Science*, Vol. 297, 2002, pp. 1016-1018.

Table 2: Possible Offensive and Defensive Developments in anti-animal biological warfare

Desirable Characteristic	Possible Offensive Developments		Possible Defensive Developments	
	For a Military Threat	**For a Clandestine Threat**	**Against a Military Threat**	**Against a Clandestine Threat**
An agent should be highly infectious.	–	Directed evolution of natural agents through advanced systems biology to increase infectivity preferentially	–	Novel prophylactics, therapies and anti-infectious agents derived from advances in the biological sciences and designed to counter the infectivity of the pathogens
An agent should pose a significant threat to livestock production (or associated industries)	–	Developing techniques to enhance the characteristics of agents on the OIE class A and B pathogen lists that have not previously been considered candidates for anti-animal biological warfare	–	Improved prophylactics and therapies that could be created from scratch faster and more safely and the development of biochemical protocols designed to minimise the impact of diseases on the animal production industry
An agent should produce a known effect consistently	Enhanced manipulation and regulation of the biological pathways of an agent through systems biology, genomics, proteomics and bioinformatics	Enhanced understanding of factors affecting production of the effect through advanced systems biology	Development of novel prophylactic and therapeutic protocols that could alter the course of an infection	Development of novel prophylactic and therapeutic protocols that could alter the course of an infection
It should be possible to store the agent for short periods of time.	-	Enhanced understanding of factors affecting agent degradation and loss of infectivity / pathogenicity through advanced systems biology.	–	Improved hand-held/transportable sensor technologies, through developments in the field of bioinformatics, genomics and proteomics, increasing the difficulty of transporting or storing pathogens—even over short distances or for short durations

It should be possible to disseminate the agent efficiently	Enhanced agent stability and environmental resistance conferred by genetic manipulation	–	Development of novel biochemical agents to diminish the stability and environmental resistance of pathogenic agents	–
It should be possible to mass produce the agent	Misapplication of advances in the field of biotechnology combined with conferred preferential production characteristics through genetic manipulation	–	Improved epidemiological surveillance and the development of remote sensing technology through advanced bioinformatics techniques, to prohibit the illicit mass production of biological agents	–
It should be stable in storage and in munitions	Induced spore formation or environmentally stable characteristics through genetic manipulation	–	Creation of agents or biochemical agents designed to degrade pathogens without having a negative impact on natural biological systems (ensured through increasing capabilities in the field of systems biology)	–
The disease should be epidemiologically explainable	–	Greater understanding of the epidemiology of animal disease outbreaks through bioinformatics, increasing the number of available epidemiological explanations	–	Greater understanding of the epidemiology of animal disease outbreaks through bioinformatics and systems biology
The disease should not be zoonotic	Altered biochemical structure to prevent infection of human tissue	Enhanced disease surveillance and future sensor technology, reducing the risk of a zoonotic outbreak spreading to humans	Enhanced interaction and information flow across the animal health/public health interface.	Enhanced interaction and information flow across the animal health/public health interface.

The dose needed to produce the effect should be low	Increased infectivity and pathogenicity through genomic and proteomics manipulation	Directed evolution of natural agents through advanced systems biology to increase infectivity and pathogenicity preferentially	Improved disease surveillance and sensor technologies which would negate some of the advantages of using reduced doses in order to overcome detection (because of current inabilities to detect agents in very small quantities), combined with enhancements in animal immune technologies that might require larger doses to cause disease	Improved disease surveillance and sensor technologies negating some of the advantages of using reduced doses in order to overcome detection (because of current inabilities to detect agents in very small quantities), combined with enhancements in animal immune technologies that might require larger doses to cause disease
The target population should have little or no immunity	Creation of novel agents for which no innate immunity exists, or the genomic or proteomic manipulation of traditional agents	–	Improved specific immunological protocols, the development of broad-spectrum prophylactics and immuno-boosting biochemical treatments	–
The user should have the means to protect his/her own animals	Enhanced control over the process of infection through systems biology, combined with enhanced capabilities to develop prophylactics and therapies derived from advances made in almost all biological fields	–	Improved surveillance of disease prevention activities through advances in bioinformatics	–
There should be a long sub-clinical infectious period	–	Directed evolution of natural agents through advanced systems biology to increase infectious period preferentially, while suppressing clinical presentation	–	Novel biochemical agents designed to interfere with the incubation processes of an infectious agent and enhanced detection and diagnostics capabilities allowing earlier intervention following an outbreak.

There should be a short predictable incubation period	Enhanced control over incubation through systems biology, combined with conferred preferential characteristics through genetic manipulation.	-	Novel biochemical agents designed to interfere with the incubation processes of an infectious agent and enhanced detection and diagnostics capabilities allowing earlier intervention following an outbreak.	–
Treatment for the disease should not be easily available to the target population	Creation of novel agents for which no treatment currently exists, or the genomic or proteomic manipulation of traditional agents	–	Improved prophylactics and therapies that could be created from scratch faster and more safely and which could be distributed to a wider group of consumers through the spread of biotechnology	–

Note: this table is a generalization. It is possible to envisage military and clandestine scenarios that would require alternative characteristics.

Anti-Plant Threats

Programmes devoted to the development and application of agents for use in the intentional destruction of plant life have formed an important component of military programmes.[1] Biological agents have been developed for their military capacity to bring about the destruction of a wide variety of plant life, including food and cash crops. In the civil sector, the large-scale production of agents for the biological control of plant pests and weeds is of increasing relevance to a strengthened international legal prohibition against biological warfare. And technologies closely related to biological warfare and biological control are being developed for employment against illicit drug crops. In the age of international terrorism, the obvious challenge that the existence of such technologies throws up is: how, in view of existing and future scientific and technological developments, their hostile use can be prevented without placing regulatory measures on science that stifle scientific progress in the sphere of plant biology?

In the first part of this section, plant diseases are discussed in the context of their development in military programmes and in regard to developments in plant biology in the civil sector that have military applications. In the second part, current capabilities and concerns are discussed in light of relevant scientific developments in these areas. In the final part there is an evaluation of the threat posed by the future development of Advanced Biological Warfare Agents.

State programmes

The principal intention in military programmes has been to develop agents for hostile use against an adversary's food and cash crops. A large number of agents pathogenic to plant life were selected for their disease-producing potential, including bacteria, fungi and viruses transmitted to plants via an agent of dissemination such as an insect. While not discussed in any detail here, investigations also involved exploring the potential of insects to destroy plants physically.

Regarded as a first-generation programme, the now widely-acknowledged campaign of covert sabotage by German agents during the First World War against livestock is also said to be one of the first instances of the deliberate targeting of crops with disease; as part of this campaign, quantities of wheat were contaminated.[2] Programmes in France in the later inter-war years, in Germany after the invasion of France in World War II, and in the mid-century programmes in Canada, Japan, the UK and the US, all benefited from the

[1] Methods of dissemination are not discussed in this paper.

[2] Wheelis, M., 'Biological sabotage in World War 1', in Geissler, E. and van Courtland Moon, J.E., *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, SIPRI Chemical and Biological Warfare Studies No. 18, (Oxford: Oxford University Press, 1999), pp. 35–62.

systematic scientific study of plant pathology for hostile purposes. Such activities represent second-generation biological warfare programmes. Together with anti-crop developments in Iraq and the former Soviet Union, each of the above programmes possessed a central characteristic relating to the selection of anti-plant agents. The agents of choice in all of the above programmes were fungal plant pathogens—those that cause annual losses amounting to billions of US dollars in some of the world's most important food and cash crops. Characteristically, fungal diseases of wheat and rice (and other cereals) are spread by means of a hardy microscopic spore and demonstrate high levels of resistance to environmental degradation. Such pathogens infect the aerial parts of plants and cause diseases that have the capacity to spread rapidly and to reach epidemic proportions throughout the course of a single growing season.

Examples of the role that such pathogens have played in the devastation of food crops include the Irish Potato Famine of 1845–46 and the Bengal Famine of 1943. While the British, Canadian, French, German, Iraqi and Japanese programmes were restricted to fundamental research and testing with pathogens and insects and were—as far as is known—capable of only modest levels of deployment, those of the former Soviet Union and the US involved great investment and the allocation of considerable resources. Both programmes resulted in the acquisition of a militarily significant anti-crop biological warfare capability, with that of the US resulting in the standardisation of munitions and

Agents standardised by the US	Agents listed as under review in 1969	Anti-crop agents in the former Soviet Union	Anti-crop agents in Iraq
Causal agent of stem rust of wheat, Puccinia graminis, code named TX	Puccinia gramins var. tritici Erikss. & Henn., race 56	Causal agents of diseases affecting wheat	Causal agent of 'cover smut' or stinking smut or bunt of wheat fungus of the genus Tilletia
Causal agent of rice blast, Piricularia oryzae, code named LX	Piricularia oryzae Cavara, races 11 and 25	Causal agents of diseases affecting rice	–
Causal agent of late blight of potatoes, Phytophthora infestans, code named LO	Causal agent of diseases of wheat and barley, Puccinia striiformis West	Causal agents of diseases affecting corn	–
Causal agent of stem rust of rye, code named SX	Causal agent of diseases of rice, wheat, corn, barley, rye, sorgum: Hoja blanca virus transmitted by plant hopper, Sogata orizicola	Causal agents of diseases affecting rye	–
Identity of fifth agent not available in the public domain	Causal agent of diseases of rice: Xanthomonas oryzae Uyeda and Ishiyama	–	–
–	Causal agent of downy mildew of poppy and diseases of papaver and argemone: Peronospora arborescens	–	–

Table 1: Anti-crop agents

the large-scale stockpiling of agents, and that of the former Soviet Union resulting in a large-scale capability to produce huge quantities of such agents on demand.

The agents listed in Table 1 can be regarded as indicative of those 'classical' anti-crop biological warfare agents that were under development in second-generation biological warfare programmes. These include fungal plant pathogens that affect the world's most economically and socially significant food and cash crops. It is important to note, however, that a much larger number of naturally occurring, unmodified agents than those described above pose a significant threat to food and cash crops. If we consider, for instance, the situation in just the USA, as Mark Wheelis and Laurence Madden[3] observe, there are 'many thousands of plant diseases … and an exact number is probably impossible to determine. Over 13,000 unique fungal plant pathogen species … and over 75,000 plant-fungus combinations (because a single pathogen species may infect many host plant species) are listed by one source. A given crop species such as wheat may be affected by over 200 different diseases worldwide'.

It is also worth noting that, although the programme in the former Soviet Union is regarded as a third-generation programme—where pathogens had been subject to genetic manipulation[4]—the available evidence does not appear to suggest that anti-crop warfare pathogens were subject to such modification techniques. The latter may also be true of the anti-crop programme in Iraq. An explanation as to why a capability was developed in the latter two countries based on a classical anti-crop BW agent is advanced in the final section. The following paragraphs consider military-related developments in the civil sector.

Biological control and plant inoculants

A 1991 initiative attempted to highlight the importance of strengthening the international legal prohibition against the threat posed by plant pathogens used in the civil sector for peaceful purposes. The head of the South African delegation to the Fifth Review Conference of the 1972 Biological and Toxin Weapons Convention (BTWC), Peter Goosen, has noted—at the official level— the mounting danger posed by the large-scale production of plant inoculants and biocontrol agents used routinely in agriculture in the control of plant pests and weeds. It is argued that, due to the dual-use capabilities of these agents, production facilities should be the subject of declarations under a strengthened BTWC. However, our interest here is in developing an appreciation of the plethora of organisms that could potentially be used as plant inoculants and biocontrol agents and their possible employment for malign purposes.

Plant inoculants are formulations containing living microorganisms, used in the treatment and promulgation of seeds and plant propagation materiel for enhancing growth and

[3] Wheelis, M., and Madden, L., 'The Threat of Plant Pathogens as Weapons Against US Crops', *Annual Review of Phytopathology*, Vol. 41, 2003, pp. 155–176.

[4] Dennis, C., 'The Bugs of War', *Nature*, Vol. 411, 17 May 2001, pp. 232–235. According to Dennis, research carried out under the former Soviet biological weapons programme on *Yersinia pestis*, the causal agent of plague, resulted in a form of the organism that was resistant to 16 different antibiotics.

disease resistance in plants. They are also used in the restoration of the microflora of soil. Unsophisticated technology is required for the production of dry peat-based formulations, and large quantities of this form of plant inoculant can be disseminated over crops. Sophisticated production facilities are required for the large-scale manufacture of liquid formulations and could easily be adapted to produce the production of plant inoculants for malign purposes. Future developments in regard to the delivery methods for plant inoculants in both dried (powder) and liquid (aerosolised) forms may further increase the future malign utility of this technology.

Biocontrol agents are living organisms, such as bacteria, fungi, insects, mites or weeds, or microorganisms that are used in the control of microbes or other organisms. A large number of biocontrol agents are currently available, such as in the USA, where they are marketed as biopesticides, and include bacteria like *Agrobacterium,* the widely-used *Bacillus thuringiensis* that produces a protein toxic to species of insects pests belonging to the orders lepidoptera (caterpillars), diptera (flies), and coleoptera (beetles and weevils), *Pseudomonas* and *Streptomyces.* Further biopesticides include fungi like *Ampelomyces*, *Candida*, *Coniothyrium* and *Trichoderma*.[5] Interestingly, freely available scientific literature[6] provides details of fermentation techniques used in the rapid and large-scale production of such biocontrol agents. Indeed, it contains references to production methods that require only limited resources, and there is increasing emphasis in the area of biocontrol and plant inoculation on research into genetic manipulation in order to enhance the effectiveness of such agents. In addition, a number of biocontrol agents with the above properties are awaiting registration—in the USA, for example, with the Environmental Protection Agency (EPA)—yet are publicly available for purchase as growth promoters and plant strengtheners. Other uses for plant inoculants and biocontrol agents have proved controversial.

Anti-narcotics

The use of biocontrol agents has been envisaged in connection with the destruction of illicit drug crops. In this respect, *Fusarium* fungi (affecting cannabis and coca) and *Pleospora* fungi (affecting poppy plants) have been developed as potential biocontrol agents. Conducted under the auspices of the United Nations Drug Control Programme (UNDCP), the USA has financed research into fungal pathogens of cannabis and coca, and UK and USA financed research into fungal pathogens of poppy has been conducted in Uzbekistan.[7] An ongoing debate raises doubts about claims regarding the host specificity of such organisms, and concern remains about the potential implications of the impact of these agents on complex ecosystems. Although no primary source data appear to be available on the above anti-narcotics research programmes, one author, Jim Hogshire, has commented on the extent to which research on anti-narcotic biological control agents has

[5] McSpadden Gardener, B.B. and Fravel, D.R., 'Biological control of plant pathogens: Research, commercialisation, and application in the USA', *Plant Health Progress*, 2000, doi:10.1094/PHP-2002-0510-01-RV. Available at www.apsnet.org/online/feature/biocontrol/top.html.

[6] Jackson, M.A., Cliquet, S. and Iten, L.B., 'Media and Fermentation Processes for the Rapid Production of High Concentrations of Stable Blastospores of the Bioinsecticidal Fungus *Paecilomyces fumosoroseus'*, *Biocontrol Science and Technology*, Vol. 13, 2003, pp. 23–33.

[7] Rufford, N., 'Britain Funds Biological Warfare Against Heroine', *Sunday Times*, 28 June 1998, p. 7.

featured genetic manipulation aimed at enhancing the target specificity and the virulence of these organisms. This secondary source offers some limited evidence as to the way in which advanced techniques may have been applied in the above programmes. According to Hogshire, research scientists have conducted experiments to manipulate the gene responsible for the destructive effect that *Fusarium* has on coca. This has included isolating 'a gene for the 24kDa protein from *Fusarium oxysporum* and [developing] a transformation system in *Fusarium oxysporum* to allow alteration of the gene expression'.[8]

Genetic modification

Negotiations by states parties under the auspices of the Ad Hoc Group to develop a means by which compliance with the BTWC could be verified through the implementation of a legally binding Protocol resulted in the production of a list of plant pathogens of concern. While not definitive in terms of its scope, the list—which was designed to assist states parties in filing their respective declarations—assessed agents against criteria where agents of concern were judged as such due to having been: the subject of research on biological warfare programmes and developed into weapons; or agents that have the capacity to cause severe socio-economic damage to staple crops. The list is interesting in that it raises official concern about the future prospect that agents with BW potential might be subject to genetic manipulation (see Table 2). It includes both bacteria and fungi that affect a broad host spectrum of important food and cash crops as likely candidates for genetic manipulation, but no information is available from this source as to how these pathogens might be modified.

While there is little evidence to suggest that applications from genome studies, such as techniques to genetically modify organisms, were used in past anti-crop biological warfare programmes, given recent advances in genomics, it would be irresponsible to assume that such techniques are not being, or will not be, applied in current or future third-generation offensive biological warfare programmes. Indeed, a number of major developments that impact on phytopathology appear to support this line of reasoning.

In the past ten years, genome studies have facilitated the manipulation of the genetic characteristics of food crops. For instance, crops can now be produced with built-in defences against insect predators (such as *Bacillus thuringiensis*, as discussed above). Crop varieties can be tailored to tolerate drought or salt or to be resistant to herbicides. They can also be manipulated so as to delay ripening, as in the case of the slow-ripening Flavr Savr tomato, which was approved for sale in the USA in 1994. Infertility can be conferred on plant seeds, as with the controversial Terminator gene. It has been possible to produce genetically-modified strains of rice with increased levels of vitamins and iron. Some 40 genetically-modified crops and microorganisms had been approved for sale by regulatory authorities in the USA by 1998, with almost one-half of US soya production resulting from genetically-modified varieties in 1999.

[8] Hogshire, J., 'Biological Roulette: The Drug War's Final Solution?', *Covert Action Quarterly*, No. 64, spring 1998, pp. 41–44. As of October 2004, the information to which this story relates is no longer available on the website of the US Agricultural Research Service.

Four major areas of research and development in plant genomics are of relevance. One rapidly developing area of research involves studies into the reaction of plants to pathogen invasion and the development of disease. Related research led to the discovery of a protein called harpin, which is used prior to pathogen invasion to activate crop defences. In order to confer resistance to plant diseases, the genes involved in the resistance are gradually being identified. Another promising area of research and development concerns protecting plants from disease through a concept known as 'pathogen-derived resistance'. This involves genes that are engineered into plants that are derived from the pathogens themselves. A third area of research concerns investigations into the role of antimicrobial peptides and proteins that bestow antimicrobial properties on plants, thus strengthening immunity and resistance to fungal and bacterial plant pathogens. With the objective of conferring a level of immunity or resistance to a pathogen, the fourth area concerns the development of genetically-engineered plants to express an antibody against a protein that is found to be crucial to the process of pathogenesis.

In addition to the above, a number of plant-derived recombinant human proteins are already being used in pharmaceuticals.[9] Phytopathology research into bacterial pathogens has also revealed recently a number of previously unknown natural chemical products, such as pyrrolnitrin, which is produced by *Pseudomonas* bacteria, used in the manufacture of a broad-spectrum chemical fungicide. Analysts have already started to think through the possibilities of how plant pathogens might be manipulated for malign purposes. A simple scenario, according to Elliott Kagan,[10] might be simply to insert noxious DNA material in the form of a bioregulator into a biocontrol agent like *Bacillus thuringiensis*, which would be present in sufficiently large quantities to contaminate the food-supply chain of a country, region or economic zone.

The complete genome sequence for *Ralstonia solanacearum*,[11] one of the most devastating soil borne plant pathogens affecting an unusually wide host range of plants globally, was published in 2002. This is likely to advance considerably the understanding of the molecular determinants that govern an organism's pathogenicity. It is important to note that the above developments open up a range of possibilities for the hostile use of plant pathogens across the biochemical spectrum, and it is easy to envisage that genome studies in plants could be used now and in future for malign purposes.

Advanced biological warfare agents

It is possible to envisage that advanced agents might emerge inadvertently as a result of scientists working with plant pathogens—as appears to have been the case in the sphere of animal biology, where scientists attempting to develop a contraceptive vaccine for

[9] Gruber, V. and Theisen, M., 'Genetically Modified Crops as a Source of Pharmaceuticals', *Annual Reports in Medicinal Chemistry*, Vol. 35, 2000, pp. 357–364.

[10] Kagan, E., 'Bioregulators as Instruments of Terror. Laboratory Aspects of Biowarfare', *Clinics in Laboratory Medicine*, Vol. 21, No. 3, September 2001, pp. 607–618.

[11] Salanoubat, M, et al., 'Genome sequence of the plant pathogen Ralstonia Solanacearum', *Nature*, Vol. 415, 2002, pp. 497–502.

mice from a relatively benign strain of mousepox virus created a lethal agent.[12] It may be possible to construct a plant pathogen from respective component parts, as was achieved in 2002 with the human polio virus.[13] It may also be possible to visualise the production of plant pathogens with novel characteristics, or it may be possible to engineer a pathogen in such a way that it becomes lethal to a broad host spectrum of plant life. It is possible to imagine the near eradication of an entire species from regions of the world, as with elm trees destroyed in some parts of Europe and the USA by a non-indigenous exotic fungal plant pathogen.[14] It would be naive to ignore the possibility that advanced anti-crop biological warfare agents might result in the total extinction of plant species. While such pathogens are easy to envisage, their production would require significant scientific investment and infrastructure.

However, given the destructive potential of naturally occurring and genetically-modified organisms against food, cash crops and other plant life, and the inherent vulnerabilities associated with large-scale agricultural practices in key industrialised countries, it is hard to foresee the need for advanced anti-crop biological weapons. J.E. van der Plank,[15] writing in the early 1960s, warned of the threat posed by naturally occurring plant pathogens that increase at a rate of 40% per day over several months. In commenting on the threat posed by the spores produced by wheat stem rust fungus, van der Plank notes that: 'Many types of spores disperse as easily as smoke. Many are tough and durable. They have only to be dispersed in the proper places at the proper times. Nature sees to the explosion … An enemy need only introduce the appropriate races, and resistance will vanish'. Mark Wheelis notes that large-scale, high-density production and a reliance on monoculture where there is a restricted range of genotypes make agriculture in advanced industrialised nations particularly vulnerable to naturally occurring but exotic pathogens to which crops can offer no resistance.[16]

The number of naturally occurring plant pathogens that pose a risk to plant life is at present unquantifiable. A great deal more work needs to be done to identify the number of pathogens and pathogen-host combinations. Genetically-modified plant pathogens would place great strain on plant extension services that struggle to address the problem of pathogens that are naturally occurring in the environment. It is hard to envisage the need for the development of advanced anti-crop biological weapons, but if we consider a worst-case scenario for plant life, it is possible to foresee the extinction of the plant species on which the world's burgeoning populations are increasingly reliant for the production of food.

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[12] Jackson, R.J., Ramsay, A.J., Christensen, C., Beaton, S., Hall, D.F.R. and Ramshaw, I.A., 'Expression of mouse interleukin-4 by a recombinant ectromelia virus suppresses cytolytic lymphocyte responses and overcomes genetic resistance to mousepox', *Journal of Virology*, Vol. 75, 2001, pp. 1205–1210.

[13] Cello, J., Paul, A.V. and Wimmer, E., 'Chemical synthesis of poliovirus cDNA: generation of infectious virus in the absence of natural template', *Science*, Vol. 297, 2002, pp. 1016–1018.

[14] Fry, W. E., *ASM News*, Vol. 62, No. 11, 1996, pp. 595–597.

[15] Van der Plank, J. E., *Plant Diseases: Epidemics and Control*, (London: Academic Press, 1963), p. 212.

[16] Wheelis, M., 'Agricultural Biowarfare & Bioterrorism: An Analytical Framework & Recommendations for the Fifth Review Conference', *Proceedings of the 14th Workshop of the Pugwash Study Group on the Implementation of the Chemical and Biological Weapons Convention: Key Issues for the Fifth BWC Review Conference 2001*, Pugwash Meeting No. 258, Geneva, Switzerland, 18–19 November 2000.

Table 2: Plant pathogens important for the BTWC

Name of pathogen	Disease caused	Distribution	Transmission	Control	Environmental stability	Ease of production	BW potential
1. Colletotrichum coffeanum var virulans [coffee berry disease].	Coffee berry disease can be very destructive in terms of yield loss and seedling death, but does not kill mature plants. Different races have not yet been recorded.	Central and Southern Africa.	Seed borne, rain splash, passive vectors, such as humans, birds and machinery.	Fungicide sprays are not effective. Chemical seed treatment not yet successfully developed. Resistant varieties are available.	Can survive as latent infection. Conidiospores have a short life, but conidia can survive more that a year on plant debris.	Can be mass produced on artificial substrate but is notoriously unstable under these condition and loses its pathogenicity rapidly.	Not a staple food and thus not regarded as important but may cause serious world wide economic problems.
2. Dothistroma pini (Scirrhia pini) (CMI 368) [blight of pines].	Dothistroma blight of pines can be highly destructive depending on the frequency of infection.	Europe, Asia, Africa, North and South America. Different races have not been recorded.	Seed borne, wind, clouds may carry spore inoculum.	Resistant pine species are available. Non-systemic fungicide sprays show some control activity, but are not practical and economically viable.	Inoculum viability debris limited to two to six months. Mass production of the pathogen is easily achieved utilising artificial substrates.		Is good; although pine is not a staple food, it is of strategic significance
3.Erwinia amylovora (CMI 44) [fire blight of apple, pear, quince and related species].	Fire blight of apple, pear, quince and related species is very destructiv e. Not yet recorded in South Africa.	North America, Central America, New Zealand, Japan, China, Europe, North Africa.	Water, vegetative material, insects.	Eradicate infected material. Chemical and antibiotic sprays not very successful. The bacteria are not stable in the environment outside their host material. This pathogen can easily be produced in commercial fermenters.			Good.
4.Pseudomona solanacearum (CMI 15) [wilt associated with numerous hosts,	Potato, tomato and tobacco wilt, slime disease, Granville wilt, bacterial ring disease, and Moko	Tropical, subtropical and warm temperate parts of: Asia, Africa,	Infected material such as contaminated soil, water, implements.	No effective chemical treatments available.- The bacterium is stable in soil and host			Excellent.

particularly potato, tomato and tobacco]	disease (in banana) are some of the most devastating diseases caused by this bacterium, which attacks numerous hosts of Solanaceae, Musaceae, Compositae and Fabacea, for instance. Different races of the bacterium are manifest, which combined with its broad host range make breeding resistance difficult.	Australasia, Europe, West Indies, North and Central America.		tissue. Spores are not produced and vegetative unprotected cells have a limited life span. Easily produced in relatively simple ferments.			
5. Pyricularia [Piricularia] orzae (CMI 169) [rice blast disease].	Blast disease of rice can be very destructive with regard to this staple food. Given its many races (219) and broad host spectrum, breeding for resistance is complex. The fungus needs a high temperature and level of humidity to infect.	Widespread: found in Africa, Asia, Australia, Europe, North America, South America, Central America and West Indies.	Wind.	Resistant cultivars and the spraying of environmentally harmful fungicides can be effective.	Stable, overwinters on straw and debris. Can easily be mass produced.		Good
6. Ustilago Maydis (CMI 79) [maize smut, blister smut and common smut].	Maize smut, common smut, blister smut can cause appreciable losses (ten to 17%). In addition, the spores can induce	Everywhere that maize (corn) is grown, except for New Zealand.	Wind, seed surface borne, contaminated soil.	Heat or chemical seed treatment, but this is useless where soil is contaminated. Possibly resistant cultivars.	Environmental stability is excellent. Spores remained viable after eight years in dry soil. Can be mass produced on artificial substrates.		Good.

	an allergic reaction in humans and may be toxic with respect to animals and humans. More than 500 races have been noted, complicating the search for resistance.						
7. Xanthomonas albilineans (CMI 18).	This bacterium causes leaf scald on sugarcane, where [it] can be highly destructive. It has a wide host range and can occur on maize and a number of grass species. The large number of races complicates breeding for resistance.	Africa, Central and South America, Asia, Australasia.	Infected sets, aerial dispersal, insects, rodents.	Heat treatment of sets, resistant varieties. No chemical treatment available.	The bacterium does not produce resistant spores. Disease may remain dormant as a systemic infection until environmental conditions favour symptom expression. The bacterium can easily be mass produced in simple commercial fermenters.		Good.
8. *Xanthomanas compestris pv. oryzae* (CMI 239).	The broad host range bacterium causes bacterial blight of rice and Kresek disease of rice. The latter is caused by systemic infection in the tropics and is extremely destructive.	Asia, Africa, South America, Mexico, Korea, Taiwan, Indonesia.	Wind, rain, flood, vegetative material, seed borne.	Chemical seed treatment, resistant cultivars, elimination of volunteers. Chemical spray not successful.	Does not produce resistant or hardy spores. Overwinters on a limited host range of plant life volunteers and in weed shizosphere. Survival on debris seems limited. Can be easily mass produced in simple commercial fermenters.		Medium to good. Candidate for genetic manipulation.
9. Tilletia tritici [cover smut, stinking smut and common bunt of	Cover smut, stinking smut, and common bunt of wheat are caused by	Worldwide.	Seed surface borne, wind, contaminated soil.	Resistant cultivars hey are short-lived because new races develop continuously.	Teliospores can survive for up to two years in soil. Production of this obligate parasite requires live		Good. Could possibly be enhanced by genetic manipulation.

wheat].	this broad host range fungus pathogen, which has a single host lifecycle. The fungus attacks the inflorescence [flower], replacing the kernels with bunt balls of black teliospores. The disease is regarded as very important, it suppresses yields and lowers the quality, and smelly trimethylamine is produced. The spores may ignite and cause an explosion during harvesting.			Chemical seed treatment.	hosts, but as vast numbers of spores can be harvested, mass production in not impossible.		
10. *Sclerotinia Sclerotorium* (CMI 513) [cottony soft rot and white mould of vegetables, beans, sunflowers, groundnuts and soya beans].	This plurivourous fungus causes cottony soft rot, white mould, and watery soft rot on a broad host spectrum, such as vegetables, beans, sunflower, groundnuts and soya beans but the fungus does not affect cereals and woody plants. The fungus can attack any parts found above ground at any developmental stage and is extremely destructive under cooler moist	Worldwide.	Airborne ascospores, seed infected with mycelium or contaminated with sclerotia (survival structure).	Airborne ascospores, seed infected with mycelium or contaminated with sclerotia (survival structure).			High. Good candidate for genetic manipulation to broaden its temperature spectrum.

	conditions, as found in relation to irrigation.						

The threat from incapacitating biochemical agents

One of the most significant current developments in bioweapon technology is the search for so-called 'non-lethal' chemical agents. These are pharmaceutical compounds, or close relatives of pharmaceutical compounds, that can cause rapid incapacitation of those exposed. They are sometimes called 'calmatives' or 'less-than-lethal' agents. None of these terms is satisfactory. Both 'less-than-lethal' and 'non-lethal' are clear misnomers, as all current candidates can be expected to cause significant lethality (probably in the range of 10% of casualties, which is in the same range as many traditional chemical weapons agents, such as mustard).[1] 'Calmative' does not accurately describe many of the agents sought, which would cause disabling delirium or unconsciousness, not calmness. Here we will simply call them incapacitating biochemical agents—terms that describe the desired effect, and that emphasize their dual biological and chemical nature.

In October 2002, a group of Chechen separatists took control of a theatre in Moscow, Russia, and held around 800 people hostage. After three days the Russian authorities ended the siege by pumping an aerosolised chemical incapacitating agent into the auditorium through the ventilation system. After allowing at least 30 minutes for the agent to impact on hostages and hostage-takers alike, troops stormed the building and shot and killed most of the rebels.[2]

A number of months prior to this incident, in response to concerns over commercial airline security following the events of 11 September 2001, the US National Institute of Justice (NIJ) completed a report entitled *Less-Than-Lethal Weaponry for Aircraft Security*.[3] NIJ Director Sarah Hart summarised the conclusions of the report in a statement to the House of Representatives. In the section covering the potential for use of chemical incapacitating agents she noted that:

'Anesthetics or calmative chemicals could, in principle, be developed into a system whereby they could be remotely released into the cabin in order to incapacitate all passengers, and the hijackers, until the plane can be landed safely'.[4]

Unfortunately there was not a safe outcome in Moscow. Over 120 hostages died as a result of exposure to the incapacitating agent and many survivors needed hospital treatment.[5] This incident underlined the danger of devising a discrete 'non-lethal/less-lethal' category

[1] Klotz, L., Furmanski, M., Wheelis, M. (2003) Beware the Siren's Song: Why 'Non-Lethal' Incapacitating Chemical Agents are Lethal. Washington DC: Federation of American Scientists (FAS). Available from http://www.fas.org/bwc/papers/sirens_song.pdf

[2] 'How special forces ended siege', BBC News, 29 October 2002, http://news.bbc.co.uk/1/hi/world/europe/2363601.stm.

[3] Hart, S., 'Statement before the Subcommittee on Aviation, Committee on Transportation and Infrastructure', US House Of Representatives, Washington DC, 2 May 2002, www.house.gov/transportation/aviation/05-02-02/hart.html.

[4] *Ibid*.

[5] This figure may have been higher, see Walsh, P., 'Families claim death toll from gas in Moscow siege kept secret', *The Guardian*, 18 October 2003, www.guardian.co.uk/international/story/0,3604,1065611,00.html.

for chemical incapacitants that would separate them from other toxic chemicals with the potential to have lethal consequences.[6] Also, one only has to alter the aircraft scenario slightly to see the problems that could arise if the hijackers, rather than the airliner, were armed with chemicals that could incapacitate everyone on-board. Experts have issued warnings about this 'double-edged sword'.[7]

Several days after the Moscow siege the Russian Minister of Health, Yuri Shevchenko, finally revealed that the agent used was a 'fentanyl-based' compound.[8] Although there is some debate as to whether it was a mixture of compounds, or perhaps a novel agent,[9] a number of experts believe that carfentanyl, an analogue that is 30 times more potent than fentanyl, was most likely a major constituent.[10] Fentanyl and its analogues are synthetic opioid analgesics that exert their major effects through action on μ opioid receptors in the central nervous system (CNS). The main side effect of fentanyl, which is commonly used in clinical anaesthesiology, having been introduced in the 1960s,[11] is respiratory depression. This is thought to have been a major factor in the death of so many in Moscow. The effect of opioid agonists, such as fentanyl and its analogues, can be reversed by the non-selective opioid antagonist, naloxone. A 2003 paper examining the implications of events in Moscow noted that:

'In the United States, naloxone, for a long time a critical antidote to treat heroin overdose and iatrogenic opioid toxicity, has now become a crucial component of our chemical warfare antidote repository'.[12]

Before looking at some of the potential agents we could face now and in the not too distant future, it is worth emphasising the overlap that exists between chemistry and biology in this area. Substances that can influence CNS functions through action on specific receptor sites can have either a synthetic chemical origin or a natural biological origin. Mark Wheelis has termed these substances potential *biochemical weapons*.[13]

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[6] See Klotz, L., Furmanski, M., Wheelis, M., *Beware the Siren's Song: Why 'Non-Lethal' Incapacitating Chemical Agents are Lethal*, (Washington, DC: Federation of American Scientists, 2003), www.fas.org/bwc/papers/sirens_song.pdf, and Federation of American Scientists Working Group on Biological Weapons, Position Paper: Chemical Incapacitating Weapons Are Not Non-Lethal, (Washington, DC: Federation of American Scientists, 2003), www.fas.org/bwc/papers/pp_chemical_incapacitants.pdf.

[7] See, for example, Coupland, R.M., 'Incapacitating chemical weapons: a year after the Moscow theatre siege, *The Lancet*, Vol. 362, p. 1346, and Wheelis, M., '"Nonlethal" Chemical Weapons: A Faustian Bargain', *Issues in Science and Technology*, Spring 2003, www.nap.edu/issues/19.3/wheelis.htm.

[8] 'Russia names Moscow siege gas', BBC News, 31 October 2002, http://news.bbc.co.uk/1/hi/world/europe/2377563.stm.

[9] BBC, 'Horizon: The Moscow Theatre Siege', transcript available from www.bbc.co.uk/science/horizon/2004/moscowtheatretrans.shtml.

[10] Stanley, T., 'Human immobilization: is the experience in Moscow just the beginning?', *European Journal of Anaesthesiology*, Vol. 20, No. 6, pp. 427–428.

[11] U.S. Drug Enforcement Administration (DEA), 'Fentanyl', www.usdoj.gov/dea/concern/fentanyl.html.

[12] Wax, P., Becker, C. and Curry, S., 'Unexpected "Gas" Casualties in Moscow: A Medical Toxicology Perspective', *Annals of Emergency Medicine*, 41(5), 2003, pp. 700–705.

[13] Wheelis, M., 'Biotechnology and Biochemical Weapons', *The Nonproliferation Review*, Vol. 9, No. 1, 2002, http://cns.miis.edu/pubs/npr/vol09/91/91whee.htm.

Possible modification of traditional agents

Military interest in incapacitants has a long history.[14] Fentanyl was being investigated by the US military as a potential weapon in the 1960s.[15] Other agents under consideration by the UK and US at this time were a group of psychoactive compounds called the glycolates,[16] which interfere with acetylcholine metabolism. One of them, BZ (3-quinuclidinyl benzilate), was subsequently weaponized by the US.[17] There are also reports that the former Soviet Union developed a derivative of BZ as a weapon[18] and that Iraq's chemical weapons programme may have incorporated a related glycolate compound known as Agent 15.[19] BZ was eventually rejected by the US as a suitable weapon due to its non-specific and unpredictable effects.[20]

Since then there have been significant developments in neuroscience. The 1980s saw the identification of numerous peptide neurotransmitters that mediate chemical transmission in the nervous system alongside 'classical' neurotransmitters, such as acetylcholine. It is work conducted over the past ten to 15 years, however, that has revolutionised the field. The impact of genomics has led to greater understanding of receptor systems and elucidation of the structure and function of certain receptor sub-types that have now become targets for therapeutic drugs. Concurrently, another enabling technology, combinatorial chemistry, has permitted the screening of large numbers of compounds to identify those affecting these specific receptor targets.[21] As well as offering the opportunity to develop more effective new drugs to treat numerous mental illnesses, as is a priority of the global pharmaceutical industry, this knowledge is of course dual use.[22]

Might the cholinergic system in the CNS now be targeted more specifically by weaponeers? The muscarinic acetylcholine receptors (there are five sub-types), which are thought to have a CNS role in motor control, temperature regulation, cardiovascular regulation and memory, are potential targets.[23] The M2 inhibitory autoreceptor regulates levels of acetylcholine release at muscarinic synapses and it has been suggested that a specific and potent agonist for this receptor could affect these fundamental acetylcholine-mediated processes in the body.[24]

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[14] Ketchum, J. and Sidell, F., 'Incapacitants', in *Textbook of Military Medicine: Medical Aspects of Chemical and Biological Warfare*, (Washington, DC: Office of the Surgeon General, Department of the Army, 1997).

[15] Meselson, M. and Perry Robinson, J., '"Non-Lethal" Weapons and Implementation of the Chemical and Biological Weapons Convention', *20th Pugwash Workshop Study Group on the Implementation of the CBW Conventions: The BWC Intersessional Process towards the Sixth Review Conference and Beyond*, Geneva, Switzerland, 8–9 November 2003, www.pugwash.org/reports/cbw/cbw20/cbw20-meselson-robinson.htm.

[16] Dando, M., 'Future Incapacitating Chemical Agents: The Impact of Genomics', in Lewer, N. (ed), *The Future of Non-Lethal Weapons. Technologies, Operations, Ethics and Law*, (London: Frank Cass, 2002). pp. 167–181.

[17] Ketchum, J. and Sidell, F., 'Incapacitants', *op. cit.*

[18] MacKenzie, D., 'Russian gas may be secret crowd-control weapon', *New Scientist*, 28 October 2002, www.newscientist.com/news/news.jsp?id=ns99992974.

[19] Dando, M., 'Future Incapacitating Chemical Agents: The Impact of Genomics', *op. cit.*

[20] Dando, M., 'The Danger to the Chemical Weapons Convention from Incapacitating Chemicals', *CWC Review Conference Paper*, No.4, (Bradford: Department of Peace Studies, University of Bradford, 2003).

[21] Wheelis, M., 'Biotechnology and Biochemical Weapons', *op. cit.*

[22] Dando, M., 'Scientific and technological change and the future of the CWC: the problem of non-lethal weapons', *Disarmament Forum*, No. 4, 2002, pp. 33–44.

[23] Dando, M., 'The Danger to the Chemical Weapons Convention from Incapacitating Chemicals', *op. cit.*

[24] *Ibid.*

Military interest in incapacitants never receded,[25] but it has gained new impetus as a result of these scientific advances. Events in Moscow are likely, if anything, to have heightened this attention.[26] One of the main recommendations of a 2003 report on the science and technology associated with non-lethal weapons (NLWs), compiled by the Naval Studies Board of the US National Academy of Sciences (NAS), was for increased research on incapacitating chemicals, or 'calmatives', as the US military calls them, and their delivery systems.[27] The report indicated that calmatives are now being studied at the US Army Edgewood Chemical Biological Center (ECBC) after a 'lull in R&D for 10 years'. Central to one project is a sponge projectile designed to deliver a 'dose' of a fentanyl derivative.

In October 2000, two years before the Moscow siege, The Applied Research Laboratory at Pennsylvania State University, whose scientists have worked closely with the Joint Non-Lethal Weapons Directorate (JNLWD) of the US military for a number of years, published a report entitled *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*.[28] It points out that potential calmatives are 'compounds known to depress or inhibit the function of the central nervous system', including 'sedative-hypnotic agents, anesthetic agents, skeletal muscle relaxants, opioid analgesics, anxiolytics, antipsychotics, antidepressants and selected drugs of abuse'. Their analysis of the available literature identified several classes of compound they considered to have high potential for use as 'non-lethal' calmatives. These, along with their sites of action in the nervous system, can be seen in Table 1.

Table 1: Selected Calmatives

Drug Class	**Site of Action**
Benzodiazepines	GABA receptors
$Alpha_2$ Adrenergic Receptor Agonists	$Alpha_2$-adrenergic receptors
Dopamine D3 Receptor Agonists	D3 receptors
Selective Serotonin Reuptake	5-HT transporter
Serotonin 5-HT_{1A} Receptor Agonists	5-HT_{1A} receptor
Opioid Receptors and Mu Agonists	Mu opioid receptors
Neurolept Anesthetics	GABA receptors
Corticotrophin-Releasing Factor	CRF receptor
Cholecystokinin B receptor antagonists	CCKB receptor

Many of these classes of compounds could clearly be used for harmful purposes. We have already discussed the effects of μ opioid agonists in the context of fentanyl and its analogues). The Pennsylvania State University report examines a drug called dexmedetomidine, which is a selective agonist of the a_{2A} adrenergic receptor, the sub-type that plays an important role in sedation.[29] Work by the US military during the 1990s to develop a_2 adrenergic agonists as weapons for the non-lethal weapons programme has been

[25] Dando, M., *A New Form of Warfare: The Rise of Non-Lethal Weapons*, (London: Brassey's Inc. Publishing, 1996).

[26] Dando, M., 'The Danger to the Chemical Weapons Convention from Incapacitating Chemicals', *op. cit.*

[27] National Academy of Sciences, *An Assessment of Non-lethal Weapons Science and Technology*, (Washington, DC: National Academies Press, 2003), www.nap.edu/books/0309082889/html.

[28] Lakoski, J., Bosseau Murray, W. and Kenny, J., *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*, State College, PA: College of Medicine, Applied Research Laboratory, The Pennsylvania State University, 2000), www.nldt.org/documents/calmative_report.pdf.

[29] Lakoski, J., Bosseau Murray, W. and Kenny, J., The *Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique, op. cit.*

documented.[30] Neuropeptide transmitter systems are also discussed in the report. CCK-B receptor agonists can induce panic attacks in humans and the authors suggest the use of CCK-B antagonists as potential anxiolytic calmative agents. Another neuropeptide, Substance P (not mentioned in the report), is thought to be involved in depression and anxiety and it has been suggested that, since receptor antagonists reduce these systems, agonists may induce them.[31] Clearly there may be opportunities for misuse of potent selective agonists affecting these two receptor systems.

One 'classical' neurotransmitter that receives attention in the report is serotonin (5-HT). Serotonin is widely distributed in the nervous system and has been implicated in playing a part in many types of human behaviour.[32] Of interest to those developing incapacitants is its role in sleep, mood and aggression. One of two April 1994 research proposals by the US Army Edgewood Research, Development and Engineering Center (ERDEC) (now the ECBC) that have recently come to light sets out an idea for a potential calmative. In the proposal, a calmative is defined as:

> 'an antipersonnel chemical that leaves the victim awake and mobile but without the will or ability to meet military objectives or carry out criminal activity'.[33]

It goes on to report the observations of a Professor of Anaesthesiology at the University of Utah School of Medicine on the 'profound calming effect' of a serotonin antagonist, structurally similar to ketanserin, in wild elk that are normally unapproachable.[34] It is suggested in the proposal that this chemical or a related compound 'should be an ideal candidate calmative agent'. The first part of the feasibility study proposed was to carry out a literature search:

> 'to correlate chemical structure of serotonin antagonists to serotonin receptor subtypes" and to 'determine receptor subtype connected with both desired and undesired pharmacological effects'.[35]

The exact mechanisms by which serotonin affects certain behaviours such as aggression are not fully understood. However, human and animal studies have shown that increased serotonergic function is associated with decreased aggressive behaviour and vice-versa.[36] Studies in animals have provided other insights; in monkeys:

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[30] Dando, M., 'Future Incapacitating Chemical Agents: The Impact of Genomics', *op. cit.*

[31] Dando, M., 'Scientific and technological change and the future of the CWC: the problem of non-lethal weapons', *op. cit.*

[32] Feldman, R., Meyer, J. and Quenzer, L., 'Serotonin', in *Principles of Neuropsychopharmacology*, (Sunderland, MA: Sinauer Associates, 1997), pp. 345–389.

[33] Ferguson, P., 'Antipersonnel Calmative Agents', Edgewood, MD: US Army Edgewood Research, Development & Engineering Center, 1994), www.sunshine-project.org/incapacitants/jnlwdpdf/.

[34] See: Stanley, T., Port, D., van der Maaten, J. and Kimball, J., 'Treatment of Stress Hyperthermia in Elk with Ketanserin, a Serotonin Receptor Blocker', *Veterinary Surgery*, Vol. 15, Issue 2, 1986, pp. 214–217.

[35] Ferguson, P., 'Antipersonnel Calmative Agents', (Edgewood, MD: US Army Edgewood Research, Development & Engineering Center, 1994), www.sunshine-project.org/incapacitants/jnlwdpdf/.

[36] Feldman, R., Meyer, J. and Quenzer, L., 'Serotonin', *op. cit.*

> 'It is clear that serotonin does not simply inhibit aggression; rather, it exerts a controlling influence on risky behavior, which includes aggression'.[37]

Having reviewed the literature in this area the authors of the Pennsylvania State University study point out that:

> 'It is hypothesised that the increase in the amount of serotonin leads to improved control of behaviours linked to this transmitter system, which include aggression, agitation, anxiety, general affect (mood), and sleep, among others'.[38]

One potential calmative technique they suggest is the use of a selective 5-HT_{1A} receptor antagonist, which 'would reduce symptoms of anxiety in an individual or individuals and promote a calmer and more compliant behavioral state'.[39] One such compound, buspirone, is used clinically to treat anxiety, and they note that numerous others are under development in the pharmaceutical industry.

As for the two military proposals produced in 1994 to develop specific incapacitant weapons, including those acting on the 5-HT system (the other was to develop synthetic opioid agonists), their fate in unclear.[40] However, the author of the proposals subsequently worked as a senior researcher at Optimetrics Inc., which won a contract with the Pentagon in early 2000 to carry out the first phase of a study to assess the military and law-enforcement applications of incapacitants.[41] This phase, which is now complete,[42] is described in the contract solicitation as follows:

> 'Phase I studies will consist of a Front End Analysis comprising the following elements: review existing data on the candidate agents; define scenarios of use and operational parameters; conduct range finding toxicological animal tests, and correlate results with those from previous studies'.[43]

Meanwhile, objectives listed in the JNLWD's Technology Investment Project for 'Front End Analysis of Non-Lethal Chemicals' for fiscal year 2001–02 included those set out below.[44]

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[37] Carlson, N., 'Emotion', in *Physiology of Behavior*, Seventh Edition, (Boston, MA: Allyn and Bacon, 2001), pp. 339–370.

[38] Lakoski, J., Bosseau Murray, W. and Kenny, J., *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique, op. cit.*

[39] *Ibid.*

[40] Sunshine Project, 'The Return of ARCAD. The Sunshine Project News Release', 6 January 2004, www.sunshine-project.org/publications/pr/pr060104.html.

[41] *Ibid.*

[42] Ruppe, D., 'United States: US Military Studying Nonlethal Chemicals', *Global Security Newswire*, 4 November 2002, www.nti.org/d_newswire/issues/2002/11/4/7s.html.

[43] US Department of Defense, *CBD 26 Phase I Selections from the 00.1 Solicitation*, Department of Defense SBIR Awards 2000, www.nttc.edu/resources/funding/awards/dod/2000sbir/001cbd.asp.

[44] US Joint Non-Lethal Weapons Directorate, 'Front End Analysis for Non-Lethal Chemicals', 2003, www.sunshine-project.org/incapacitants/jnlwdpdf/feachemical.pdf.

- To identify advances in the pharmaceutical industry and elsewhere for potential non-lethal applications.
- To conduct military user workshops to identify a range of desired operational effects.
- To create a searchable database of potential candidates.
- To provide a list of promising candidates to Judge Advocate General's office for preliminary legal review.

Writing in early 2003, the University Professor of Anaesthesiology who had contributed to the 1994 proposal to explore serotonin antagonists as incapacitants reflected on events in Moscow. Recognising the dangers of employing fentanyl and other opioids he goes on to say:

> 'However, remarkable progress has been made in the techniques to deliver immobilizing agents and in the development of safer, faster-acting potent compounds of extremely short duration in the last decade. Much of this work is either privileged or currently not available to the public and therefore unpublished'.[45]

Future threats: targeting interacting biological systems with possible advanced biological warfare agents

A 2001 review of bioregulators with the potential for use in bioterrorism underlined the varied nature of these compounds:

> 'Bioregulators are structurally diverse compounds that are capable of regulating a wide range of physiologic activities, such as bronchial and vascular tone, muscle contraction, blood pressure, heart rate, temperature, and immune responses'.[46]

Those reviewed included cytokines, eicosanoids, plasma proteases, neurotransmitters and hormones. It is important to place this discussion in a historical context. The Soviet biological weapons effort, ostensibly halted in 1992, included programmes, championed by the most influential biomedical scientist of the time, Yuri Ovchinnikov, to weaponize bioregulators:[47]

> 'He [Yuri Ovchinnikov] saw a way around arms control treaties and weapons conventions by using microbes to produce biologically active substances that would replace

[45] Stanley, T., 'Human immobilization: is the experience in Moscow just the beginning?', *European Journal of Anaesthesiology*, Vol. 20, No. 6, pp. 427–428.

[46] Kagan, E., 'Bioregulators as Instruments of Terror', *Clinics in Laboratory Medicine*, Vol. 21, No. 3, 2001, pp. 607–618.

[47] Alibek, K. and Handelman, S., *Biohazard*, (New York: Random House, 1999). Also see Davis, C., 'Nuclear Blindness: An Overview of the Biological Weapons Programs of the Former Soviet Union and Iraq', *Emerging Infectious Diseases*, Vol. 5, No. 4, 1999, pp. 509–512, www.cdc.gov/ncidod/EID/vol5no4/pdf/davis.pdf.

> classic chemical weapons; their production could then be concealed in the biotechnology or pharmaceutical industry'.[48]

But what of the systems biology approach to weapons agent design of which James Petro et al. warn, which may enable targeting of certain biological processes to produce a variety of effects, including 'death, incapacitation, or neurological impairment'.[49]

Some examples can be gleaned from consideration of the interconnectivity between the nervous, immune and endocrine systems. In the past 25 years it has emerged that immune regulation is influenced by the brain and that neural and endocrine functions are influenced by the immune system.[50] These systems also share the same means of communication through hormones, neurotransmitters, cytokines and their respective receptors.[51] All three systems are interconnected through the hypothalamus-pituitary-adrenal (HPA) axis via cytokines, hormones, neurotransmitters, peptides and their receptors, and also through hardwiring of neural and lymphoid organs.[52]

Under conditions of stress, the hypothalamus region of the brain releases corticotrophin-releasing factor (CRF), which, in turn, causes the release of adrenocorticotrophin hormone (ACTH) from the pituitary gland. ACTH in the blood results in the release of glucocorticoid hormones that regulate metabolism and immune function. Glucocorticoids have a negative feedback effect on CRF and ACTH release. Other neurotransmitters are also involved in regulating the HPA axis. It is known that disturbances in this system have significant ramifications: over stimulation of the HPA axis and excessive production of glucocorticoids lead to immune suppression and increased susceptibility to infection, while under stimulation, resulting in lower glucocorticoid levels, can lead to inflammation and autoimmune conditions.[53] Clearly, this system is open to influence at several levels and could be a target of weapon designers.

To illustrate how the one system can affect the other, with possible detrimental consequences for both, the interaction of soluble bioregulators of the immune system (cytokines) and the neuroendocrine system (hormones and neurotransmitters) within the HPA axis will be taken as an example. The proinflammatory cytokines IL-1β, TNFα and IL-6 are produced by cells of the immune system after contact with microorganisms or their products.[54] The cytokines gain entry into the circulation after being produced at sites of the immune response in tissues and organs. Normally, these cytokines are of sufficiently large size that would prevent them from passing through the blood-brain barrier. However,

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[48] Davis, C., 'Nuclear Blindness: An Overview of the Biological Weapons Programs of the Former Soviet Union and Iraq', *op. cit*.

[49] Petro, J. B., Plasse, T.R. and McNulty, J. A., 'Biotechnology: impact on biological warfare and biodefense', *op. cit.*

[50] Dunzendorfer, S. and Wiedermann, C., 'Neuropeptides and the Immune System: Focus in Dendritic Cells', *Critical Reviews in Immunology*, 21(6), 2001, pp. 523–557.

[51] Blalock, J., 'The syntax of immune-neuroendocrine communication', *Immunology Today*, Vol. 15, No. 11, 1994, pp. 504–511.

[52] Straub, R.H., Westermann, J., Schölmerich, J. and Falk, W., 'Dialogue between the CNS and the immune system in lymphoid organs', *Immunology Today*, Vol. 19, 1998, pp. 409–413.

[53] Webster, J., Tonelli, L. and Sternberg, E., 'Neuroendocrine Regulation of Immunity', *Annual Reviews in Immunology*, Vol. 20, 2002, pp. 125–163.

[54] Steinman, L., 'Elaborate interactions between the immune and nervous systems', *Nature Immunology*, Vol. 5, 2004, pp. 575–581.

the preoptic area of the anterior hypothalamus represents a window in the barrier, allowing the cytokines to enter this region.[55] They subsequently bind to receptors on cells in the hypothalamus and trigger reactions collectively known as sickness behaviour, which is characterised by fever, drowsiness, lethargy and loss of appetite.[56]

Another effect that the proinflammatory cytokines have on the hypothalamus is to induce the production of CRF, which in turn causes the pituitary to produce ACTH.[57] As stated above, this hormone enters the circulation and acts on the adrenal cortex to induce the production of glucocorticoids, which have a profound effect in suppressing immune responses. However, CRF also has an effect on the central nervous system. In this regard, overproduction of the hormone has been shown to be connected to neurotoxicity and neurodegeneration in animal studies. In an animal model of acute ischemia (stroke), for instance, it was shown that CRF antagonists could protect against the loss of neurons that occurs as a result of a stroke. In addition, CRF has been associated with major depression, anorexia nervosa and Alzheimer's disease.[58] Normally, these interactions within the HPA axis work as a check and balance system to keep reactions from getting out of hand. But it is easy to see that selective overproduction of proinflammatory cytokines could tip the balance to potentiate effects on both the immune and the neuroendocrine systems, leading to debilitating sickness behaviour, significant immune suppression and even damage to neurons.

A dual-acting weapon could combine a substance that suppresses immunity with a pathogenic microorganism for increased effect. Or a non-pathogenic bacterium with a plasmid expressing a gene for say CRF production might cause immune suppression and neuronal damage in the target person(s). The Pennsylvania State University report looked at the actions of CRF in the brain alone rather than within the HPA axis. The authors propose that CRF antagonists might be used to produce 'a calm behavioral state' because of the role of CRF receptors in the brain in anxiety and stress.[59]

Just how susceptible the immune system is to modulation through the nervous system can be seen in a 2002 study on the effects of subclinical doses of sarin,[60] a potent organophosphorus nerve agent that irreversibly inactivates cholinesterase activity. The latter is an enzyme that is needed to degrade the neurotransmitter acetylcholine after it binds receptors on muscle fibres, causing the muscle to contract. Degradation of acetylcholine allows the receptors and therefore the muscle cells to return to their original state of relaxation. If cholinesterase is inactivated, the neurotransmitter continues to stimulate until the muscle is exhausted. Sarin can cause seizures and even death in high doses. It has been

[55] *Ibid.* Also see Licinio, J. and Frost, P., 'The neuroimmune-endocrine axis: pathophysiological implications for the central nervous system cytokines and hypothalamus-pituitary-adrenal hormone dynamics', *Brazilian Journal of Medical and Biological Research*, Vol. 33, 2000, pp. 1141–1148.

[56] Inui, A., 'Cytokines and sickness behaviour: implications from knockout animal models', *Trends in Immunology*, Vol. 22, 2001, pp. 469–473.

[57] Straub, R.H., Westermann, J., Schölmerich, J. and Falk, W., 'Dialogue between the CNS and the immune system in lymphoid organs', *op. cit.*

[58] Licinio, J. and Frost, P., 'The neuroimmune-endocrine axis: pathophysiological implications for the central nervous system cytokines and hypothalamus-pituitary-adrenal hormone dynamics', *op. cit.*

[59] Lakoski, J., Bosseau Murray, W. and Kenny, J., *The Advantages and Limitations of Calmatives for Use as a Non-Lethal Technique*, *op. cit.*

[60] Kalra, R., Singh, S.P., Razani-Boroujerdi, S., Langley, R.J., Blackwell, W.B., Henderson, R.F. and Sopori, M.L., 'Subclinical doses of the nerve gas sarin impair T cell responses through the autonomic nervous system', *Toxicology and Applied Pharmacology*, Vol. 184, 2002, pp. 82–87.

proposed that subclinical exposures to sarin may have played a role in the development of Gulf War syndrome.[61]

In their study, Kalra et al.[62] found that rats exposed to inhalation of subclinical doses of sarin (0.4 mg/m3 for one hour per day for five days) showed significantly reduced antibody (three-fold) and T cell proliferative (two-fold) responses over those rats that had not been exposed to the nerve agent. These researchers further determined that the observed immune suppression was not caused by increased glucocorticoid production, as might be expected if sarin were affecting the immune system through the CNS–HPA axis. Pretreatment of the rats with the ganglionic blocker chlorisondamine, which blocks behavioural responses to neuroactive substances, abrogated the effects of sarin on T cell proliferation. These results indicated that the nerve agent was exerting its effects through the autonomic nervous system.

Implications for the BTWC

Incapacitating biochemical agents are prohibited as weapons by the Biological and Toxin Weapons Convention (BTWC), as they are toxins, or analogues of toxins. The term toxin refers to a toxic chemical compound that is made by a living organism. Most current disabling biochemicals are related to compounds derived initially from living organisms, commonly plants. For instance, opiates include several categories of plant compounds that cause sedation, unconsciousness, or death in very small amounts. Because of their potent analgesic and anaesthetic activity, they have been extensively developed as pharmaceutical compounds (as have many other toxins), and because of their capability to cause unconsciousness at very small doses, they are of interest as weapons. Most opiates in current use are synthetic analogues of plant opiates, but are still covered by the BTWC, as States Parties at the Second and Third Review Conferences made it clear that the Convention applies equally to synthetic analogues of toxins.[63]

The revolution in biology, including genomics and proteomics, promises to allow the synthetic design of many new disabling chemicals, not modelled on existing toxins. These will be analogues of natural bioregulator compounds by which cells in the body communicate with each other. New, powerful techniques in biology are increasingly allowing detailed understanding of the communication of nerve impulses across cells, including details of the sites at which receptor proteins bind bioregulators. Bioregulators are extremely toxic in doses above the normally infinitesimal concentrations in which they are

[61] Abou-Donia, M.B., Wilmarth, K.R., Jensen, K.F., Oehme, F.W. and Kurt, T.L., 'Neurotoxicity resulting from coexposure to pyridostigmine bromide, deet, and permethrin: implications of Gulf War chemical exposures', *Journal of Toxicology and Environmental Health*, Vol. 48, 1996, pp. 35–56.

[62] Kalra, R., Singh, S.P., Razani-Boroujerdi, S., Langley, R.J., Blackwell, W.B., Henderson, R.F. and Sopori, M.L., 'Subclinical doses of the nerve gas sarin impair T cell responses through the autonomic nervous system', *op. cit.*

[63] Second Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (1986), Final Document, BWC/CONF.II/13; Third Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (1991), Final Declaration, BWC/CONF.III/23.

found in the body, and they are thus themselves toxins. Indeed, one bioregulator (the hormone insulin) has been used as a murder weapon on several occasions.

Incapacitating biochemicals are distinct from traditional riot control agents, such as mace (CN) and tear gas (CS). The latter are synthetic chemicals and are not analogues of naturally produced toxins, nor do they exert their action by virtue of being an analogue of a natural bioregulator. Rather, they appear to act as non-specific irritants to skin and mucous membranes. The more recently-developed riot control agent, oleoresin capsicum (OC) is, however, properly considered a toxin, as it is a toxic natural product of the *Capsicum* plant. That the plant is widely used as a culinary ingredient does not invalidate the classification of OC as a toxin weapon when used for hostile purposes, just as medical uses of opiates do not prevent recognition of them as toxins.

Because they are chemical compounds, incapacitating biochemical weapons are also prohibited by the Chemical Weapons Convention (CWC). However, the CWC allows the use of toxic chemicals for law enforcement purposes, so that it is legal for a country to develop, produce, stockpile, and use incapacitating biochemicals so long as the purpose is for domestic law enforcement.

However, the BTWC has no such exclusion, and it appears that development of incapacitating biochemicals would be prohibited under the convention, even if for law enforcement purposes—which involve intrinsically hostile interactions. At least two states—the US and Russia—are actively interested in developing incapacitating biochemicals as weapons for law enforcement, and possibly for military application. It is highly likely that other states have similar interests, which they have not yet made public. The momentum behind such weapons development is likely to increase significantly in the next few years as new agents or mixtures of agents are identified and different delivery devices become available. The treaty implications of such developments are complex and serious.

Science and technology considerations at the seventh BTWC Review Conference in 2011

In 2005 the Biological and Toxin Weapons Convention (BTWC) will have been in force for 30 years. Yet, for almost one-third of a century, the BTWC has had no effective means of verifying that states parties have been living up to their treaty obligations. In fact, some powerful voices have spoken out against the development of a verification system—even against the continuation of multilateral arms control—at a time when the pace and scope of scientific and technological change could well be accelerating. In the opinion of many, the past three decades have been characterised by rapid advancements in the science and technology sphere, which are of relevance to the BTWC. This constellation of factors raises the question of whether the BTWC could be overwhelmed by scientific and technological progress, in the sense that states decide to put much more emphasis on other policies, such as bio-defence or even deterrence via the threat of retaliation in kind. In short, could there be so many new possibilities for biological warfare and biological terrorism that the BTWC comes to be seen as an irrelevant relic of a bygone—pre-genomic—age?

This chapter is intended to contribute to an examination of that question. It begins by reviewing the depositary states' background paper on science and technology produced for the First Review Conference in 1980.[1] This provides a baseline perspective on developments at an early stage of the genomics revolution. The chapter then moves on a decade to review contributions from states parties to the 1991 Third Review Conference and on another decade to assess papers for the 2001–2002 Fifth Review Conference. The intention is not to focus on the detail of these papers, but rather to highlight statements on the scope and pace of scientific and technological change and to draw some general conclusions. To illustrate our argument in more detail we then consider recent strides made in immunology. Next we outline how things might look in 2011, compared with 2001, at the time of the Seventh Review Conference. By way of conclusion, we attempt to pull together some implications of the analysis to aid those who will be considering scientific and technological developments at the Sixth Review Conference in 2006.

The First Review Conference, 1980

For the First Review Conference the three depositary states—the Soviet Union (now the Russian Federation), the United Kingdom and the United States—produced a joint paper that was divided into seven sections:

[1] BWC/CONF.I/5, 6 February 1980.

Introduction;
I. Recombinant DNA techniques;
II. New infectious diseases;
III. Chemical synthesis of toxins;
IV. The industrial use of fermentation techniques;
V. Microbial control of pests; and
VI. Scientific and technological findings.

The assessments made in the paper appear today to have been somewhat optimistic. With regard to new recombinant DNA techniques, for example, the paper states that: 'now and for the foreseeable future, development and production of fundamentally new agents or toxins would present a problem of insurmountable complexity'. More generally, it notes that: 'Although recombinant DNA techniques could facilitate genetic manipulation of micro-organisms for biological or toxin warfare purposes, the resulting agents are unlikely to have advantages over known agents sufficient to provide compelling new motives for illegal production or military use in the foreseeable future'. How many people would agree with such sentiments today?

In the section on infectious diseases, which considered Marburg, Ebola and Lassa fever, the following conclusion was reached: 'It is doubted that there are any current technical reasons for regarding these diseases as posing a new biological warfare threat'. And with respect to fermentation technology: 'From a scientific and technological standpoint, growing industrial use of fermentation techniques does not appear to substantially alter capabilities or incentives for biological warfare'. Again, it is unlikely that these views would be widely shared today.

As for bio-control, the paper again adopted an optimistic perspective: 'misuse of both expertise and facilities is adequately covered by the terms of the Convention and this risk appears to be outweighed by the significant peaceful potential in this method of pest control'.

The paper's general conclusion was in line with the specific ones: 'From a scientific and technological standpoint, the developments discussed in this paper, which are directed to peaceful purposes, do not appear to alter substantially capabilities or incentives for the development or production of biological or toxin weapons'.

This, then, is the baseline assessment: the authors of the 1980 paper believed that there was little to be greatly concerned about.

The Third Review Conference, 1991

A number of states parties—Australia, Czechoslovakia, Sweden, the UK and the US—contributed to the background paper on scientific and technological developments that was produced for the Third Review Conference.[2] The UK submission is particularly

[2] BWC/CONF.III/4, 26 August 1991.

useful for our purposes, since it is structured in the same way as the 1980 paper. Hence we can make direct comparisons between the conclusions.

For recombinant DNA techniques, now termed genetic modification (GM), the British authors concluded that: 'in the period since the [BTWC] entered into force the techniques of GM remain the most significant development among the scientific and technological activities that have relevance for the [convention]. Worryingly, though, they added: 'There has been steady refinement of those biotechnology aspects other than GM that an aggressor nation could misuse in developing an offensive BW capability; important among the capabilities that could be misused are techniques for the large-scale production of natural or modified micro-organisms or toxins'. The paper noted that further advances in such capabilities were to be expected.

With regard to new infectious diseases, again, there was a change in outlook: 'it must be recognised that the continuing increase in knowledge and expertise related to these newly recognised diseases and arboviruses in the public health context with the passage of time, can only increase the potential for misuse of such micro-organisms'.

Similarly with respect to pest control: 'there has been increased study of factors relevant to effective dissemination. Such knowledge could in principle be misused by an aggressor intending to attack crops ... Some aspects of the dissemination technology would also be relevant to the deliberate release of organisms or toxins harmful to humans or animals'.

Not surprisingly, given such specifics, the general conclusion was also different. While stressing that all of these developments continued to be covered under the BTWC and that some also had the potential to aid bio-defence, the 1986 paper stated that there was: 'increased potential for the large-scale production of BW agents with enhanced military utility. The current UK view is that worldwide the increase in knowledge of many of the pathogenic species of micro-organisms, and the knowledge of toxins and other biological agents, and the continuing pace of developments in civil biotechnology areas, have further increased the possibilities for production and hostile use of biological agents, whether naturally occurring or not'.

Essentially, the threat had progressively increased over the five-year period.

Australia also made the general point that, while appreciating the benefits derived from advances in the production, harvesting and preservation of micro-organisms, plant and animals cells, these advances also have 'the potential, if misused, to provide the expertise and experience needed for developing and producing BW agents'. Furthermore, it noted that, as a result of these advances and their commercial utility, many nations now possessed biotechnology capabilities that could be misused.

Sweden also emphasised the speed of change in the summary and conclusions section of its contribution: 'There has been a rapid progress in many areas of molecular biology and biotechnology in the period 1986–1991. Using molecular biology, mechanisms of virulence and infection have been identified and the same techniques may also permit deliberate manipulations of these mechanisms. Thus there is a potential danger that new or genetically modified BW agents may be created'. The Swedish authors also underlined the growth in, and the spread of, industrial biotechnology capabilities.

The Canadians likewise drew attention to changing developments in a special monograph entitled *Novel Toxins and Bioregulators: The Emerging Scientific and Technological Issues Relating to Verification and the Biological And Toxin Weapons Convention.* The publication was distributed to all states parties at the Third Review Conference.

The US also covered peptide bioregulators in some detail: 'Their range of activity covers the entire living system, from mental processes (e.g. endorphins) to many aspects of health such as control of mood, consciousness, temperature control, sleep, or emotions, exerting regulatory effects on the body. Even a small imbalance in the natural substances could have serious consequences, including fear, fatigue, depression or incapacitation. These substances would be extremely difficult to detect but could cause serious consequences or even death if improperly used'.

In general, the US agreed on the speed of change: 'The past ten years have witnessed impressive strides in the fields of molecular biology and biotechnology. As the two juxtaposed words "molecular biology' imply, the distinction between biology and chemistry is becoming blurred'.

As with the other contributions, the benefits to security and defence are noted, but significantly, the US added: 'The confidence derived from the belief that certain technical problems would make biological weapons unattractive for the foreseeable future has eroded'.

There is no doubt that there was a major shift in the perceptions of the contributors to these background papers between 1980 and 1991. However, developments were subject to proper review in 1986 and 1991 and final declarations were agreed. The situation deteriorated significantly thereafter. In 1996, less attention was paid to other issues, since the focus was on the work of the Ad Hoc Group, and in 2001–2002, the disruption caused by the US prevented agreement being reached on a final declaration. Nevertheless, it is possible to examine the background paper produced by states parties in 2001 and to make comparisons with 1991.

The Fifth Review Conference, 2001

The background paper produced for the 2001 Review Conference was made up of contributions from Bulgaria, South Africa, Sweden, the US[3] and the UK.[4] The substantial UK contribution will be discussed after the others have been reviewed.

South Africa began by noting that many treaty-relevant developments had occurred during the period, but it opted to deal just with bio-control agents and plant inoculants. This was reasonable, since anti-plant biological warfare possibilities are frequently neglected—not to mention the sanguine conclusions reached at the First Review Conference. After carrying out a thorough evaluation of these issues, the South Africans concluded that there were many points of concern. With regard to plant inoculants, for example, the paper drew attention to: 'A growing industry and more sophisticated production facilities that have the potential to be diverted to BW-producing facilities, as in the case of vaccine production

[3] BWC/CONF.V/4, 14 September 2001.

[4] BWC/CONF.4/Add.1, 26 October 2001.

facilities', and 'The development of liquid inoculants that will make their application by spraying and aerosolization a possibility'. This conclusion clearly differed from that reached in 1980.

Sweden began with the observation that: 'The development within the field of biotechnology continues to be fast and innovative especially in the field of medicine. Part of this development is of concern to the [BTWC]'. It added: 'Our understanding of the molecular mechanisms of microbial infections has increased immensely over the last decade'.

It also referred to the unintentional result of the Australian mousepox experiment[5] and pointedly suggested that it showed that even inadvertent outcomes of peaceful research could 'play into the hands of those with malevolent aims'. In 20 years, therefore, an assessment of little likelihood of misuse of genetic engineering had morphed into a judgement that we even have to worry about the unplanned products of not very sophisticated research.

In general, Sweden concluded that: 'Since the last Review Conference in 1996 the research in the field of biotechnology and molecular biology has entered a new and more complex era. Huge amounts of knowledge concerning basic principles of life have found worldwide applications … While these developments have been and are mostly beneficial they can also be misused'.

Here Sweden appeared to be going along with the widely-held view that, to some extent, completion of the Human Genome Project signified the transformation of biology and associated sciences into a new and more powerful state.

The US contribution is replete with references to rapid developments in science and technology relevant to the BTWC. In paragraph two, it states that: 'Since the fourth Review Conference in 1996, there have been significant advances in the field of biotechnology. The major advances have occurred in the fields of genetic modification, genomics, proteomics, bioremediation, biocontrol agents, vaccine development and bioinformatics'. It continues: 'Of special interest to the [BTWC] are applications in directed molecular evolution (i.e. genetic modification), proteomics, bioinformatics, and vaccinology'.

These issues are dealt with in some detail. With regard to bioinformatics, for instance: 'The first and most striking change in the last 5 years has been the amount of genetic information available worldwide ... Second, is the rapid increase in information technology that enables discovery of new constructs and their interrelationships to others on readily available low-cost computer equipment'. As for microbial genetics: 'Since the publication of the *Haemophilus influenzae* genome in 1995, the sequences of close to 30 microbial genomes have been completed during the past 5 years, and the sequences of more than 100 genomes, including several traditionally considered to be agents capable of being developed as biological weapons, should be completed within the next 2 to 4 years'.

Again, seemingly in agreement with Sweden, the text notes that: 'Science, particularly in the biological and genomic areas, has advanced at incredible speed during the last 5 years, in large measure due to the stimulus of the Human Genome Project'. This makes sense, as

[5] Jackson, R.J., Ramsay, A.J., Christensen, C., Beaton, S., Hall, D.F.R. and Ramshaw, I.A., 'Expression of mouse interleukin-4 by a recombinant ectromelia virus suppresses cytolytic lymphocyte responses and overcomes genetic resistance to mousepox', *Journal of Virology*, Vol. 75 (2001), pp. 1205–1210.

the project did push biology in the direction of 'Big Science' with huge funding and coordinated direction towards a particular goal. The point is made in the summary of the US contribution, where it is indicated that progress in the biological sciences has been enabled by parallel advances in other sciences and 'large-scale, international collaborative efforts'.

The UK clearly put a great deal of time and effort into producing its 29-page contribution to the background paper. One statement stands out as a general viewpoint: 'Throughout the various studies and consultations carried out by the UK to inform this review, it has been clear that the rate of change in science and technology fields relevant to the BTWC has been much greater than in the previous five-year period, that is between the third and fourth Review Conferences'. The text continues: 'A number of advances in scientific knowledge and its applications could be of consequence for the provisions of the BTWC. *Given the accelerating pace in science and technology, the UK wonders whether it is prudent to maintain a five-year gap between such assessments under the BTWC'* [Emphasis added].

Significantly, the submission continued by making a practical proposal: 'The UK suggests that the upcoming Review Conference consider establishing a mechanism for State Parties to work together on a more frequent basis to conduct such scientific and technical reviews and to consider any implications at the necessary level of expertise'.

Unfortunately, it would appear that this recommendation to design a more adequate collective instrument for assessing and responding to scientific and technological change vanished amidst the chaos of the 2001–2002 Review Conference.

In order to appreciate the rapid advances in life sciences and the complexity of dealing with these changes, developments in the field of immunology will be taken as an example.

Current advances in immunology

The immune system plays a crucial role in protecting against infectious diseases. This is clearly demonstrated in the case of individuals with genetic defects in certain immune mechanisms, which frequently result in a devastating infectious disease state and eventually death, despite the use of antibiotics or other chemotherapeutic agents. Characteristic of the immune system is its ability to respond to an invasion of the body by microorganisms or toxic components in ways that afford protection against potential detrimental effects. The responses of the immune system include both non-specific (innate immune system) and specific (adaptive immune system) ones. These react in different ways to antigens (chemical components, mainly proteins and polysaccharides, of the microorganisms), which are substances that can elicit an immune response if they are foreign to the host. Microorganisms are made up of many different antigens. The immune system reacts to these antigens, stimulating defence mechanisms that are designed to eradicate the microorganisms.

Indeed, the pathogenicity of a microorganism can only rightly be defined in terms of its interaction with the immune system. To be a successful pathogen, a microorganism must be able to utilise strategies that enable it to evade immune defence mechanisms. Immune responses are regulated to a great extent through the production of cytokines, which are

bioregulators that can have positive and negative effects depending on the quantities produced. The immune system is thus extremely vulnerable to immune evasion strategies and immune bioregulators, a situation that can be easily exploited for good or malign purposes. The central dual-use role that the immune system plays in the context of life-sciences research can be seen in the examples of research activities that have been frequently highlighted in recent years as being potentially very dangerous. Most of these examples, including the mousepox experiment[6] and the potentiation of a virulence factor of vaccinia virus,[7] involve the exploitation of immune evasion strategies.

In just the past three decades we have witnessed incredible accumulation of knowledge on the mechanisms and functions of the immune system. Some of the key advances that might be mentioned include: unlocking the mechanisms of the recombination of antibody genes along with the mechanisms employed to create enormous antibody diversity; development of hybridoma technology, enabling the production of monoclonal antibodies that have since proven to be invaluable tools for research, diagnostic and therapeutic purposes; identification of the T lymphocyte receptor for antigen and delineation of the mechanisms of T cell antigen recognition as well as T cell function.

One area of immunology that has gained enormous importance and has developed most rapidly since the mid-1990s is that of innate immunity. With the discovery of mammalian Toll-like receptors (TLRs)[8] and awareness of their importance in governing recognition of, and the response to, different classes of microorganisms by macrophages[9] of the innate immune system, research activity in this area has increased dramatically. In 2004 alone, a series of papers have appeared in *Nature Reviews Immunology* on the role of TLRs in immunology[10] and in *Nature Immunology* on the role of TLRs in connecting the functions of innate immunity with those of adaptive immunity.[11]

The special position of innate immunity in controlling infectious diseases is evidenced by the fact that the National Institute of Allergy and Infectious Diseases (NIAID) of the US National Institutes of Health (NIH) expanded its programme significantly in 2003 to attract immunologists to the area of bio-defence research.[12] The NIAID reported that it 'awarded a multi-component grant to create an "encyclopedia" of innate immunity: a comprehensive and detailed picture of this ancient, essential first line of defense against bacterial and fungal diseases'. The stated goal of this undertaking is to generate knowledge that could lead to the development of treatments of infectious diseases. At the same time, however, this information could provide a blueprint for launching a malign attack on the innate immune system.

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[6] Jackson, R.J. et al., *op. cit.*

[7] Rosengard, A.M., Liu, Y., Nie, Z. and Jimenez, R., 'Variola virus immune evasion design: expression of a highly efficient inhibitor of human complement', *Proceedings of the National Academy of Sciences USA*, Vol. 99 (2002), pp. 8808–8813.

[8] Medzhitov, R., Preston-Hurlburt, P. and Janeway, C.A., Jr., 'A human homologue of the *Drosophila* Toll protein signals activation of adaptive immunity', *Nature*, Vol. 388 (1997), pp. 394–397.

[9] Poltorak, A., He, X., Smirnova, I., Liu, M.Y., Huffel, C.V., Du, X., Birdwell, D., Alejos, E., Silva, M., Galanos, C. et al., 'Defective LPS signalling in C3H/HeJ and C57BL/10ScCr mice: mutations in Tlr4 gene', *Science*, Vol. 282 (1998), pp. 2085–2088.

[10] Beutler, B., 'Toll-like receptors and their place in immunology', *Nature Reviews Immunology*, Vol. 4 (2004), p. 498. Three additional articles follow this lead article in the journal.

[11] 'Toll bridges', *Nature Immunology*, Vol. 5 (2004), p. 969. Four additional articles follow this lead article.

[12] US National Institutes of Health (NIH), 'NIAID biodefense research agenda for CDC category A agents, Progress Report', NIH Publication No. 03-5432, August 2003.

Each key advance in immunology has been followed by an exponential burst of research activity that has contributed to the procurement of an enormous amount of knowledge. One has the sense that, with every half decade, the accumulation of knowledge reaches yet another order of magnitude. Nevertheless, in some areas of immunology, only the surface has been scratched; much more is still to be unveiled. This section will try to show where immunology is heading and highlight the relevance that this might have for arms control in future.

Some pertinent facts about the immune system

The innate immune system includes components that are ready for action even before an antigen challenge is encountered (such as phagocytic cells, complement). Some of these components must be activated in order to function, but this takes only minutes or a few hours at most. The cellular and molecular components of the innate immune system are less specific than those of the adaptive system, that is, they can detect classes of substances and microorganisms, but not specific structures. Nevertheless, the innate immune system represents the all-important first line of defence against pathogens and is absolutely essential for keeping an infection in check before adaptive immunity can be induced. If the innate immunity system comes under malign attack, the battle against infections is lost from the start.

The cellular components of adaptive immunity (B and T lymphocytes) can recognise antigens in a highly specific way. However, these cells must be induced by antigens to proceed through different phases of activation, expansion (multiplication of cells) and differentiation in order to carry out their functions, including the production of antibodies by B lymphocytes and the destruction of pathogen-infected cells by T lymphocytes. Therefore, it takes days to activate adaptive immune responses, compared to minutes or a few hours for innate immune responses. Additionally, adaptive immunity has a 'memory' that allows a quicker and stronger response to be launched the next time a specific pathogen is encountered. In sum, adaptive immunity affords a high degree of specific protection, but it takes time to be induced.

Immune evasion strategies

An area of immunological research that is advancing at an extremely rapid rate is that which is focussed on elucidation of the mechanisms that pathogens utilise to evade immune defences. There is a great deal of interest in studying these processes in order to develop the means to counter evasion strategies. At the same time, the possibility of the exploitation of evasion mechanisms for malign purposes is of particular concern. A classic example of an immune evasion strategy is antigenic variation, involving the mutation of surface components of the microorganism so that the immune system can no longer respond effectively to that pathogen.[13] It has become evident, however, that there are many other immune evasion strategies that pathogens might employ, including: the negative

[13] Gupta, S., Ferguson, N. and Anderson, R., 'Chaos, persistence, and evolution of strain structure in antigenically diverse infectious agents', *Science*, Vol. 280 (1998), pp. 912–915.

regulation of complement activity through the production of proteins that mimic inhibitors of complement components;[14] the induction of the production of cytokine homologues by certain viruses so that the immune response is redirected in ways that suppress antiviral activity;[15] the induction of the production of a variety of viral inhibitors of apoptosis, which is also called programmed cell death. With regard to the latter, viruses protect the cells they invade from dying, so that these cells will continue to produce new viral particles. Other viruses can suppress the activity of so-called natural killer lymphocytes that are normally an important component of innate immunity.[16]

Vulnerability of the immune system to attack by bioregulators

In addition to immune evasion by pathogens, there is a great deal of concern about the possibility of modulating immune responses in a negative way using bioregulators that are not microorganisms, but rather are substances normally found in the body that regulate biological processes. Cytokines are soluble substances produced mainly by immune system cells that regulate many aspects of immune responses. The production of proinflammatory cytokines, such as interleukin (IL)-1β, tumour necrosis factor (TNF)α or IL-6, in moderate amounts during immune responses, can contribute greatly to the activation of the immune system and to the healing process in general. However, overproduction of these cytokines could lead to autoimmunity, or eventually even to shock and death.[17] Inhibiting the production of these cytokines, though, might result in a lack of innate immune protection.

A second example of the modulation of immune responses using bioregulators concerns 'super-antigens'. The immune system is particularly vulnerable to attack by certain super-antigens. Normally, less than 0.01% of B or T lymphocytes respond to a particular antigen. In contrast, a number of super-antigens has been described that can react with a significant proportion of T lymphocytes (5–25%).[18] The bacterial product *Staphylococcus* enterotoxin B (SEB) is a super-antigen of this type. This toxin was on the US list of favoured anti-personnel agents as early as 1949[19] and was apparently weaponised by the US army prior to the negotiation of the BTWC.[20] SEB acts as a super-antigen in that it can induce a large proportion of T lymphocytes to produce excessive amounts of cytokines, which can cause systemic reactions, including inflammation, fever, widespread blood clotting and shock.[21]

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[14] Alcami, A. and Koszinowski, U.H., 'Viral mechanisms of immune evasion', *Trends in Microbiology,* Vol. 8 (2000), pp. 410–418.

[15] *Ibid.*

[16] Carayannopoulos, L.N. and Yokoyama, W.M., 'Recognition of infected cells by natural killer cells', *Current Opinion in Immunology,* Vol. 16 (2004), pp. 26–33.

[17] Rietschel, E.T. and Brade, H., 'Bacterial endotoxins', *Scientific American,* Vol. 267 (1992), pp. 54–61.

[18] Goldsby, R.A., Kindt, T.J., Osborne, B.A. and Kuby, J. *Immunology* (fifth edition), (New York: W.H. Freeman and Company, 2003).

[19] Van Courtland Moon, J.E., 'The US BW Program: Dilemmas of Policy and Preparedness', in Wheelis, M., Rozsa, L. and Dando, M.R. (eds), *Deadly Cultures: Bioweapons from 1945 to the Present,* (Cambridge: Harvard University Press, forthcoming), Chapter 2.

[20] Geissler, E. and Lohs, K., 'The changing status of toxin weapons', in Geissler, E. (ed), *Biological and Toxin Weapons Today,* (Oxford: Oxford University Press, 1986), pp. 36–56.

[21] Goldsby, R.A. et al., *op. cit.*

Recently, a B cell super-antigen has been described that can bind up to 50% of the B cell population, resulting in an increased rate of apoptosis (death) of the bound cells.[22]

Assault on the immune system in interaction with the neuroendocrine system

It is increasingly recognised that the immune system interacts intricately and extensively with the nervous and the endocrine systems. All three systems are connected along the hypothalamus–pituitary–adrenal (HPA) axis via cytokines, hormones, neurotransmitters, peptides and their receptors, and also through hard-wiring of neural and lymphoid organs.[23]

There is a fine network of checks and balances that influences the operation of all three systems, via the elements within them. The perturbation of the elements of one system will invariably affect the operation of the others. It is easy to see, therefore, that the possible ways in which these systems can be malignly manipulated suddenly take on a whole new form as a result of this interdependence.

Selective overproduction of proinflammatory cytokines by cells of the immune system, for example, could easily tip the balance in favour of the negative side, with detrimental ramifications for both the immune and the neuroendocrine systems. Some of the reactions that might result include a debilitating form of sickness (characterised by fever, drowsiness, lethargy and loss of appetite) caused by the action of the cytokines on cells of the hypothalamus. In addition, corticotropin-releasing factor (CRF) produced by the hypothalamus in response to the cytokines is known (from animal studies) to cause damage to neurons.[24] The CRF can also trigger the production of adenocorticotropin hormone (ACTH) by the pituitary, which, in turn, can cause the adrenal gland to release glucocorticoids, powerful suppressants of immune function.[25] Thus, overproduction of proinflammatory cytokines alone could result in severe debilitation, damage to neurons and significant immune suppression. This scenario is not at all far-fetched. The ability to attack these systems using bioregulators is intimately related to developments in targeting technology. The mousepox experiment demonstrated that viruses can successfully deliver cytokine genes to tissues in which the cytokines will be overproduced.

A final point is that the interaction of these systems and the interdependence of the resulting reactions to this interaction take the dual-use dilemma to a new level of complexity. With the rapid advances in the accumulation of knowledge concerning the mechanisms of interaction of these systems that will surely occur, trying to deal with this information to

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[22] Silverman, G.J., Nayak, J.V., Warnatz, K., Jajjar, F.F., Cary, S., Tighe, H. and Curtiss, V.E., 'The dual phases of the response to a neonatal exposure to a V_H family-restricted staphylococcal B cell superantigen', *Journal of Immunology,* Vol. 161 (1998), pp. 5720–5732; and Goodyear, C.S. and Silverman, G.J., 'Death by a B cell superantigen: in vivo V_H-targeted apoptotic supraclonal B cell deletion by a staphylococcal toxin', *Journal of Experimental Medicine,* Vol. 197 (2003), pp. 1125–1139.

[23] Straub, R.H., Westermann, J., Schölmerich, J. and Falk, W., 'Dialogue between the CNS and the immune system in lymphoid organs', *Immunology Today,* Vol. 19 (1998), pp. 409–413.

[24] Licinio, J. and Frost, P. 'The neuroimmune-endocrine axis: pathophysiological implications for the central nervous system cytokines and hypothalamus-pituitary-adrenal hormone dynamics', *Brazilian Journal of Medical and Biological Research,* Vol. 33 (2000), pp. 1141–1148.

[25] Steinman, L. 'Elaborate interactions between the immune and nervous systems', *Nature Immunology,* Vol. 5 (2004), pp. 575–581.

exploit the benefits while minimising the risks is going to become more and more of a Herculean task in future.

The Seventh Review Conference (2011)

It is, of course, dangerous to predict the future. However, certain things seem very likely to feature in considerations of scientific and technological developments at the Seventh Review Conference in 2011—should there indeed be one.

First is 'Big Science'. The enormous increase in funding made available in the US for research on bio-threat agents is bound to result in a dramatic rise in knowledge on the pathogenic mechanisms of these agents and on the immune system's defences. Whether this research will lead to as great an improvement in applicable countermeasures is, of course, open to debate.

Second, it seems certain that the biotechnology industry will expand in many countries and that the apparatus needed to carry out standard procedures will be simplified, reduced in size, and become cheaper and more widely available. In short, the potential for misuse will have increased significantly.

Third, we should expect surprises. It seems highly unlikely, in such a large and rapidly expanding field, that RNAi (ribonucleic acid that interferes with gene expression and leads to gene silencing) and other mechanisms for controlling gene expression will be the last major feature of life's fundamental processes that we are surprised to discover.

Fourth, there is every reason to expect that the search for single nucleotide polymorphisms (SNPs) and the drive towards personalised medicine will reveal more and more about the genomic differences between human groups. If, as seems probable, there are successful advances in gene therapy (for example, to attack cancers), these advances—together with gene expression control—could bring us back to a discussion of ethnic weapons.

Given that we are dealing with such a wide-ranging set of scientific developments, with increasing amounts of government and commercial funding being made available, it will undoubtedly be possible to add to this list as time passes. Where, for example, will the new field of systems biology have taken us in terms of understanding microbial metabolism by 2011? And how far will we have progressed by then in our understanding of the immune system and nervous system circuits and sub-receptor types and of how to disrupt normality bio-chemically?

Conclusion

The implications of this short account are fairly obvious. Clearly, the five-year review of science and technology developments of relevance to the BTWC is increasingly inade-

quate. It will not be good enough, therefore, for states parties merely to produce their background paper and final declaration in 2006, although this must, of course, occur.

If the BTWC is not to be seen as an irrelevant relic, one thing that states parties will have to do is devise and implement a better mechanism for reviewing science and technology advances that are relevant to the convention. Surely, though, even this will not be enough to save the regime in the longer term. Unless we take the view that whatever happens is inevitable and we just have to live with it, we will have to find a means by which a more coherent assessment of developments in the field of science and technology can feed into considerations on how the regime should be developed nationally and internationally.

The thrust of Stuart Croft's *History and Typology of Arms Control* is that each generation uses its ingenuity to solve the arms control and disarmament problems of its time—drawing on what has been learnt and achieved in the past and what it can work out for itself. Why should we not be able to establish some constructive assessment and control mechanisms in 2006 and 2011 rather than abdicating our responsibility and waiting for others to deal with what will almost certainly be a much more difficult problem in future? In short, as Nicholas Sims[26] has argued, we have to construct a research regime for the BTWC sooner rather than later.

[26] Sims, N.A., ,Towards the BTWC Sixth Review Conference: making the best use of the 26 March 2005 anniversary', Bradford Briefing Paper No. 10 (Second Series), 2003, www.brad.ac.uk/acad/sbtwc.

Chronology July 2002–July 2004

July 2002

12 July In the USA, the Monterey Institute's Center for Nonproliferation Studies releases *The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program*, the first authoritative translation of an official Soviet report describing a previously unknown outbreak of smallpox in1971 in the city of Aralsk, Kazakhstan. In violation of the World Health Organization's regulations at the time, the Soviet Union failed to report the matter. Alan Zelicoff, a biological warfare expert at Sandia National Laboratories and one of the contributors, concluded that it originated in an open-air test of a smallpox biological weapon on Vozrozhdeniye Island.[1]

14 July In Switzerland, the pharmaceutical industry draws up guidelines with a view to preventing dangerous chemicals falling into the hands of terrorists. The aim of the charter—entitled *Principles to Avoid the Abusive Use of Biologically Dangerous Substances or Materials*—is to reduce the risk of products stored or made by three major companies from ending up as raw material for the illegal production of biological weapons.[2]

17 July The *New Scientist* runs an article that states the successful synthesis of the poliovirus could also be used to recreate Ebola or the 1918 flu strain that killed up to 40 million people.[3]

22 July US Under Secretary of State for Arms Control and International Security John Bolton writes to Congressman Lincoln Diaz-Balart that while there is no 'smoking gun', the US continues to have 'major' and 'legitimate' concerns that Cuba is developing BWs for offensive purposes. Bolton says that these concerns are based on reports from defectors, émigrés and other intelligence sources. The letter goes on to say that Cuba's advanced biotechnology infrastructure and its research into various biological pathogens 'are inconsistent with and exceed their declared applications'.[4]

26–27 July In Guayaquil, Ecuador, the heads of state of Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, Paraguay, Peru, Surinam, Venezuela and Uruguay adopt a declaration on a South American peace zone, which includes the prohibition of the development, transport or use of any weapons of mass destruction.[5]

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[1] Jonathan Tucker and Ray Zilinskas, The Monterey Institute of International Studies—CNS—Occasional Paper No.9, 12 Jul 02, *The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program.*

[2] Swissinfo web site (Bern) from Bern in English, 0814 hrs GMT 14 Jul 02, as transcribed in BBC-WWM, 15 Jul 02, 'Swiss pharmaceutical firms address bioterrorism threat'.

[3] Sylvia Pagan, *New Scientist*, (20 July 2002) p 7, 'Ebola virus could be synthesized'.

[4] Tom Carter, *The Washington Times*, 24 Jul 02, p 13, 'State suspects Cuba of biological-war program'.

[5] Caribbean Media Corporation news agency (Bridgetown) from Georgetown (Guyana) in English, 1902 hrs GMT 3 Aug 02, as transcribed in BBC-WWM, 4 Aug 02, 'Latin American countries adopt peace zone declaration'.

August 2002

6 August The South Korean government issues an order to the effect that its reservations to the 1925 Geneva Protocol be withdrawn.[6] South Korea acceded to the Protocol on 4 January 1989.

8 August In Gaithersburg, Maryland, the US National Institute of Allergy and Infectious Diseases (NIAID) announces during a public briefing the establishment of a network of ten 'regional centers of excellence' to conduct basic and clinical research, train the next generation of biodefence scientists, and to be on-hand in the event of a bio-attack. Each centre will receive between $4 million and $6 million per annum, however, this is expected to be supplemented by additional funds, including millions of dollars in regular NIAID grants. NIAID expects to have selected the first four such centres by next May.[7]

12 August The Sunshine Project issues a press release claiming that the US Special Forces made a request in January for US scientists to contribute proposals for the creation of genetically engineered offensive biological weapons. It says the request was part of a collaborative effort between the Defense Advanced Research Projects Agency and the US Naval Research Laboratory. Researchers were supposedly asked to show their patriotism through turning their attention to, e.g., genetically engineered agents having the potential to 'eat materials', and 'taggants' to invisibly 'paint' a target so as to enable them to be subsequently neutralized.[8]

15 August The Israeli Health Ministry announces that Israel has commenced vaccinating about 1,500 health workers against smallpox.[9]

19 August *USA Today* reports a US–Russian dispute over a genetically engineered strain of vaccine resistant anthrax, currently kept at the Obolensk facility in Russia. Obolensk scientists first published the existence of the strain in 1997. Russian officials are said to have failed to fulfil two contracts in which they agreed to provide a sample of the strain and data on its makeup, in exchange for sizeable US grants to study its vaccine resistance. Russia is basing its refusal on regulations preventing the export of dangerous pathogens. The said regulations were passed under US pressure to tighten its laws in order to prevent the possible proliferation of bioweapons technology.[10]

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[6] Yonyap news agency (Seoul) from Seoul in English, 0746 hrs GMT 6 Aug 02, as transcribed in BBC-WWM, 6 Aug 02, 'South Korea renounces use of biological weapons'; Y Sang-ho, *Seoul Tong-allbo* (Internet edition) from Seoul in Korean, 0914 hrs GMT 6 Aug 02, '[ROK is] Renouncing first, in order to prevent DPRK biological weapons'.

[7] *Science*, vol 297, no 5584 (16 August 2002), as at: www.sciencemag.org/content/vol297/issue5584/s-scope.shtml, 'Biodefense Buzz'.

[8] The Sunshine Project, 12 Aug 02, press release, 'US Special Forces seek genetically engineered bioweapons'.

[9] S Schmemann, *The New York Times* (Internet edition), 16 Aug 02, 'Israel begins vaccinating health workers for smallpox'; and Global Security Newswire (NTI), 21 Aug 02, 'Smallpox: Israel to vaccinate 15,000 emergency personnel workers'.

[10] P Eisler, *USA Today* (Internet edition), 19 Aug 02, 'US, Russia tussle over deadly anthrax sample'.

21 August The German Ministry of Defence has ordered a million doses of smallpox vaccine, according to *Der Spiegel*. A mass civilian vaccination programme is not envisaged.[11]

26 August US Under Secretary for Arms Control and International Security John Bolton gives a speech at the Tokyo America Center on *The US Position on the Biological Weapons Convention: Combating the BW Threat*. Referring to the status of the BTWC Protocol negotiations, he says: 'The United States rejected the draft protocol for three reasons: first, it was based on a traditional arms control approach that will not work on biological weapons; second, it would have compromised national security and confidential business information; and third, it would have been used by proliferators to undermine other effective international export control regimes … Detecting violations [of the BTWC] is nearly impossible; proving a violation is impossible. Traditional arms control measures are based on detecting violations and then taking action—military or diplomatic—to restore compliance. Traditional arms control measures are not effective against biology. Using them, we could prove neither non-compliance nor compliance … We carefully studied the draft Protocol and found it to be a least common denominator compromise that, in our view, was worse than nothing … Several nations came to the United States privately and thanked us for rejecting the Protocol, which in their view was seriously flawed but for them was untouchable for political reasons … The time for 'better than nothing' proposals is over.'[12]

27 August Nuclear Watch of New Mexico issues a press release announcing its filing of a federal lawsuit to block the construction—due to commence next month—of the BSL-3 facility at the Los Alamos National Laboratory. The group claims that hitherto conducted environmental, health and safety impact assessments are deficient and inaccurate.[13]

28 August In Russia, having been greeted by Russian officials at the airport serving the Kirov 200 facility, a visiting US delegation headed by Senator Richard Lugar is informed that permission for their entry to the facility has been refused. Lugar had said beforehand that he was particularly interested in Kirov 200 because 'no westerner has previously been admitted to [it]'.[14] Lugar also acknowledges that he was unsuccessful during his visit in resolving a five-year dispute with Russia over a genetically modified strain of *B. anthracis*.[15]

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[11] S Weiland, *Der Spiegel* (Internet edition), 21 Aug 02, 'Bio-terrorismus: Bundeswehr ordert massenhaft Impfstoff gegen Pocken'.

[12] US Department of State (web site, at: www.state.gov/t/us/rm/13090.htm, 26 Aug 02, transcript of US Under Secretary for Arms Control and International Security J Bolton's speech a the Tokyo America Center on 26 Aug 02.

[13] Nuclear Watch of New Mexico, press release, (web site. at: www.nukewatch.org), 27 Aug 02, 'Watchdog group files federal lawsuit challenging construction of advanced bio-hazard facility at Los Alamos'.

[14] Senator Richard Lugar's website, at: www.lugar.senate.gov/082602.html, 26 Aug 02, 'Lugar observes work on anthrax vaccination and other progress of the Nunn-Lugar program'.

[15] J Warrick, *The Washington Post* (Internet edition), 8 Sep 02, p A25, 'Russia denies US access on bioweapons'.

September 2002

2 September In Geneva, members of the BTWC Western Group gather to discuss strategy for the forthcoming resumption of the 5th BTWC Review Conference. Leaked peaking notes for a US presentation set out the US stance as follows: 'The US does not/not support follow-on meetings between November 2002 and 2006 Review Conferences… [If] the RevCon is very short, the US would not 'name names'. We would do so in a longer RevCon… [On] the termination of the Ad Hoc Group, the US position remains unchanged. We seek the end of the Ad Hoc Group and its mandate. The US will make our position on the Ad Hoc Group clear. If the RevCon is very short, we would not explicitly address the issue. We would do so in a longer RevCon… [The] US prefers a very short RevCon, if any… US definition of a 'very short RevCon' is one with the sole purpose and outcome of agreeing to hold a RevCon in 2006… A prolonged [RevCon] will quickly degenerate into a heated battle.'[16]

12 September At UN Headquarters, US President George Bush addresses the General Assembly. Of Iraq he says: 'are Security Council resolutions to be honored and enforced, or cast aside without consequence? Will the United Nations serve the purpose of its founding, or will it be irrelevant? … We will work with the UN Security Council for the necessary resolutions… Security Council resolutions will be enforced… or action will be unavoidable. And a regime that has lost its legitimacy will also lose its power.'[17]

16 September Iraqi Minister for Foreign Affairs, Naji Sabri, transmits a letter to UN Secretary-General Kofi Annan allowing the return of the UN weapons inspectors to Iraq without conditions.[18]

20 September *Business Week* reports a letter written in 1995 stating that between 1 October 1984 and 13 October 1993 the Centers for Disease Control and Prevention had supplied Iraqi scientists with a number of biological agent samples including *Yersinia pestis*, *West Nile Encephalitis*, *Rickettsia rickettsi* and *Dengue* virus. The letter was written by the then-Director of the CDC David Satcher to Senator Donald Riegle in connection with a congressional inquiry. The letter, which lists all biological agents provided by the CDC to Iraq, states: 'Most of the materials were non-infectious diagnostic reagents for detecting evidence of infections to mosquito-borne viruses'.[19]

23–24 September In Montreux, Switzerland, the International Committee of the Red Cross hosts a meeting of government and independent experts on *Biotechnology, Weapons and Humanity*. The focus is on potential threats arising from new sci-

[16] US paper presented to the BTWC Western Group on resumption of the 5th BTWC Review Conference, 2 Sep 02, 'Western Group Distribution: US Biological Weapons Convention talking points'.

[17] The White House, web site, at: www.whitehouse.gov/news /releases/2002/09/print/20020912-1.html, 12 Sep 02, 'Remarks by the President in Address to the United Nations General Assembly'.

[18] Letter dated 16 September 2002 from the Minister of Foreign Affairs of Iraq addressed to the Secretary-General, Un doc no S/2002/1034.

[19] BusinessWeek online (web site, at: www.businessweek.com), 20 Sep 02, 'A US gift to Iraq: deadly viruses'.

entific developments in biotechnology.[20] Following the conference, the ICRC launches an appeal for all political and military authorities; the scientific and medical communities; and, the biotechnology and pharmaceutical industries to 'work together to subject potentially dangerous biotechnology to effective controls'. The appeal calls for governments to affirm the principles and prohibitions enunciated under the 1925 Geneva Protocol and the BTWC. It also calls on national authorities to ensure that the said prohibitions are understood and respected by members of their armed forces and to prosecute any violations thereof. The scientific community and biotech industry are urged to 'adopt professional and industrial codes of conduct aimed at preventing the abuse of biological agents'.[21]

24 September In the UK, during a recalled sitting of the House of Commons to debate the Iraq crisis, Prime Minister Tony Blair presents *Iraq's Weapons of Mass Destruction: The Assessment of the British Government*, which is based primary on the assessment of the Joint Intelligence Committee.[22]

27 September In the US Congress, the General Accounting Office releases its report *Arms Control: Efforts to Strengthen the Biological Weapons Convention*. The purpose of the report is to: discuss experts' views on the strengths and limitations of existing international treaties on biological weapons; analyze the BTWC draft protocol and the reasons why the US rejected it; and, discuss proposals to strengthen the prohibition against biological weapons in the absence of the draft protocol. The report states: 'Since the US rejection of the draft protocol in July 2001, the United States and the United Kingdom have proposed ways to strengthen the prohibition against the development of biological weapons. Both proposals contain elements of the draft protocol, specifically (1) procedures for countries to request the investigation of possible violations of the BTWC; (2) provisions for voluntary information exchanges, visits, and clarification of BTWC concerns among states; (3) improvements to global infectious disease surveillance; and (4) requirements for countries to make it a criminal offense to violate the BTWC. In addition, the US and British proposals would both establish standards for securing, accessing, and handling pathogens, areas that were not covered in the draft protocol. The proposals differ in whether each member country will implement the provisions voluntarily, as the United States would prefer, or whether a legally binding treaty will be adopted. Many other parties to the BTWC, including the United Kingdom, would prefer the latter.' The report continues: 'The Center for Nonproliferation Studies at the Monterey Institute of International Studies proposes the development of international standards to account for specific pathogens and toxins that are stored, transferred, imported, or exported; a national register of laboratories that work with microbe collections and their genetically modified strains; and a licensing process to control the export of specific agents … The Harvard Sussex Program on Chemical and Biological Weapons Armament and Arms Limitation proposes an agreement to make the production, acquisition, or use of biological and chemical weapons a crime under international law. This proposal would require each country to make violations of the BTWC a criminal offense, investigate possible offenders on its territory, and prosecute or extradite alleged offenders… The International Weapons Control Cen-

[20] *Biotechnology, Weapons and Humanity*, ICRC Summary Report, 'An informal meeting of government and independent experts Montreaux, Switzerland, 23-24 Sep 02,

[21] ICRC, 25 Sep 02, press release no 02/53, 'Biotechnology and weapons: ICRC makes solemn appeal'.

[22] *Iraq's Weapons of Mass Destruction: The Assessment of the British Government*, published 25 Sep 02.

ter at Depaul University College of Law proposes an international biological terrorism agreement that combines elements of the above two proposals. It would (1) criminalize BTWC violations, (2) establish biosecurity and biosafety regulations, (3) create an international system to license users of biological agents and equipment, and (4) require information sharing and cooperation among national and international law enforcement agencies.'[23]

30 September At UN headquarters, during the general debate of the First Committee of the General Assembly, Danish representative Erling Nielsen presents a statement on behalf of the EU, part of which reads: 'The European Union attaches high priority to the strengthening of the [BTWC]… Member States of the EU have considered the issue of national compliance and legislative and regulatory implementation measures and support proposals to strengthen such measures… The [EU] believes that such proposals could be agreed for a follow-up process to strengthen the BTWC when the Review Conference resumes in November of this year.'[24]

October 2002

1 October Bruno Rodriguez Parrilla, delegate for Cuba, states: 'Some US government senior officials have addressed slandering accusations against Cuba, alleging that our country carries out a 'limited offensive research work and biological warfare development'. Once again, Cuba rejects with strong determination such lies.'[25]

2–6 October In Washington DC, the World Medical Association (WMA) holds the fifty-third session of its general assembly.[26] A WMA press release describes the main topic of the assembly as a scientific session on *Responding to the Growing Threat of Terrorism and Biological Weapons*. The programme of the session, arranged by the American Medical Association, features, among others, DA Henderson, George Poste, David Heymann of the World Health Organization and the President of the 5th BTWC Review Conference, Tibor Tóth.[27] A new Washington Declaration on Biological Weapons is approved. It urges national medical associations worldwide to promote an international ethos condemning the development, production, or use of toxins and biological agents that have no justification for peaceful purposes. The WMA calls for an international consortium of medical and public health leaders to monitor the threat of biological weapons proliferation, and to

[23] GAO Report to the Chairman, Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, House of Representatives, report *Arms Control: Efforts to Strengthen the Biological Weapons Convention*, GAO-02-1038, 27 Sep 02.

[24] 57th Session of the General Assembly, First Committee, General Debate, document prepared under the Danish Presidency of the European Union, New York, 30 Sep 02, 'Statement by H E Ambassador Erling Harild Nielsen on behalf of the European Union'.

[25] UN General Assembly, press release: GA/DIS/3225, at: http://www.un.org/News/Press/docs/2002/gadis3225.doc.htm, 1 Oct 02, 'Cuba says it will accede to nuclear non-proliferation treaty as Disarmament Committee continues general debate'.

[26] BBC News Online, 1002 hrs GMT 4 Oct 02, 'Doctors warn of bioterrorism risks'.

[27] World Medical Association, 5 Sep 02, press release, 'WMA general assembly, Washington, Oct 2 to 6 2002'.

develop a coordinated plan for monitoring the worldwide emergence of infectious diseases.[28]

3 October South African delegate Ncumisca Pamella Notutelan sets out a number of detailed proposals for the forthcoming resumed session of the 5th BTWC Review Conference. Notutelan says: 'South Africa would support a proposal at the reconvened meeting of the Review Conference that would include: the rapid conclusion of the Review Conference's work with a focus to enhance the implementation of the Convention, also without raising divisive issues where it is known that agreement will not be possible; no reference to the BTWC Ad Hoc Group and its draft Protocol in the final documents of the Review Conference; agreement to establish a Group or Groups of Experts to deal with a limited and non-exhaustive list of specific issues related to the Convention and to consider and reach agreement on proposals that could enhance the implementation of the Convention; annual meetings of the Group or Groups of Experts for a period of approximately four weeks in two separate periods (if there is still time available after the reconvened meeting of the Review Conference in November has completed its work, then the remaining time could be used by the newly-established Expert Group or Groups to begin an initial consideration of their work); annual meetings of the states parties for a limited duration of time (a few days) that would consider the work of the Group or Groups and decide upon further work once issues had been dealt with (the annual meeting should coincide with one of the periods of time that have been allocated for a meeting of the Expert Group or Groups); and, the possible strengthening of the UN Secretariat in the area of biological weapons so as to assist the states parties, especially from developing countries, in the above mentioned work.'[29]

4 October In the US, the Director of Central Intelligence, George Tenet, releases an intelligence community report on *Iraq's Weapons of Mass Destruction Programs*. The section on biological weapons notes: 'In addition to questions about activity at known facilities, there are compelling reasons to be concerned about BW activity at other sites and in mobile production units and laboratories. Baghdad has pursued a mobile BW research and production capability to better conceal its program. UNSCOM uncovered a document on Iraqi Military Industrial Commission letterhead indicating that Iraq was interested in developing mobile fermentation units, and an Iraqi scientist admitted to UN inspectors that Iraq was trying to move in the direction of mobile BW production. Iraq has now established large-scale, redundant, and concealed BW agent production capabilities based on mobile BW facilities.'[30]

6–9 October In Cuba, a delegation sponsored by the Washington-based Center for Defense Information (CDI) visits nine biotechnology centres of its choosing, where it is given unlimited access to the facilities. The mission, like that of former US President Jimmy Carter earlier in the year, had been stimulated by the publicity given to statements such as that of US Under Secretary of State John Bolton that Cuba has 'a limited offensive biological warfare research and development effort'. The team

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[28] World Medical Association General Assembly, at: www.wma.net/e/press/02_11.html, 2-6 Oct 03.

[29] UN General Assembly, press release: GA/DIS/3226, at: http://www.un.org/News/Press/docs/2002/gadis3226.doc.htm, 2 Oct 02, 'Disarmament apparently 'out of fashion', Bangladesh tells First Committee as it continues general debate'.

[30] Director of Central Intelligence, *Iraq's Weapons of Mass Destruction Programs*, October 2002, available at: http://www.odci.gov/cia/reports/iraq_wmd/Iraq_Oct_2002.htm.

comprises scientists, a former UNSCOM Chief Inspector, military experts and videographers. The facilities visited include La Fabriquita, which is managed by the Ministry of the Armed Forces. [The report is published seven months later.[31]]

8 October North Korea withdraws its reservation to the 1925 Geneva Protocol. The move follows South Korea's announcement of its decision to withdraw an identical reservation to the Protocol on 6 August.[32]

14 October In Beijing, the State Council promulgates the *Regulations on Export Control of Dual-Use Biological Agents and Related Equipment and Technologies*, which will enter into force on 1 December.[33] They include a control list that incorporates a number of human, animal and plant pathogens and certain dual-use biological equipment.

17 October At UN headquarters, Hungary introduces a draft resolution on the BTWC calling on the UN Secretary-General to continue rendering assistance to allow the implementation of previous Review Conference decisions and recommendations, and particularly to the resumption of the 5th BTWC Review Conference in November. Introducing the draft, President of the Review Conference Tibor Tóth says: 'As a result of serious setbacks encountered in the last 18 months, there is a new realism emerging about the BTWC regime as well: a less ambitious, but still meaningful role to be assigned to the regime. We should be candid with ourselves and with the outside world: this potential new role is different than building in a holistic way an all-encompassing compliance system. But it is becoming more and more evident that even in a more realistic role the BTWC regime can provide a unique framework for measures to benchmark and enhance implementation, and to decrease the likelihood of deliberate, accidental or naturally occurring diseases occurring and taking a high toll. It can be done through successive steps, through measures, which would not necessarily be legally binding, and through efforts undertaken both nationally and internationally.' With a view to the forthcoming Review Conference, Tóth says: 'The three rounds of informal presidential consultations I carried out in the spring, summer and autumn of this year revealed, hopefully not just to me, but to all the participants, that a forward-looking, modest, but meaningful agreement on the follow-up to the review conference is within reach. Since the summer round of these consultations there is a widening support for focusing in the resumed review conference specifically on the follow-up and wrap up its work swiftly. The follow-up mechanism would enable States Parties to meet annually and consider measures to strengthen the BTWC. Such annual meetings could be supplemented by experts meetings for enhancing the effectiveness of the measures forwarded by consensus. Both the annual meetings of States Parties and the expert meetings will have to concentrate on a relatively limited number of issues to ensure that a focused and result-oriented work is taking place in the limited time available annually for those meetings. A programme of work for a couple of years ahead should outline how to carry

[31] Glenn Baker (editor), *Cuban Biotechnology: A First-hand Report*, Washington, DC: Center for Defense Information, May 2003

[32] 5th BTWC Rev Con: Summary of Events, press release, 15 Nov 02, 'Successful conclusion of Fifth Review Conference I Sight'.

[33] China, Ministry of Foreign Affairs, 14 Oct 02, *Regulations of the People's Republic of China on Export Control of Dual-Use Biological Agents and Related Equipment and Technologies*.

forward the work in a way that by the beginning of the next review conference the mechanism indeed produces concrete and effective measures.'[34]

22 October In the UK House of Commons, the Foreign Affairs Committee conducts a session on the Government's Green Paper on *Strengthening the Biological and Toxin Weapons Convention: Countering the Threat from Biological Weapons*. Giving evidence are two Foreign and Commonwealth Office officials, Tim Dowse and Patrick Lamb, the head and deputy head respectively of the FCO Non-Proliferation Department. While answering Committee members' questions, Dowse says of the BTWC Protocol that the UK had looked at it from the 'point of view of the perceived benefit against the burden and the considered view of the British Government, across government to other departments who were involved in this, was that the balance came down on the side of benefit. It was certainly not everything that we would like to have seen. We would like to have seen a rather more intrusive inspection regime, for example. That had not been possible to achieve in the negotiations. We nevertheless concluded that the benefit outweighed the burden. The United States came to a different conclusion.' He goes on to say: 'We are not starry-eyed about international treaties as being the answer to our problems. They have to be combined with export controls. They have to be combined with strong political measures against proliferators. They have when necessary, as we have seen in the case of Iraq perhaps, to be combined with more direct means, but as part of the toolbox we have always felt that the treaty regimes underpinned by compliance measures do have a value. We would be foolish to discard them and where we can strengthen them we should do so.'[35]

22 October At UN headquarters, the NGO Committee on Disarmament, Peace and Security hosts a panel discussion on *Reducing the Risk of Biological Weapons*. Former US BTWC negotiator Jim Leonard acts as moderator for the panel which consists of US Special Negotiator for Chemical and Biological Arms Control Issues Donald Mahley, UK Permanent Representative to the Conference on Disarmament David Broucher and Matthew Meselson, co-director of the Harvard Sussex Program.[36] In his intervention, Mahley outlines US thinking on the forthcoming 5th BTWC Review Conference as follows: 'We see no problem with using the Convention Review Conference as a forum in which to compare notes, if you will, on what people have done. And to make recommendations in terms of what should happen, and also, quite frankly, to take care of one other international problem of what you do domestically. That is recognizing that states may not have in all cases a zeal about preventing biological weapons from existing somewhere on their territory. We think there is value in having a forum in which you can ask not only what is the nature of the legislative package that you have enacted, that says that these things are illegal and asks what are the enforcement mechanisms established domestically that allow you to go out and implement those objectives through the criminal law you have established.'

Broucher addresses US and UK differences in dealing with non-compliance: 'As you also know, the UK, unlike the US, has not so far named other names.

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[34] UN document A/C.1/57/L.22 dated 10 October 2002.

[35] UK Foreign Affairs Committee, uncorrected evidence, 22 Oct 02, at: www.publications.parliament.uk/pa/cm200102/cmselect/cmfaff/uc1248-i/uc124802.htm

[36] Transcript of proceedings, *Reducing the Risk of Biological Weapons*, sent under cover of a privat communication dated 31 Oct 02.

This is not because we disagree fundamentally with US concerns about non-compliance. We share them. But we think that naming names at a Review Conference suffers from some disadvantages. Firstly we think that regrettably the list of other countries which are not compliant, or may not be compliant, is longer than the list given by the US. We think we should either name all or none. Secondly, the need to protect sources often limits the information that can be made public, and without evidence, accusations of non-compliance at a review conference tend to lead only to sterile exchanges. Thirdly, I think Don Mahley has already made the point that any country with a basic knowledge of infectious diseases and a pharmaceutical industry is potentially capable of developing biological weapons in very short order.' Regarding the 5th BTWC Review Conference, Broucher says: 'My hope is that the resumed Review Conference will agree on a procedure to take these ideas forward. It need not be a heavy or onerous undertaking. A series of annual meetings, prepared by experts, leading to the sixth Review Conference in 2006, would be sufficient. The resumed Review Conference should complete this work as quickly as possible without returning to the contentious issues that led to deadlock last year.'

November 2002

1 November US Under-Secretary of State John Bolton accuses a number of 'rogue states' of pursuing chemical, biological and nuclear weapons programmes. His comments are made at the *Second Global Conference on Nuclear, Bio/Chem Terrorism: Mitigation and Response* at the Hudson Institute in Washington DC. According to Bolton: 'Iran […] is known to be seeking dual-use materials, technology and expertise for its offensive biological and chemical weapons programs from entities in Russia, China and Western Europe … [Iraq] has rebuilt its civilian chemical infrastructure and renewed production of chemical warfare agents, probably including mustard, sarin and VX. It actively maintains all key aspects of its offensive BW program. And in terms of its support for terrorism, we have established that Iraq has permitted al-Qaeda to operate within its territory … [T]here is little doubt that North Korea has an active [chemical weapons] program …The news on the biological weapons front is equally disturbing. The U.S. government believes that North Korea has one of the most mature offensive bioweapons programs on earth'. Bolton continues: 'Libya continues to pursue an indigenous chemical warfare production capability, relying heavily on foreign suppliers for precursor chemicals, technical expertise, and other key chemical warfare-related equipment. Moreover, the United States believes that Libya has an offensive BW program in the research-and-development [R&D] stage, and it may currently be capable of producing small quantities of biological agent … Syria, through foreign assistance, is seeking to expand its chemical weapons program, which includes a stockpile of nerve agent. We believe that it is developing biological weapons and is able to produce at least small amounts of biological warfare agents'. He also says: 'Cuba … we believe has at least a limited, developmental offensive biological warfare R&D effort, and … has provided dual-use biotechnology to other rogue states … We are also concerned about the activities of some states not party to the treaty, including Syria and Sudan. The administration believes it is

critical to put such states on notice. Should they choose to ignore the norms of civilized society and pursue biological weapons, their actions will not go unnoticed.'[37]

5 November The *Washington Post* reports the US Central Intelligence Agency as suspecting that France—together with Russia, Iraq and North Korea—possesses covert stockpiles of smallpox virus. The paper says it obtained the information from unidentified officials who received a classified briefing from 'senior homeland security, public health and national security officials' last spring. The quality of the information in the Agency's Weapons Intelligence, Nonproliferation and Arms Control Center assessment is said to vary from 'very high' to 'medium'. The assessment is reported to say with 'very high' confidence that Russia, contrary to diplomatic assurances, retains covert stocks of the virus. France and Iraq are assessed as having smallpox with 'high', and North Korea with 'medium' confidence. The assessment is said to consider that France is most likely using its stockpile as part of a defence programme.[38] The next day France denies that it possesses any stocks of smallpox. French Foreign Ministry spokesman Bernard Valero says: 'France scrupulously respects its international engagements … Therefore, France does not possess any stocks of smallpox in its laboratories, either civilian or military'. He adds, that France has limited its smallpox research to the search for a new-generation vaccine and that researchers have used only 'authorized animal samples, which are not dangerous to man'.[39]

7 November In Geneva, the Western Group backs a proposal put forward by Tibor Tóth, Chairman of the Fifth BTWC Review Conference, comprising a five-point plan requiring annual meetings on such matters as strengthening national laws. The said plan is to be circulated at the resumed BTWC Review Conference, which is reconvening in four days time. Diplomatic sources say that there is general support for the plan, and that China and Russia—both strongly in favour of a protocol—have indicated that they could accept it.[40]

8 November The UN Security Council unanimously adopts resolution 1441, under which UNMOVIC weapons inspectors are sanctioned to return to Iraq. After eight weeks of negotiations, the breakthrough only came after French and Russian concerns—that only the UN inspectors could declare Iraq to be in 'material breach' of its obligations—were addressed.[41]

11 November In Geneva, states parties to the BTWC reconvene for the resumption of the 5th BTWC Review Conference—officially set to conclude on 22 November—under the continuing presidency of Ambassador Tóth. The original session, held from 19 November to 7 December 2001, was suspended in controversial circumstances. Toth circulates the following five-point plan to be considered by delegations over the coming days on a 'take it or leave it' basis:

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[37] US Department of State, Washington File (web site), 1 Nov 02, 'Transcript: Bolton says rogue states seek WMD capabilities'.

[38] B Gellman, *The Washington Post* (Internet edition), 5 Nov 02, '4 Nations thought to possess smallpox'.

[39] Associated Press, 1127 hrs EST, 6 Nov 02, 'France denies having smallpox stocks'.

[40] Reuters, as published in *The New York Times*, 7 Nov 02, 'Pressure mounts on US over germ war pact'.

[41] D Linzer, Associated Press (miami.com), 8 Nov 02, 'UN adopts new Iraq resolution'.

1. The Conference decides to hold three annual meetings of the States Parties of one week duration each year commencing in 2003 until the Sixth Review Conference, to be held not later than the end of 2006, to discuss, and promote common understanding and effective action on:

i. the adoption of necessary national measures to implement the prohibitions set forth in the Convention, including the enactment of penal legislation;

ii. national mechanisms to establish and maintain the security and oversight of pathogenic microorganisms and toxins; enhancing international capabilities for responding to, investigating and mitigating the effects of cases of alleged use of biological or toxin weapons or suspicious outbreaks of disease;

iv. strengthening and broadening national and international institutional efforts and existing mechanisms for the surveillance, detection, diagnosis and combating of infectious diseases affecting, humans, animal, and plants;

v. the content, promulgation, and adoption of codes of conducts for scientists.

2. All meetings, both of experts and of States Parties, will reach any conclusions or results by consensus.

3. Each meeting of the States Parties will be prepared by a two week meeting of experts. The topics for consideration at each annual meeting of States Parties will be as follows: items i and ii will be considered in 2003; items iii and iv in 2004; item v in 2005. The first meeting will be chaired by a representative of the Eastern Group, the second by a representative of the Group of Non-Aligned and Other States, and the third by a representative of the Western Group.

4. The meetings of experts will prepare factual reports describing their work.

5. The Sixth Review Conference will consider the work of these meetings and decide on any further action.[42]

'I am aware that the proposal is not likely to fully satisfy many or even any delegation … This is a rescue operation,' says Tóth. 'Everyone in the conference is walking on eggshells', adds Indian Ambassador Rakesh Sood.[43] A number of NAM states subsequently press for a broader range of subjects to be considered, as well as a change to allow discussion of export control regimes, e.g. Australia Group restrictions. The Western Group, however, resists any change to the plan.[44]

11 November In Geneva, during the ongoing resumed session of the 5th BTWC Review Conference, the BioWeapons Prevention Project (BWPP) is launched. The Project was conceived partly as a result of the breakdown in intergovernmental negotiations to formulate a BTWC protocol and partly to raise awareness of biological weapons issues in developing countries. With the objective of reinforcing the international

[42] Draft Decision of the Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bateriological (Biological) Weapons and on Their Destruction, 6 November 2002, BTWC/CONF.V/CRP.3

[43] A Higgins (AP, *The Washington Times* (Internet edition), 12 Nov 02, 'Nations seek reduced germ-warfare theat'.

[44] D Ruppe, Global Security Newswire, as posted at: www.nti.org, 13 Nov 02, 'BTWC: States dispute plans for future meetings'.

norm against the weaponization of disease, BWPP aims to establish a global monitoring network to increase openness in biological weapons matters.[45] Making the keynote speech at the BWPP launch event is UN Under-Secretary-General for Disarmament Affairs Jayantha Dhanapala. In his statement, Dhanapala says: 'As I have reiterated on numerous occasions, NGOs and civil society are an indispensable part of international disarmament efforts. They have played various roles in this respect, complementing the work of Governments, being engaged in advocacy on disarmament issues, educating the public and working in partnership with Governments and intergovernmental organizations.' Addressing the creation of BWPP, Dhanapala says: 'It is also encouraging to see that this new endeavour will establish a global network of civil society organizations working not only in the area of disarmament and arms control, but also in related fields such as biosciences and technology, health and the environment. By increasing the level of general awareness of biological weapons issues and generating new expertise in this area in countries around the world, as it is proposed, such a network could actually be tapped by interested Governments for the expertise that it will have at hand.'[46]

13 November Iraqi Minister for Foreign Affairs Naji Sabri transmits to UN Secretary-General Kofi Annan a letter under which Iraq accepts the terms of UN Security Council resolution 1441.[47] In Washington DC, UN Secretary-General Kofi Annan makes a statement vis-à-vis the US interpretation of UN Security Council resolution 1441. 'The US does seem . . . to have a lower threshold than others may have' to justify military action, he tells reporters prior to a meeting with US President George Bush. 'I think the discussion in the council made it clear we should be looking for something serious and meaningful, and not for excuses to do something'.[48] Ten days later Sabri transmits to Annan a lengthy and detailed follow-up letter setting out the reasons why Iraq takes exception to the Resolution. Sabri concludes the letter by saying: 'Your Excellency, the above facts [as set out in the letter] prove that those who urged the UN Security Council to issue Resolution No 1441 have aims other than ascertaining that Iraq had not produced weapons of mass destruction'.[49]

14 November In Geneva, states parties to the 5th BTWC Review Conference agree to adopt—without amendment—the draft decision proposed by BTWC Chairman Tibor Tóth on 11 November.[50] A statement submitted on behalf of the group of the Non-Aligned Movement (and other states) reads: 'The NAM and Other States are disappointed at the limited nature of the decision that we've just taken … which at the best only has the potential of enhancing the implementation of the Convention'. It adds that 'the language of the decision has many ambiguities'; that at any time states could 'together and at any time decide on further work that may be required'; that the time set aside to decide on accepting the decision had been 'extremely limited',

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[45] D Ruppe, Global Security Newswire, as posted at: www.nti.org, 11 Nov 02, 'BTWC II: Nongovernmental groups launch alternative treaty compliance network'.

[46] Jayantha Dhanapala [UN Under-Secretary-General for Disarmament Affairs], 11 Nov 02, 'Opening statement for the BioWeapons Prevention Project launch'.

[47] Letter dated 13 November 2002 from the Minister for Foreign Affairs of Iraq addressed to the Secretary-General, SC no S/2002/1242, 13 Nov 02.

[48] C Lynch, *The Washington Post* (Internet edition), 17 Nov 02, 'US, UN differ on arms hunt'.

[49] Iraqi Satellite Channel (Baghdad) from Baghdad in Arabic, 1205 hrs GMT 24 Nov 02, as transcribed in BBC-WWM 25 Nov 02, 'Iraqi foreign minister raises objections to Resolution 1441 in letter to UN'.

[50] UN press release DC/2848, 15 Nov 02, 'Biological weapons conference reaches agreement on future work'.

and that during the next Review Conference in 2006 states parties would 'decide on further action'; and that the Convention 'forms a composite whole' and as such it was 'necessary for all of the inter-linked elements of the Convention … to be dealt with'.[51] A statement submitted on behalf of the Western Group reads: 'The text … circulated to us a week ago and which we adopted today, carefully balances the views of all the States Parties and results in a substantive and valuable conclusion to the Fifth Review Conference'. It notes that the decision 'provides for a qualitatively different outcome to that found in the final products of previous Review Conferences'. It also states that the decision is 'clear and self-explanatory'; and would 'strengthen the effective implementation' of the Convention by 'establishing a framework for an ongoing multilateral process in the lead-up to the Sixth Review Conference'.[52] US Assistant Secretary of State for Arms Control Stephen Rademaker says: 'Our efforts to combat the threat of biological weapons have to be pressed on multiple fronts at the national level, at the plurilateral level, and at the multilateral level. There are many other efforts that we believe can be pursued with greater success in other venues and it is the policy of the United States to pursue the problem of biological weapons in all appropriate venues to the maximum degree practicable. We believe the decision today at this Review Conference represents a realistic judgement about what can successfully be achieved in this forum over the next several years.'[53] The Review Conference formally closes the next day.

18 November The UK Foreign and Commonwealth Office transmits a memorandum on the subject of CBW criminalization to the House of Commons Foreign Affairs Select Committee, which is conducting a review of the *Biological Weapons Green Paper*.[54]

19 November In Kazakhstan, all the sites where stockpiles of Soviet-era anthrax were buried on the Vozrozhdeniye peninsula have now been decontaminated, according to the director of the Kazakh scientific centre for quarantine and zoonotic infections Bakhyt Atshabar. The ten anthrax burial sites were decontaminated during the summer under a project organized by the US and undertaken together with Uzbekistan, says Atshabar.[55]

25 November Mali deposits its instrument of ratification to the BTWC with the USA, thereby making it—in thirty days—the 147th party to the Convention.[56]

25 November In Havana, UNESCO's biotechnology adviser Albert Sasson says that the United States lacks any evidence to accuse Cuba of producing biological weapons and that the US Government, its scientists, the WHO and other international institutions know that Cuban policy is aimed at improving the quality of life of its popula-

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[51] Statement on Behalf of the Group of the Non-Aligned Movement and Other States, 5th Review Conference of the BTWC, 18 Nov 02, BTWC/CONF.V/15.

[52] Statement on Behalf of the Western Group, 5th Review Conference of the BTWC, 18 Nov 02, BTWC/CONF.V/16.

[53] US Department of State, web site, at: www.state.gov/t/ac/rls/rm/15151pf.htm, 14 Nov 02, 'Fifth Review Conference of the Biological Weapons Convention'.

[54] UK Foreign and Commonwealth Office memorandum to the Foreign Affairs Committee, 18 Nov 02, as published in: UK House of Commons [session 2002-2003] Foreign Affairs Committee, *The Biological Weapons Green Paper*, House of Commons Paper 150, ordered to be printed 11 Dec 02.

[55] Interfax news agency (Moscow) from Almaty in English, 1215 hrs GMT 20 Nov 02, as transcribed in BBC-WWM 20 Nov 02, 'Kazakhstan to investigate Soviet biological weapons test site from 2003'.

[56] Personal communication, 10 July 2003.

tion. Speaking on the second day of the six-day International Biotechnology Congress on 'Agro-Biotech in the New Millennium'[57]—attended by around 900 experts from 48 countries—he says, that in contrast to other nations, Cuba's success can be traced to the systematic political and governmental support that favours social and economic development.[58]

27 November In Iraq, after nearly four years of absence, UN weapons inspectors are once again undertaking verification duties.[59]

28 November The Canadian health ministry announces that it is to purchase enough smallpox vaccine to vaccinate Canada's entire population.[60]

29 November Kazakh Foreign Minister Kasymzhomart Tokayev is reported by *Novoye Pokoleniye* as having requested information from Russian Foreign Minister Igor Ivanov on tests undertaken on the Vozrozhdeniye peninsula. Ivanov replies: 'As a rule, harmless simulated biological means based on non-pathogenic strains of micro-organisms were used in the tests. Pathogenic micro-organisms were used in insignificant quantities and the necessary safety and environmental protection measures were observed. Under the impact of powerful solar radiation and high temperatures, all the micro-organisms that were used remained viable for between a few hours to a few days'. The Kazakh newspaper therefore asks what US experts were recently doing on the peninsula and why the US has allocated $6 million to decontaminate the area. It also points out that the heads of the Russian and Kazakh emergency ministries announced a joint programme to decontaminate the peninsula a year ago. The Russian Foreign Ministry is also reported to have denied that 'any biological materials were buried on the territory of the island which might lead to negative environmental consequences'.[61]

December 2002

December In Canada the Department of Foreign Affairs and International Trade publishes a study, *Strengthening the Biological and Toxin Weapons Regime: Strategies for the Fifth Review Conference and Beyond*, that the International Security Research and Outreach Programme of its International Security Bureau had commissioned from Peter Gizewski. Observing that 'political realities strongly suggest that the creation of a comprehensive, legally-binding compliance protocol for the BTWC is unlikely in the near term', the study sees a possibility for limited progress in 'adoption of a number of voluntary, *politically-binding* measures in the near term as well as the pursuit of measures aimed at enhancing the institutional capacity of the

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[57] EduToursToCuba.com (http://edutourstocuba.com/congress/biotech-Havana-2002-travel.htm) Biotechnology Havana 2002, 'Agro-Biotech in the New Millenium', November 24-29, 2002 Center for Genetic Engineering and Biotechnology, Havana, Cuba.

[58] AIN news agency (Havana) from Havana in English, 25 Nov 02, as transcribed in BBC-WWM 26 Nov 02, 'UNESCO adviser rejects US accusations against Cuba on biological weapons'.

[59] BBC (Internet version), 1412 hrs GMT, 'First Iraq inspection completed'.

[60] R Sekhri (Reuters), www.boston.com, 29 Nov 02, 'Canada will buy smallpox vaccine'.

[61] Olga Malakhova, *Novoye Pokoleniye* (Kazakhstan), 29 Nov 02, as transcribed in BBC WWM, 10 Dec 02, 'Kazakh paper critical of Russia's stance on former bio testing ground'.

BTWC'. It also suggests 'more limited initiatives aimed at improving somewhat the BTWC's verification/compliance capabilities'. These are the views of the author, the publishers of the study make clear, and are not necessarily those of the Government of Canada.[62]

2 December The UK Department of Health publishes *Interim Guidelines for Smallpox Response and Management in the Post-Eradication Era*. The Guidelines describe contingency plans for diagnosis and management of the first cases, vaccination strategies before and in the event of an outbreak; and other essential measures to ensure outbreak preparedness and control.[63]

2 December In Washington DC, the World Health Organization (WHO) and the Nuclear Threat Initiative (NTI) announce the formation of the WHO-NTI Emergency Outbreak Response Fund. The purpose of the Fund (which starts with $500,000) will be to strengthen the global response to infectious disease outbreaks—whether naturally occurring or from the release of biological weapons— by ensuring that response teams can be on the ground within 24 hours of a detected outbreak anywhere in the world. It will comprise a key operational element of the Global Outbreak Alert and Response Network, coordinated by the WHO Alert and Response Operations Centre in Geneva. WHO Director-General Gro Harlem Brundtland says: 'Crucial hours lost in the early days of a disease outbreak can mean the difference between a handful of cases and a major epidemic … As soon as an outbreak occurs, it is critical to get people on the ground as soon as possible. This revolving fund will enable WHO to provide medical experts and equipment immediately'. Co-chairman of the Nuclear Threat Initiative Sam Nunn says: 'The nexus between health and security has become increasingly clear … Diseases don't recognize national boundaries. In today's global world, it is in our own health and security interest to immediately contain an outbreak wherever it occurs around the world'.[64]

7 December In Baghdad, Iraq submits its declaration to UNMOVIC and the IAEA in accordance with Security Council resolution 1441.[65] The declaration—amounting to around 12,000 pages and accompanied by numerous CD ROMs—is not made public. The table of contents of the declaration, which is published on the website of the *New York Times*, is divided into four parts: nuclear, chemical, biological, and ballistic missile. Part 3 relates to biological weapons. Section 1 thereof contains the following chapters: activities of the Hassan bin al-Maytham Establishment (1974–1978); activities of the Muthanna State Establishment (1985-1987); activities of the Salman facility (1987–1990); activities of the Taji facility (January 1988–October 1998); activities of the Hakam factory (1988–1991); activities of the Foot-and-Mouth Disease Institute (July 1990–January 1991); activities of the Failiyah facility (1990–1991); weaponization activities; organizational chart of the former biological weapons programme and military institutions connected with the former biological weapons programme; miscellaneous subjects (288 pages). Section

[62] As posted on the Internet at: www.dfait-maeci.gc.ca/arms/pdf/Gizewski_btw.pdf.

[63] *British Medical Journal*, vol 325 p 1371-1372 (14 December 2002) 'Interim smallpox guidelines for the United Kingdom'.

[64] World Health Organization (web site, at: www.who.int) press release, 2 Dec 02, 'WHO-NTI establish a global emergency outbreak response fund'.

[65] UNMOVIC/IAEA press statement on the handover of the Iraqi declaration, 7 Dec 02, as per Hiro Ueki (spokesman for UNMOVIC and the IAEA in Baghdad).

2 describes the non-proscribed activities during the period 1991–2002 and includes information on the biological research, development and production facilities that contain dual-use equipment or materials, as well as on new facilities for biological activities unrelated to any proscribed activities.[66]

13 December US President Bush announces the Administration's smallpox vaccination plan, which involves the mandatory vaccination of around 500,000 frontline military personnel and a voluntary program to inoculate as many as 439,000 first responders.[67]

17 December In New York City, the inaugural issue of the magazine SEED carries an interview with Dr Vladimir Pasechnik, who, aged 64, had died a year previously having been a leading figure in the clandestine USSR BW programme prior to his defection from it in 1989. The interview adds much detail to the public record. In 1974, Dr Pasechnik had been recruited by General Ogarkov to build the All Union Scientific Research Institute of Ultra Pure Biochemical Preparations, which was to be a part of the FARMPRIBOR production association that would be one of six such associations making up Biopreparat. Headquartered in Leningrad, the new institute occupied three sites when it opened in 1981 and employed around 3500 people. Pasechnik's own work involved the breeding of a strain of *Yersinia pestis* (the plague bacterium) that was capable of resisting 15 types of antibiotic. Pasechnik had also been credited with inventing an 'air mill' capable of converting a dried cake of cultured plague bacteria into ultrafine powder using a blast of compressed air. 'Weapon of Special Designation Number One' was what the Soviet military had called his *Y pestis* preparation. By 1987, Pasechnik had developed a process for producing it at a rate of 200 kg/week. The preparation had a shelf-life of five months, and a 20-tonne stockpile was maintained. In 1988 Pasechnik was made general director of FARMPRIBOR, and it was while on a purchasing visit to Paris a year later that he telephoned the British embassy, after being rebuffed by the Canadian embassy, to set in motion his defection. One of his subsequent British interrogators, Dr David Kelly is quoted thus: 'He believed that the Soviet BW program was immoral. It wasn't so much that it contravened the BW Convention—although that was of course a motivating factor—but it was that, as a person, the whole concept of using these materials for military purposes was unacceptable.'[68]

23–24 December In Washington DC, the US National Research Council hosts a meeting on bioterrorism that brings together non-governmental scientists and members of the Strategic Assessments Group of the CIA Office of Transnational Issues.[69] Several months later, the CIA Directorate of Intelligence publishes an unclassified report from the meeting entitled *The Darker Bioweapons Future*. It concludes that 'advances in biotechnology, coupled with the difficulty in detecting nefarious bio-

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[66] Headings of Iraqi Declaration submitted to the UN Security Council in accordance with paragraph 3 of SC Resolution 1441, under cover of a letter written by the Permanent Representative Mission of the Republic of Iraq to the UN Mohammed A Aldouri, No M/7/657, 7 Dec 02.

[67] R.W.Stevenson & S.G.Stolberg, *The New York Times* (Internet edition), 13 Dec 02, 'President Bush announces smallpox vaccination plan'.

[68] Simon Cooper, *SEED* (New York City), January/February 2003, pp 66-68, 70-72 & 104-107, 'Life in the pursuit of death'.

[69] Peg Brickley, *The Scientist*, 7 Apr 03, 'CIA openness report to be classified?'.

logical activity, have the potential to create a much more dangerous biological warfare threat'.[70]

26 December In Israel, unidentified government officials say that Israel will not be vaccinating its entire population against smallpox, however, it will increase the number of first responders being vaccinated to over 40,000. The officials say that the decision was taken upon the Government having concluded that the likelihood of a smallpox attack on Israel was slim.[71] Israel has so far vaccinated around 15,000 first responders since July[72]. Two months earlier Israeli Health Ministry Director-General Boaz Lev promoted vaccinating the entire Israeli population as a precautionary measure.[73]

January 2003

15 January In Texas, Thomas Butler, a professor at the Texas Tech University Health Science Center, is arrested after yesterday informing the US Federal Bureau of Investigations that more than thirty vials of Yersinia pestis bacteria had disappeared three days previously. The Bureau says that Butler had in fact already destroyed the vials prior to the alleged date of their disappearance. In a written statement released the following day, Butler writes: 'I made a misjudgment because I knew that the pathogen was destroyed and there was no threat to the public, I provided an inaccurate explanation … and did not realize it would require such an extensive investigation.' The Bureau suspect that Butler may have been trying to cover himself from possible university and federal sanctions after not having properly documented the bacteria's destruction in lab records.

27 January At UN headquarters, UNMOVIC Executive Chairman Hans Blix updates the Security Council in accordance with Security Council resolution 1441.[74] On biological weapons, Blix says: 'Iraq has declared that it produced about 8,500 litres of [anthrax], which it states it unilaterally destroyed in the summer of 1991. Iraq has provided little evidence for this production and no convincing evidence for its destruction. There are strong indications that Iraq produced more anthrax than it declared, and that at least some of this was retained after the declared destruction date. It might still exist. Either it should be found and be destroyed under UNMOVIC supervision or else convincing evidence should be produced to show that it was, indeed, destroyed in 1991. As I reported to the Council on 19 December last year, Iraq did not declare a significant quantity, some 650 kg, of bacterial growth media, which

[70] *Secrecy News* [Federation of American Scientists Project on Government Secrecy] no 101/2003, 14 Nov 03, 'CIA looks at the future of bioweapons'. The CIA paper is posted on the FAS website at www.fas.org/irp/cia/product/bw1103.pdf.

[71] D Filkins, *The New York Times* (Internet edition), 26 Dec 02, 'Israel will expand its smallpox vaccinations, but no to everyone'.

[72] J Miller, *The New York Times* (Internet edition), 10 Dec 02, 'Israel vaccinates soldiers and health care workers'.

[73] N Gilbert, *The Jerusalem Post* (Internet edition), 23 Oct 02, 'Health Ministry: public vaccination against smallpox must start'.

[74] United Nations web site, at: www.un.org, , UNMOVIC Executive Chairman Hans Blix 'An update on inspection, transcript of speech to Security Council, 27 Jan 03.

was acknowledged as imported in Iraq's submission to the Amorim panel in February 1999. As part of its 7 December 2002 declaration, Iraq resubmitted the Amorim panel document, but the table showing this particular import of media was not included. The absence of this table would appear to be deliberate as the pages of the resubmitted document were renumbered. In the letter of 24 January to the President of the Council, Iraq's Foreign Minister stated that 'all imported quantities of growth media were declared'. This is not evidence. I note that the quantity of media involved would suffice to produce, for example, about 5,000 litres of concentrated anthrax. Some 400 names for all biological and chemical weapons programmes as well as their missile programmes were provided by the Iraqi side. This can be compared to over 3,500 names of people associated with those past weapons programmes that UNSCOM either interviewed in the 1990s or knew from documents and other sources. At my recent meeting in Baghdad, the Iraqi side committed itself to supplementing the list and some 80 additional names have been provided'.

28 January US President Bush proposes the earmarking of 'almost $6 billion to quickly make available effective vaccines and treatments against agents like anthrax, botulinum toxin, Ebola, and plague'. During his State of the Union address to Congress, he says that the programme—called Project Bioshield—is based on the assumption that the United States' 'enemies would use these diseases as weapons'. On the issue of Iraq possessing chemical and biological weapons, Bush says: 'The United Nations concluded in 1999 that Saddam Hussein had biological weapons [*sic*] sufficient to produce over 25,000 liters of anthrax … He hasn't accounted for that material. He's given no evidence that he has destroyed it.'[75]

29 January Antigua and Barbuda deposits its instrument of ratification to the BTWC with the UK, thereby making it—in thirty days—the 148th state party.[76]

February 2003

5 February In New York, US Secretary of State Colin Powell addresses a specially convened session of the Security Council, on Iraqi possession of weapons of mass destruction. He plays recordings of intercepted conversations between Iraqi officers that he claims evidences a deliberate intention to deceive the UN weapons inspectors. He also presents various slides and some satellite imagery that he claims shows the Iraqi military relocating weapons of mass destruction. Some conceptual drawings are also adduced to illustrate what an Iraqi mobile biological-weapons laboratory might look like. '[E]very statement I make today is backed up by sources, solid sources. These are not assertions. What we are giving you are facts and conclusions based on solid intelligence', says Powell.[77] Iraqi Foreign Minister Naji Sabri later

[75] US White House (web site, at: www.whitehouse.gov), 28 Jan 03, 'State of the Union Address by President George W Bush'.

[76] UK Foreign and Commonwealth Office web site, at: http://www.fco.gov.uk/Files/kfile/018_ProhibitionBiologicalToxinWeapons.pdf, accessed on 31 Jul 03.

[77] US Department of State, Office of the Spokesman, 5 Feb 03, 'Transcript of presentation to UN Security Council, 5 Feb 03'.

transmits a letter to UN Secretary-General Kofi Annan rejecting Powell's accusations.[78]

15 February In Denver, Colorado, the Journal Editors and Authors Group on Scientific Publishing and Security—comprising 32 leading journal editors—presents a joint statement at the annual meeting of the American Association for the Advancement of Science. The third part of the statement reads: 'Scientists and their journals should consider the appropriate level and design of processes to accomplish effective review of papers that raise such security issues. Journals in disciplines that have attracted numbers of such papers have already devised procedures that might be employed as models in considering process design'. The fourth part reads: 'We recognize that on occasions an editor may conclude that the potential harm of publication outweighs the potential societal benefits. Under such circumstances, the paper should be modified, or not be published. Scientific information is also communicated by other means: seminars, meetings, electronic posting, etc. Journals and scientific societies can play an important role in encouraging investigators to communicate results of research in ways that maximize public benefits and minimize risks of misuse'.[79] Speaking at a press briefing in Denver, president of the American Society for Microbiology Ronald Atlas says that two research papers submitted to ASM-published journals had been modified prior to publication because of fears the information they contained could help bio-terrorists. Atlas hints that one paper had included details of how a toxin could be modified to make it more lethal, so it is reported.[80]

20 February Palau deposits its instrument of accession to the BTWC with the USA. In thirty days it will become the 149th party to the Convention.[81]

24–25 February In Kuala Lumpur, the 12th Conference of Heads of State or Government of the Non-Aligned Movement takes place. On biological weapons, the Final Document states that they 'recognised the particular importance of strengthening the Convention through multilateral negotiations for a legally binding Protocol to the Convention … They have been deeply disappointed at the inability that has been demonstrated in the endeavours of the States Parties to the [Convention] to successfully undertake initiatives to strengthen the implementation of the Convention'[82]

25 February UK Foreign Secretary Jack Straw responds to the report of the House of Commons Foreign Affairs Committee on the Biological Weapons Green Paper. In response to the Committee's recommendation to consider establishing an organization similar to the OPCW, he says: '[T]his was one of the major losses when the Protocol negotiations ended in failure … [I]f as a result of the work undertaken in the Review Conference follow-up meetings over the next two to three years, it became apparent that such a proposal had the necessary support, then HMG would wish to

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[78] Iraqi Ministry of Foreign Affairs web site (Baghdad) from Baghdad, 21 Feb 03, as translated from the Arabic in BBC-WWM, 25 Feb 03, 'Iraqi foreign minister rejects allegations in US Secretary Powell's UN speech'.

[79] Statement of Journal Editors and Authors Group on Scientific Publishing and Security, 14 Feb 03, as posted on the internet at <www.asmusa.org/pcsrc/releases/edstate.htm>.

[80] Michael Le Page from Denver, *New Scientist*, vol 177 no 2383 (22 February 2003) p 5, 'Journal editors agree to censor research papers'.

[81] Private communication, 9 June 2003.

[82] Bernama (Kuala Lumpur) from Kuala Lumpur in English, 25 Feb 03, as transcribed in BBC-WWM, 26 Feb 03, 'Text of final document of Non-Aligned Movement summit in Kuala Lumpur'.

explore with other States Parties the option of more permanent institutional arrangements as a practical proposition'. With regard to the recommendation to consider the establishment of a central authority responsible for dangerous pathogens in the UK, Straw states: 'There is little evidence to suggest that a new body would manage the different approvals and enforcement regimes any more effectively than they are already. Furthermore, responsibility for each approvals mechanism is sited within Departments where there is a large body of experience and technical understanding of the issues'. In response to the Committee's recommendation that the Government take steps to promulgate an international code of conduct for scientists working with dangerous pathogens, even before BTWC states parties consider the matter in 2005, he replies: '[E]arly preparation for the meetings in 2004 and 2005 will be essential to ensure the maximum use and productive outcome of these meetings. The Government plans therefore to begin work on a code of conduct this year. The UK has volunteered to chair the work on this topic in 2005.' In relation, to the Committee's request for the Government to outline how it hopes to proceed towards achieving greater transparency between states parties on legitimate dual-use capabilities which might be in danger of being misconstrued or misused, the Secretary of State says that this 'does not depend on a single measure taken in isolation or adopted at a single moment in time'. In this regard, he says of the general purpose criterion: 'The UK's experience with the implementation of the BTWC Convention can be used to initiate dialogues with other States Parties with a view to exchanging experiences and learning from best practices on the implementation of the General Purpose Criterion; this process need not be confined to the UK. The Government will encourage other States Parties to pursue similar exchanges, either bilaterally or in the context of the Review Conference follow-up work'.[83]

25 February US Secretary for Health and Human Services Tommy Thompson announces the award of two contracts totalling $20 million in first-year funding to Acambis and Bavarian Nordic for the development of second-generation smallpox vaccines.[84] The two companies will develop, manufacture and conduct safety trials of modified *vaccinia ankara* (MVA) smallpox vaccine.

March 2003

1 March In Finland, the *Penal Code Amendment Act* comes into force which inserts into the Penal Code a new provision entitled 'breach of the prohibition of biological weapons'. Before this amendment, Finland did not have specific penal provisions concerning biological weapons or their use. The new provision constitutes a dedicated criminalization of all acts that are contrary to the BTWC and also covers the use of biological weapons. Offences covered by the amendment are punishable by imprisonment from four months to six years. The Act also inserts a new chapter on 'terrorist offences' into the Penal Code which criminalizes also any terrorist activity or preparation of terrorist acts that may involve biological weapons or toxins. In its

[83] UK, Foreign and Commonwealth Office, 25 Feb 03, *First Report of the Foreign Affairs Committee, Session 2002-03, The Biological Weapons Green Paper, Response of the Secretary of State for Foreign and Commonwealth Affairs*, Cm 5713.

[84] US, Department of Health and Human Services, 25 Feb 03, press release, 'HHS announces contracts to develop safer smallpox vaccines'.

current form, Finnish legislation imposes criminal liability also to persons involved in a hoax or the preparation of the same.[85]

1 March From the University of Maryland School of Public Affairs, Robert Sprinkle publishes in *Bioscience* his ideas for an institutional innovation he calls 'The Biosecurity Trust'—a transnational non-governmental life-sciences organization that would promote complementarity between what might otherwise be divergent, namely the advancement of bioscience and the enhancement of biosecurity. Its functions would include: (a) the 'promulgation and continual improvement of widely agreed and globally feasible standards for research safety and institutional and corporate research responsibility'; and (b) the 'nonintrusive tracking of life scientists' careers in more worrisome states, laboratories, and corporations and in subfields with the clearest potential for abuse'.[86]

6 March At UN headquarters, UNMOVIC completes a working draft of the document *Unresolved Disarmament Issues: Iraq's Proscribed Weapons Programmes*.[87] Although Security Council resolution 1284 only requires UNMOVIC to submit its work programme to the Security Council, Executive Chairman Hans Blix has decided to declassify this document and make it available to Council members on request. It is posted on UNMOVIC's website five days later. After a description of the factors which have shaped Iraq's policies on weapons of mass destruction and a summary of developments from December 1998 until the present, the report categorizes the unresolved disarmament tasks into 29 clusters and presents them by discipline: missiles; munitions; chemical; and biological. As well as providing UNMOVIC's assessment of each cluster, the report also contains suggestions as to how Iraq could resolve the issues. Finally, appended to the report is a historical account of Iraq's proscribed weapons programmes.[88]

7 March At UN headquarters, UNMOVIC Executive Chairman Hans Blix briefs the Security Council on UNMOVIC's twelfth quarterly report, which he notes is the first of the reports to describe three months of inspections.

With respect to claims by Western intelligence agencies that Iraq has mobile BW production units [see 5 Feb], Blix says: 'As I noted on 14 February, intelligence authorities have claimed that weapons of mass destruction are moved around Iraq by trucks and, in particular, that there are mobile production units for biological weapons. The Iraqi side states that such activities do not exist. Several inspections have taken place at declared and undeclared sites in relation to mobile production facilities. Food testing mobile laboratories and mobile workshops have been seen, as well as large containers with seed processing equipment. No evidence of proscribed activities have so far been found. Iraq is expected to assist in the development of credible ways to conduct random checks of ground transportation.'

Blix refers to 'a significant Iraqi effort underway to clarify a major source of uncertainty as to the quantities of biological and chemical weapons, which were

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[85] Meeting of the States Parties to the BTWC, First Meeting, document BTWC/MSP.2003/MX/WP.57 dated 28 August 2003.

[86] Robert H Sprinkle, *Bioscience* vol 53 no 3 (1 March 2003), 'The Biosecurity Trust'.

[87] UNMOVIC, 'Cluster Document', 6 Mar 03, 'Unresolved disarmament issues: Iraq's proscribed weapons programmes', as posted on the internet at <www.un.org/depts/unmovic/documents/6mar.pdf>.

[88] Mark Turner and Guy Dinmore from New York, *Financial Times*, 8-9 Mar 03, p 10, 'Complex Blix report gives hope to both sides in UN'.

unilaterally destroyed in 1991.' This concerns the re-excavation of a disposal site during which Iraq has unearthed eight complete bombs consisting of two intact liquid-filled R-400 bombs and six other complete bombs. Bomb fragments were also found and samples taken.

Blix also reports Iraqi proposals to use advanced technology to quantify the amount of unilaterally destroyed anthrax dumped at a site. Blix notes however, that 'even if the use of advanced technology could quantify the amount of anthrax, said to be dumped at the site, the results would still be open to interpretation. Defining the quantity of anthrax destroyed must, of course, be followed by efforts to establish what quantity was actually produced.' Iraq has also suggested using a similar method to quantify a VX precursor said to have been unilaterally destroyed in 1991.[89]

Following Blix's briefing the Security Council reconvenes at ministerial level. US Secretary of State Colin Powell states that: 'I was sorry to learn that all of this still is coming in a grudging manner, that Iraq is still refusing to offer what was called for by 1441: immediate, active and unconditional cooperation. Not later, immediate; not passive, active; not conditional, unconditional in every respect.' Blix is later criticized by US officials for not having specifically mentioned in his briefing new information which was included in the UNMOVIC report on unresolved disarmament issues. According to media reports, the officials are particularly surprised that Blix did not refer to Iraqi work on unmanned aerial vehicles or on cluster munitions.[90] US Secretary of State Colin Powell says on television: 'That's the kind of thing we're going to be making some news about in the course of the week … And there are other things that have been found that I think more can be made of.'[91]

12 March In Cuba, the government recently invited science journalists to visit the Centre for Genetic Engineering and Biotechnology to demonstrate that US allegations about Cuba's 'limited offensive biological warfare research and development effort' are false, so it is reported.[92]

16 March *The New York Times* reports that the biological weapons declaration submitted to the UN by Iraq reveals that all the samples of biological agents obtained from abroad and used in the Iraqi biological weapons programme were supplied by the American Type Culture Collection (ATCC) in Virginia and the Pasteur Institute in Paris. The Iraqi declaration shows that the US and French suppliers shipped 17 types of biological agent to Iraq in the 1980s, including *Bacillus anthracis, Francisella tularensis, Clostridium perfringens, Clostridium botulinum* and *Bacillus cereus*. The newspaper has obtained a copy of the Iraqi declaration via Gary Pitts, a Houston lawyer who is representing sick US servicemen in a lawsuit claiming that

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[89] Hans Blix [UNMOVIC Executive Chairman], 7 Mar 03, 'Oral introduction of the 12th quarterly report of UNMOVIC', as posted on the internet at <www.un.org/Depts/unmovic/SC7asdelivered.htm>

[90] John Cushman with Steven Wiseman from Washington, *The New York Times* (internet edition), 10 Mar 03, 'US says Iraq retools rockets for illicit uses'; Marcus Warren from New York and David Rennie from Washington, *The Daily Telegraph* (London), 11 Mar 03, p 12, 'Blix 'hid devastating facts on weapons''; AP from New York, 0313 hrs ET 11 Mar 03, 'US: Iraqi drone proves secret weapons'; Steven Wiseman, *The New York Times*, 11 Mar 03, p 12, 'US says Blix played down details of banned weapons';

[91] John Cushman with Steven Wiseman from Washington, *The New York Times* (internet edition), 10 Mar 03, 'US says Iraq retools rockets for illicit uses'.

[92] Global Security Newswire, 13 Mar 03, 'Cuba: Scientists deny biological weapons development'.

their illnesses are related to exposure to chemical and biological weapons during the Gulf War. The ATCC is a defendant in the lawsuit.[93]

17 March In New York, UNMOVIC Executive Chairman Hans Blix submits to the Security Council the Commission's draft work programme as required by resolution 1284. The 83-page work programme identifies twelve 'key disarmament tasks' from the clusters in the earlier unresolved disarmament issues document [see 6 Mar]: Scud missiles and associated biological and chemical warheads; SA-2 missile technology; research and development on missiles capable of proscribed ranges; munitions for chemical and biological agent fill; spray devices and remotely piloted vehicles/unmanned aerial vehicles; VX and its precursors; mustard gas and its precursors; sarin, cyclosarin and their precursors; anthrax and its drying; botulinum toxin; undeclared agents, including smallpox; and any proscribed activities post 1998.[94]

17 March UN Secretary-General Kofi Annan orders the withdrawal of all remaining UN personnel from Iraq.[95] The following day, UNMOVIC inspectors begin leaving Iraq.[96]

17 March US President George Bush, in an address to the nation from the White House, issues a 48-hour ultimatum for Saddam Hussein and his sons to leave Iraq.[97]

20 March At 0234 GMT, shortly after the expiry of President Bush's 48-hour ultimatum, US and allied forces begin Operation *Iraqi Freedom* to remove the Iraqi regime from power and disarm it of its weapons of mass destruction.

29 March–4 April In Nice, France, the World Health Organization convenes a two-day meeting on *Improving Public Health Preparedness for and Response to the Threat of Epidemics: Anthrax Network* with the participation of the Office International des Epizooties and the Food and Agriculture Organization. The objectives of the meeting are to review WHO's activities on anthrax and plan future strategies and to revise specific sections of the 4th edition of the previously entitled *Guidelines for the Surveillance and Control of Anthrax in Humans and Animals*.[98] On the second day, and upon the conclusion of the above meeting, the Fifth International Conference on Anthrax takes place. More than 300 people attend from 30 countries. Topics discussed are: genomics including detection, identification and epidemiology; the spore: structure and germination; gene regulation and genetic tools; toxins: structure and function; detection, identification, ecology, epidemiology of *Bacillus cereus*,

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[93] Philip Shenon, *The New York Times*, 16 Mar 03, p 16, 'Iraq links germs for weapons to US and France'.

[94] UNMOVIC, 17 Mar 03, 'Draft work programme' as posted on the internet at <www.un.org/depts/unmovic/documents/draftWP.pdf>.

[95] UN, 17 Mar 03, press release, SG/SM/8640 SC/7693 IK/330, 'Secretary-General authorizes withdrawal of United Nations personnel from Iraq'.

[96] David Blair from Baghdad, *The Daily Telegraph* (London), 17 Mar 03, p 4, 'UN arms inspectors join the exodus'.

[97] US White House, Office of the Press Secretary, 17 Mar 03, 'Remarks by the President in address to the nation'.

[98] WHO document WHO/CDS/CSR/GAR/2003.9, 2003, as posted on the Internet at <www.who.int/csr/resources/publications/anthrax/en/WHO_CDS_CSR_GAR_2003.9.pdf>.

Bacillus anthracis and *Bacillus thuringensis*; lessons of the 2001 anthrax episode; and, vaccines and therapeutics of anthrax.[99]

31 March In Canada, researchers at the University of Victoria have found that a liquid biological agent can be effectively disseminated on a large-scale using crop-dusting planes.[100] The researchers have studied a 1999 campaign in Victoria to eradicate the European gypsy moth which involved the spraying of an insecticide containing *Bacillus thuringiensis* spores. The eradication campaign was accompanied by an extensive study of the short-term health effects on the local population, both before and after the spraying. This study showed that the spraying produced droplets small enough (2 to 7 microns in size) to penetrate houses and to contaminate the nasal passages of residents inside their homes. The research is published in the new journal *Biosecurity and Bioterrorism: Biodefense Strategy, Practice and Science*. The authors conclude: 'The study of the *B. thuringiensis* spray in Canada in 1999 provides data that refutes arguments asserting that there are technological barriers that would prevent all but major military programs from using *B. anthracis* as an aerosol disseminated bioweapon. These findings should be understood by those with responsibility for preventing or responding to the consequences of bioterrorist attacks. These data provide evidence that it is technologically feasible to disseminate biological agents from aircraft (or backpack sprayers, or truck-mounted foggers).'[101]

April 2003

2 April In the UK House of Commons, Parliamentary Under-Secretary of State for Foreign and Commonwealth Affairs Mike O'Brien says: 'We have no clear evidence that Cuba is engaged in a programme to develop WMD, although we do have some concerns about the scale of their pharmaceutical production capacity'.[102]

20 April The *Washington Post* reports on an attempt by a South African scientist, Daan Goosen, formerly involved in South Africa's biological warfare programme, to sell biological agents developed under that programme to the US Federal Bureau of Investigation. The newspaper reports that, on 6 May 2002, Goosen handed a vial containing a strain of *E. coli* genetically altered to include a gene from *Clostridium perfringens* hidden inside a toothpaste tube to a retired CIA officer, Don Mayes, who passed the sample on to the FBI. Goosen proposed to supply an entire collection of the pathogens developed by Project Coast, if the FBI would pay him $5 million and supply immigration permits for Goosen and 19 associates and family members. The US considered the offer but balked at the price, so the *Washington Post* reports, and the deal collapsed in confusion in 2002 after FBI agents turned the matter over to the

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[99] US, Office of Naval Research, International Field Office, 5th International Conference on Anthrax, Nice, 30 Mar—3 Apr 03, as posted on the internet at <www.onrifo.navy.mil/reports/2003/NewsletterAnthrax.doc>.

[100] Global Security Newswire, 31 Mar 03, 'Threat assessment: Crop dusting techniques could spread biological agents, study says'.

[101] David Levin, Giovana Valadares de Amorim, *Biosecurity and Bioterrorism: Biodefense Strategy, Practice and Science*, vol 1 no 1 (2003) pp 37-42, 'Potential for aerosol dissemination of biological weapons: Lessons from biological control of insects'.

[102] *Hansard* (Commons), daily part, 2 Apr 03, vol 402, no 76 col 745W, written answers, Mike O'Brien to Mr Laws.

South African authorities. The pathogen collection therefore remains in private hands in South Africa, where it has reportedly continued to attract interested buyers.[103] The following day, the *Washington Post* reports on a three-day meeting in Pretoria in July 2002 between US officials and Wouter Basson, the former head of Project Coast. According to unidentified officials knowledgeable of the meeting, it had been requested by Basson in an attempt to clear his record with US law enforcement officials. He was given an assurance that none of his statements could be used against him in a criminal or civil court. Although the US officials doubted some of his evidence, they were reportedly concerned about Basson's claim that Project Coast scientists developed a strain of *Bacillus anthracis* which could not be detected by standard field tests used in South Africa and neighbouring countries at the time and which, although with a reduction in virulence, could sicken and debilitate without leaving a trace. Basson claimed that he had learnt the technique involved from Israeli government scientists.[104]

22–25 April In Geneva, a workshop on *Preventing Disease Weaponization: Strengthening Law Enforcement and National Legislation* takes place at the Palais des Nations. Participants from a variety of IGOs and NGOs discuss such issues as the role of law enforcement, the role of scientific research, information sharing, technical assistance and consequence management.

May 2003

May In Washington DC, the Center for Defense Information publishes *Cuban Biotechnology: A First-hand Report*, which is an account of the mission of inquiry it had sent to Cuba following allegations by US Under Secretary of State John Bolton that Cuba had 'a limited offensive biological warfare research and development effort'. The introduction to the report, by CDI Cuba Project Director Glenn Baker, observes that the four-day visit to nine different biotechnology facilities 'would provide neither the 'smoking gun' nor the 'clean bill of health' that might put an end to the controversy'. The introduction goes on, however, to record what the visit did do, *viz*: 'provide a great deal of first-hand information about a subject long on rhetoric and short on fact; gauge Cuban openness and transparency on issues related to its biotechnology sector; engage American and Cuban scientists and security experts in a much-needed dialogue on how, in the age of terrorism, to balance the need to protect trade secrets in a highly sensitive industry with the need to establish international confidence in the legitimacy of your work; [and] provide a framework for routinized future exchanges in the field that will build confidence on biotech issues and facilitate information-sharing that can lead to scientific advances in both countries.'[105]

[103] Joby Warrick and John Mintz, *Washington Post*, 20 Apr 03, p A1, 'Lethal legacy: Bioweapons for sale'.

[104] Joby Warrick, *Washington Post*, 21 Apr 03, p A1, 'Biotoxins fall into private hands'.

[105] Glenn Baker (editor), *Cuban Biotechnology: A First-hand Report*, Washington, DC: Center for Defense Information, May 2003.

5 May Timor-Leste deposits its instrument of accession to the BTWC with the USA. In thirty days it will become the 150th party to the Convention.[106]

7 May US Under-Secretary of Defense for Intelligence Stephen Cambone announces that on 19 April Kurdish forces discovered what could be a mobile biological weapons laboratory at a checkpoint near Tallkayf in northern Iraq.[107] Two days later US forces uncover what they believe to be a second mobile biological-weapons laboratory at the al-Kindi Rocket and Missile Research and Development Center. According to Major General David Petraeus—speaking four days after the discovery—the second trailer contains a 5,000 pounds-per-square-inch compressor, a 2,000-litre reaction vessel, a small feed tank, a 3,000-liter water tank and a water cooler. 'It had a manufacture date of 2003 and a serial number of 2', says Petraeus, adding that the plate from the first trailer had a date of 2002 and a serial number of '1'. He says that 'several welds were not finished, and shipping plugs were still in place', and that a water pump, forward air compressor, canvas cover and some of the piping had been looted.[108]

28 May In Geneva, the World Health Assembly adopts—on the last day of the ten-day 56th World Health Assembly—a resolution authorizing the World Health Organization to verify disease outbreaks from all available official and unofficial sources, and, when necessary to determine the severity of an outbreak through on-the-spot investigations. Member states note that 'national and international experiences with SARS contribute lessons that can improve preparedness for responding to, and mitigating the public health, economic, and social consequences of the next emerging infectious disease, the next influenza pandemic, and the possible use of a biological agent to cause harm.'[109]

28 May The US Central Intelligence Agency and the Defense Intelligence Agency release an assessment on *Iraqi Mobile Biological Warfare Agent Production Plants*.[110]

29 May In London, BBC defence correspondent Andrew Gilligan states on the BBC's *Today* radio programme that a senior official in charge of compiling the UK Government's dossier on Iraqi weapons of mass destruction has informed him that the government ordered the dossier to be 'sexed up' a week before its publication.[111] In a statement to the BBC, the Prime Minister's Director of Communications Alastair Campbell responds to the report thus: 'Not one word of the dossier was not

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[106] Ministry of Foreign Affairs of Japan, at: http://www.infojapan.org/announce/announce/2003/5/0508-2.html, 8 May 03, 'Statement by the Press Secretary/Director-General for Press and Public Relations, Ministry of Foreign Affairs, on Timor-Leste Accession to the NPT and the BTWC'

[107] US Department of Defense, www.defenselink.mil, news transcript, 7 May 03, 'Briefing on weapons of mass destruction exploitation in Iraq'.

[108] Merle Kellerhals, Washington File staff writer, US Department of State, at: www.usinfo.state.gov, 13 May, 'US troops find second biological weapons trailer near Mosul'.

[109] World Health Organization, at: www.health.fgov.be, 2 Jun 03, 'Key step forward to international health rules'.

[110] US Central Intelligence Agency, US Defense Intelligence Agency, at: www.cia.gov, 28 May 03, 'Iraqi mobile biological warfare agent production plants'.

[111] BBC News (Internet edition), 24 Jul 03, 'Full text: Gilligan's Today reports—Here is the full text of defence correspondent Andrew Gilligan's original report on BBC Radio 4's Today programme from 29 May, 2003'.

entirely the work of the intelligence agencies'.[112] Gilligan reiterates his claims following Campbell's statement.[113]

30 May The US Department of Defense announces that by 7 June it will have deployed a new team of weapons inspectors to Iraq: the Iraq Survey Group (ISG) will replace the 75th Exploitation Force. According to Defense Intelligence Agency Operations Director Major General Keith Dayton, who is to head the ISG, the new team represents 'a significant expansion of the effort in the hunt for weapons of mass destruction'. Comprising between 1,300 and 1,400 personnel from military and civilian agencies in the US, the UK and Australia, Dayton says that the ISG will take a different approach to the 75th Exploitation Force, by 'going to places where the intelligence community's analytic powers tell us that there is a much more probable likelihood of finding something or finding people who know something about what was there'.[114] The overall ISG operation will include a joint interrogation/debriefing centre, a joint materiel exploitation centre, chemical and biological intelligence support teams and an operation centre. The ISG will be headquartered in Baghdad but with 'virtual connectivity' to an interagency intelligence community 'fusion centre' in Washington.[115] Dayton has a British deputy, Brigadier John Deverell, and approximately 100 of the ISG are from the UK.[116]

31 May In Krakow, Poland, US President Bush announces the creation of the Proliferation Security Initiative, the purpose of which is to establish cooperation between states to interdict shipments of weapons of mass destruction and missile-related equipment and technologies via land, air and sea.[117] Initially, eleven states—the USA, the UK, Australia, France, Germany, Italy, Japan, the Netherlands, Poland, Portugal and Spain—will participate in the Initiative.[118]

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[112] Sarah Lyall, *The International Herald Tribune*, 31 May—1 Jun 03, p 3, 'Blair denies Iraq data on arms were inflated'.

[113] BBC News (Internet edition), 24 Jul 03, 'Full text: Gilligan's Today reports—Here is the full text of defence correspondent Andrew Gilligan's original report on BBC Radio 4's Today programme from 29 May, 2003'.

[114] Federal News Service, US Department of Defense briefing, 30 May 03, 'Defense Department special briefing re: Iraq Survey Group'.

[115] US, Department of State, International Information Programs, 30 May 03, 'New WMD survey group to begin operation in Iraq soon'.

[116] Stephen Farrell, Elaine Monaghan and Michael Evans, *The Times* (London), 9 Jul 03, p 15, 'Weapons specialists who can help Blair'.

[117] US, White House, Office of the Press Secretary, 31 May 03, 'Remarks by the President to the people of Poland'.

[118] Rebecca Weiner, Monterey Institute for International Studies (CNS), at: http://cns.miis.edu/pubs/week/030716.htm, 16 Jul 03, 'Proliferation Security Initiative to stem flow of WMD matériel'.

June 2003

2–5 June In Paris, the Australia Group convenes for its annual plenary session. A press release issued following the meeting notes that participants stress that 'the importance of preventing the spread of CBW was greater than ever before in the 18-year history of the Group. Efforts by terrorists to acquire CBW were identified as presenting a significant challenge, in addition to ongoing concerns over state weapons programs.'[119]

The Group agrees to add a further fourteen human pathogens to its Biological Control List, comprising twelve viruses and two bacteria. The viruses are: Kyasanur Forest virus; Louping ill virus; Murray Valley encephalitis virus; Omsk haemorrhagic fever virus; Oropouche virus; Powassan virus; Rocio virus; St Louis encephalitis virus; Hendra virus (Equine morbillivirus); South American haemorrhagic fever (Sabia, Flexal, Guanarito); pulmonary and renal syndrome-haemorrhagic fever viruses (Seoul, Dobrava, Puumala, Sin Nombre); and Nipah virus. The bacteria are: *Clostridium perfringens* (toxin producing); and enterohaemorrhagic *Escherichia coli* (serotype O157 and other verotoxin producing serotypes). The Biological Control List now includes a total of 70 human pathogens.[120]

In addition, the Group agrees to endorse 'a cooperative programme of action for more effectively engaging countries in the Asia-Pacific region on CBW-related export control issues', approves 'a practical guide for compliance and enforcement officers to help them more efficiently detect, identify and prevent illegitimate transfers of items controlled by the Australia Group' and also agrees 'new procedures for improving transparency and enhancing information sharing among members'. Other issues discussed at the plenary session include the desirability of controlling new precursor and other types of chemicals, as well as dissemination devices for biological agents.

As is traditional, participants also reaffirmed their commitment to the CWC and BTWC: 'Participants also reiterated their commitment to fair and transparent trade in chemical and biological materials for peaceful purposes. They agreed that non-discriminatory application of national export licensing measures allows legitimate trade to expand unhampered by proliferation fears. As parties to the CWC and the BTWC, participants reaffirmed that such measures were fully consistent with all of our obligations under these conventions.'[121]

15 June In the UK, an unnamed biological weapons expert and member of a UK team asked to examine the mobile laboratories recently found in Iraq is reported by the London *Observer* as saying that the laboratories 'are not mobile germ warfare laboratories'. He says: 'You could not use them for making biological weapons. They do not even look like them. They are exactly what the Iraqis said they were—facilities for the production of hydrogen gas to fill balloons.'[122]

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[119] Australia Group, 5 Jun 03, press release AG/June 5/Press/Chair/26, 'The Australia Group: Strengthening measures to prevent the spread of weapons of mass destruction'.

[120] Australia Group, Aug 03, 'List of biological agents for export control', as posted on the internet at <www.australiagroup.net/en/control_list/bio_agents.htm>.

[121] Australia Group, 5 Jun 03, press release AG/June 5/Press/Chair/26, 'The Australia Group: Strengthening measures to prevent the spread of weapons of mass destruction'.

[122] Peter Beaumont, Anthony Barnett and Gaby Hinsliff, *The Observer*, 15 Jun 03, 'Iraqi mobile labs nothing to do with germ warfare, report finds'.

16 June In Luxembourg, European Union foreign ministers reach agreement on a common strategy to prevent the proliferation of weapons of mass destruction, which as a last resort envisages the use of 'coercive measures' with the UN Security Council playing a 'central role'. The said strategy comes in the form of two documents released by the Political and Security Committee of the Council of the European Union six days ago. These documents are: Basic Principles of an EU Strategy against Proliferation of Weapons of Mass Destruction and Action Plan for Implementation of the Basic Principles of an EU Strategy against Proliferation of Weapons of Mass Destruction. The Basic Principles state inter alia: 'An EU strategy against the proliferation of WMD needs to be based on a common assessment of global proliferation threats. The EU Situation Centre has prepared and will continuously update a threat assessment using all available sources; our intelligence services should keep this issue under review and remain engaged in the process … To address the new threats, a broad approach is needed. Political and diplomatic preventative measures (multilateral treaties and export control regimes) and resort to the competent international organisations (IAEA, OPCW, etc) form the first line of defence. When these measures (including political dialogue and diplomatic pressure) have failed, coercive measures under Chapter VII of the UN Charter and international law (sanctions, selective or global, interceptions of shipments and, as appropriate, the use of force) could be envisioned. The UN Security Council should play a central role … The EU is committed to the multilateral system … The EU will place particular emphasis on defining a policy reinforcing compliance with the multilateral treaty regime. In this context, the role of the UN Security Council, as the final arbiter on the consequences of non-compliance - as foreseen in multilateral regimes - needs to be effectively strengthened … To ensure effective detectability [sic] of violations and thereby deter non-compliance we will make best use of existing verification mechanisms and systems. We will also support the establishment of additional international verification instruments and, if necessary, the use of non-routine inspections under international control beyond facilities declared under existing treaty regimes … Proliferation of WMD is a global threat, which needs a global approach. However, as security in Europe is closely linked to security and stability in the Mediterranean, we should pay particular attention to the issue of proliferation in the Mediterranean area … An [sic] common approach and co-operation with key partners such as the US and the Russian Federation is essential in order to effectively implement WMD non-proliferation regime, and constitute an important ground for reinforcing transatlantic relations.' On chemical weapons, the Action Plan states: 'In order to more effectively address cases of suspected non-compliance with the [CWC] the EU should discuss activating the challenge inspection instrument.' On the BWC, the Action Plan states: 'The [BWC] does not contain at present a verification mechanism. The EU must find ways to strengthen compliance. A group of experts to give advice on how this could be done could be established.'

26 June In New Mucklenneuk, South Africa, there is a workshop on *Chemical and Biological Weapons: A New Approach for a New Era*, hosted by the Institute for Strategic Studies and the Centre for Conflict Resolution. The workshop aims to inform the media, NGOs and government representatives about the CWC and BTWC and the challenges they currently face. Particular emphasis is put on the implication of the Conventions on Africa and how they might be strengthened in this context.[123]

[123] Bio-Weapons Prevention Project, 22 Jul 03, web site, at: www.bwpp.org, report, 'International cooperation the answer to chemical and biological weapons'.

July 2003

1 July In Geneva, the Geneva Forum hosts a seminar on *The BTWC Work Programme (2003-2005): What Does It Mean and What Can It Achieve?* Presentations are made by Trevor Findlay of VERTIC, Kathryn McLaughlin of the Landau Network—Centro Volta, Elisa Harris of the University of Maryland, Terence Taylor of the IISS and Jean Pascal Zanders of the BWPP.

1 July From the UK, the current issue of the *Journal of the Royal Society of Medicine* carries an article on 'influenza as a bioweapon' in the light of the ongoing work to sequence the genome of the 1918 Spanish flu virus.[124] The authors of the article state: 'Sequencing of the genome of the 1918 Spanish influenza virus is nearly complete; once it is published, unscrupulous scientists could presumably utilize candidate virulence sequences. Recently, the possibility of synthesizing an infectious agent solely by following instructions from a written sequence has moved from theory to practice.' They go on: 'Taken together with the fact that influenza virus is readily accessible and may be causing more deaths than previously suspected, the possibility for genetic engineering and aerosol transmission suggests an enormous potential for bioterrorism.' Among the proposals put forward by the authors is that the World Health Organization and the Centers for Disease Control and Prevention should bring together experts in influenza, bioterrorism, health policy, international law and ethics to study the problem.[125]

4 July UK Secretary of State for Foreign and Commonwealth Affairs Jack Straw publishes his response to the report of the House of Commons Foreign Affairs Committee on *The Biological Weapons Green Paper*. The response states that from 'a practical and policy perspective it is now perhaps more important to focus on the new Biological Weapons Convention (BTWC) follow-up work programme'. As requested by the Committee, the response lists 48 countries which indicated at the 24th session of the Ad Hoc Group that they supported the Chairman's composite text as the basis for concluding the Group's work. The Secretary of State's response includes the following: 'The UK continues to support the principle of the need to strengthen the BTWC through detailed implementation/verification arrangements, but as long as there is no prospect of the US Administration accepting the need for such a Protocol, the UK will not support its establishment; such a Protocol would be meaningless, create a false sense of security and impose an unfair burden on our industry and biodefence programmes which would not be borne elsewhere.' It continues: 'The Government's judgement remains, … that it is not politically feasible to resurrect the Protocol given the strong opposition in Washington, as well as the continuing reluctance of many others to move forward without the US. For these reasons it would not be a productive use of time and effort to work for such an unlikely outcome. Expending effort here could well prejudice the chances of a successful outcome of the August Experts' meeting by provoking the US to reassess its policy, and

[124] Global Security Newswire, 1 Jul 03, 'Threat assessment: Influenza could be used as bioterror weapon, scientists say'; BBC News Online, 0041 hrs GMT 1 Jul 03, 'Flu bioweapons fears'.

[125] Mohammad Madjid, Scott Lillibridge, Parsa Mirhaji and Ward Casscells, *Journal of the Royal Society of Medicine*, vol 96 no 7 (July 2003) pp 345-346, 'Influenza as a bioweapon'.

by taking the pressure off other States Parties to meet their obligations to implement legislation and biosecurity.'[126]

8 July The UK Ministry of Defence issues a statement revealing that 'an individual working in the MOD has come forward to volunteer that he met Andrew Gilligan of the BBC on May 22.'[127] One day after the original MOD statement, Downing Street provides specific personal details allowing journalists to identify the individual whose name is subsequently confirmed by the MOD.[128] Dr David Kelly, an adviser to the Ministry's Counter-Proliferation and Arms Control Secretariat is a former UNSCOM chief inspector and was heavily involved in the trilateral inspections in Russia. An unidentified MOD spokesman is quoted as saying: 'He is the man who came forward to us. Whether or not he is the source Gilligan talks about, that is a matter for the BBC to confirm.'[129] The BBC, however, refuses to confirm or deny that Dr Kelly was the source for the story.[130] During a private meeting, the House of Commons Foreign Affairs Committee, which has only recently published its report on *The Decision to go to War in Iraq*, decides to call Dr Kelly to give evidence before it.[131]

19 July The UK government announces an investigation into the death of Dr David Kelly two days earlier. The inquiry into the circumstances surrounding the death of Dr Kelly will be conducted by Lord Hutton, a former Lord Chief Justice of Northern Ireland.[132]

25 July The UN Department for Disarmament Affairs has received from 26 states parties to the BTWC the annual declarations that fell due on 15 April under the voluntary confidence-building measures agreed at the third BTWC review conference. Declarations have been received from: Argentina; Armenia; Belarus; Belize; Bulgaria; China; Cuba; Czech Republic; Estonia; Georgia; Germany; Italy; Japan; Lithuania; Netherlands; New Zealand; Norway; Poland; Romania; Russian Federation; Slovakia; Switzerland; Turkey; Ukraine; United States of America and Uzbekistan. The Department now distributes a compendium of the declarations to all states parties.[133]

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[126] UK House of Commons, Foreign Affairs Committee, 4 Jul 03, session 2002-03, Cm 5857, 'Fifth report of the Foreign Affairs Committee, session 2003-03, the biological weapons green paper, response of the Secretary of State for Foreign and Commonwealth Affairs'.

[127] James Blitz and Tim Burt, *Financial Times*, 9 Jul 03, p 2, 'MoD claims to have identified BBC source'; Michael Smith and Benedict Brogan, *The Daily Telegraph* (London), 9 Jul 03, p 1, 'Civil servant 'admits talking to BBC man''; *Nature*, vol 424 no 6946 (17 July 2003) p 244, 'News in brief: Nerve-gas experiments will not go to court'.

[128] BBC News Online, 1112 hrs GMT 10 Jul 03, 'Official named in weapons row'; James Blitz, Christopher Adams, Tim Burt and Mark Huband, *Financial Times*, 10 Jul 03, p 2, 'Alleged source of contested report named'; Michael Smith, *The Daily Telegraph* (London), 10 Jul 03, p 6, 'MoD leaks name of official who met Gilligan'.

[129] BBC News Online, 1112 hrs GMT 10 Jul 03, 'Official named in weapons row'.

[130] Michael Smith, *The Daily Telegraph* (London), 11 Jul 03, p 2, 'BBC bosses say Gilligan is being smeared'.

[131] BBC News Online, 1628 hrs GMT 11 Jul 03, 'MPs to quiz weapons official'.

[132] UK, Ministry of Defence, 19 Jul 03, press release 168/03, 'Statement by Geoff Hoon, Secretary of State for Defence'.

[133] Document ref DDA/BTWC/2003/CBM dated 25 July 2003.

August 2003

9 August In the UK, the Verification, Research, Training and Information Centre (VERTIC) releases a database of BTWC national implementation legislation. Only 31 of the 150 states parties responded to the VERTIC questionnaire by which they were asked to identify measures adopted in fulfilling their obligations under the BTWC. Legal researcher at VERTIC Angela Woodward says that the non-response level was 'very high in Africa, quite high in the Americas, and Asia, so our fairly educated guess from similar efforts under other treaties is that a lot of states just won't have appropriate measures in place, unfortunately'.[134]

9 August *The New York Times* reports a team of US Defense Intelligence Agency engineers as having concluded that the most likely use for the two trailers recently discovered in Iraq was to produce hydrogen for weather balloons. This contradicts the Central Intelligence Agency's earlier findings—as set out in *Iraqi Mobile Biological Warfare Agent Production Plants*—which concluded that the trailers were mobile biological weapons laboratories.[135]

18–29 August In Geneva, there is the first Meeting of Experts of States Parties to the BTWC under the new process established by the 5th BTWC Review Conference. During the first week, participants discuss the adoption of necessary national measures to implement the prohibitions set forth in the BTWC, including the enactment of penal legislation. The following week, national mechanisms to establish and maintain the security and oversight of pathogenic micro-organisms and toxins are discussed. The purpose of the meeting is to prepare the way for the Meeting of States Parties in November when the issues discussed will be considered.[136] The meeting is chaired by Ambassador Tibor Tóth of Hungary, who also chaired the Fifth Review Conference. As well as national delegations, experts from a range of international organizations, including the World Health Organization, the Food and Agriculture Organization and the Office International des Epizooties participate.[137] The Secretariat had collated submitted information on national implementation measures on a CD-ROM before the meeting and distributed it prior to its commencement. No summary report of the meeting is provided by the Chair. In his closing remarks Tóth says: 'A great deal of useful, practical and directly applicable information will be taken back to capitals and used directly in strengthening national implementation'.[138]

20 August In Geneva, during the ongoing BTWC experts meeting, the BioWeapons Prevention Project organizes a seminar on *National Implementation Legislation and Biosafety Issues under the Biological and Toxin Weapons Convention*. Presentations are made by Angela Woodward, from VERTIC; Jill Dekker-Ballamy, from the Euro-

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[134] David Ruppe, Global Security Newswire, 13 Aug 03, 'BTWC: Survey finds many nations lacking required treaty legislation'.

[135] Douglas Jehl, *The New York Times* (internet edition), 9 Aug 03, 'Iraqi trailers to make hydrogen, not biological arms'.

[136] UN News Service (internet version), 19 Aug 03, 'Experts meet at UN headquarters in Geneva to strengthen biological arms ban'.

[137] UN, 18 Aug 03, press release no DC/2882, 'Biological Weapons Convention members begin new process'.

[138] J.Littlewood, *Disarmament Diplomacy*, no 73 (November 2003), pp 63-66, 'Substance hidden under a mountain of paper: the BTWC experts' meeting in 2003'.

pean Group for Non-Proliferation Studies; and Barbara Hatch Rosenberg, from the Federation of American Scientists.[139]

September 2003

4 September US Secretary for Health and Human Services Tommy Thompson announces grants totalling approximately $350 million spread over five years to establish eight Regional Centers of Excellence for Biodefense and Emerging Infectious Diseases Research (RCE). The RCE programme's primary role is to foster the physical and intellectual environments in which wide-ranging research on infectious diseases can proceed productively and safely. The eight institutions receiving an RCE grant are: Duke University, Harvard Medical School, New York State Department of Health, University of Chicago, University of Maryland (Baltimore), University of Texas Medical Branch (Galveston), University of Washington, and Washington University (St. Louis). Research to be conducted under the RCE programmes includes: developing new approaches to blocking the action of anthrax, botulinum and cholera toxins; developing new vaccines against anthrax, plague, tularemia, smallpox and ebola; developing new antibiotics and other therapeutic strategies; studying bacterial and viral disease processes; designing new advanced diagnostic approaches for biodefense and for emerging diseases; conducting immunological studies of diseases caused by potential agents of bioterrorism; developing computational and genomic approaches to combating disease agents; and creating new immunization strategies and delivery systems. The NIAID is also funding two Planning Grants for RCEs at the University of Iowa and the University of Minnessota, which will support training, planning, research development and resource acquisition that could lead to the future establishment of a regional centre.[140]

11 September The Cartagena Protocol on Biosafety 2000 enters into force following the expiration of ninety days from the date of the fiftieth instrument of ratification. The Protocol—adopted under the Convention on Biological Diversity 1992—seeks to protect biological diversity from potential risks that may be posed by living modified organisms (LMOs). It establishes an advance informed agreement (AIA) procedure to ensure that countries are provided with prior written notification and information necessary to make informed decisions before agreeing to the first import of an LMO destined to be intentionally introduced into the environment. The Protocol adopts the precautionary approach, as first formulated under Principle 15 of the 1992 Rio Declaration on Environment and Development. It also establishes a Biosafety Clearing House to facilitate the exchange of information and experiences on LMOs and to assist countries in the implementation of the provisions of the Protocol.[141]

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[139] BioWeapons Prevention Project, announcement dated 14 Jul 03, at: www.bwpp.org, *National Implementation Legislation and Biosafety Issues Under the Biological and Toxin Weapons Convention*

[140] US, Department of Health and Human Services, news release, as posted at: http://www.hhs.gov/news/press/2003pres/20030904.html, 4 Sep 03, 'HHS announces new regional centers for biodefense research'.

[141] Convention on Biological Diverstiy, web site, as posted at: http://www.biodiv.org/biosafety/signinglist.aspx?sts=rtf&ord=dt, accessed on 25 Nov 03.

25 September In Geneva, there is a meeting organized by the BioWeapons Prevention Project and the Geneva Forum *The New Process: First Impressions and the Way Ahead*. The purpose of the meeting—attended by 31 people, mainly government representatives—is to analyse and discuss the first Meeting of Experts under the BTWC 'new process' and to preview the follow-up November Meeting of States Parties.[142]

29 September A leaked US Defense Intelligence Agency (DIA) assessment concludes that almost all claims made by Iraqi defectors regarding Iraq's weapons of mass destruction were either useless or false.[143]

30 September The US National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health, announces funding for the construction of two National Biocontainment Laboratories (NBLs) and nine Regional Biocontainment Laboratories (RBLs). The RBLs will receive grants of between $7 and $21 million each in construction funds. Each institution will be required to provide matching funds. The two NBLs will be constructed at Boston University and the University of Texas Medical Branch, Galveston. The nine RBLs will be constructed at: the Colorado State University, Fort Collins; Duke University, Durham; Tulane University, New Orleans; the University of Alabama, Birmingham; the University of Chicago, the University of Medicine and Dentistry of New Jersey, Newark; the University of Missouri, Columbia; the University of Pittsburgh; and the University of Tennessee, Memphis. The NBL and RBL sites were selected based on multiple factors, but primarily on the scientific and technical merit of the applications as assessed by peer review and on the applicant's ability to contribute to the overall NIAID biodefense research agenda. The NBLs and RBLs will complement and support the research activities of NIAID's recently awarded Regional Centers of Excellence for Biodefense and Emerging Infectious Diseases Research.[144]

October 2003

2 October In the US Congress, Iraq Survey Group (ISG) leader David Kay presents his long-awaited interim progress report on his group's activities during the first three months of its operations in Iraq to a closed session of the House and Senate select committees on intelligence. The 200-page report is classified, but a 13-page unclassified testimony is posted on the CIA website. In the testimony, Kay says: 'We have not yet found stocks of weapons, but we are not yet at the point where we can say definitively either that such weapon stocks do not exist or that they existed before the war and our only task is to find where they have gone. We are actively engaged in searching for such weapons based on information being supplied to us by Iraqis.' However, Kay continues: 'We have discovered dozens of WMD-related program activities and significant amounts of equipment that Iraq concealed from the United Nations during the inspections that began in late 2002.' Many such activities

[142] BWPP Seminar Report #1, as posted at: http://www.bwpp.org/publications/seminars/030925-seminar1.pdf, *The New Process: First Impressions and the Way Ahead*

[143] Julian Borger, *The Guardian* (London), 30 Sep 03, p 17, 'Pentagon: defectors were wrong about WMD'.

[144] NIAID News, as posted at: http://www.niaid.nih.gov/newsroom/releases/nblscorrect21.htm, press release, 30 Sep 03, 'NIAID funds construction of biosafety laboratories'.

relate to biological warfare, which Kay says has been one of the ISG's two initial areas of focus. Among these, Kay lists: 'A clandestine network of laboratories and safehouses within the Iraqi Intelligence Service that contained equipment subject to UN monitoring and suitable for continuing CBW research. A prison laboratory complex, possibly used in human testing of BW agents, that Iraqi officials working to prepare for UN inspections were explicitly ordered not to declare to the UN. Reference strains of biological organisms concealed in a scientist's home, one of which can be used to produce biological weapons. New research on BW-applicable agents, Brucella and Congo Crimean Hemorrhagic Fever (CCHF), and continuing work on ricin and aflatoxin were not declared to the UN.' Summarizing the biological warfare activities so far uncovered, Kay say: 'All of this suggests Iraq after 1996 further compartmentalized its program and focused on maintaining smaller, covert capabilities that could be activated quickly to surge the production of BW agents.'

Kay's testimony also mentions the discovery in a scientist's house of a collection of reference strains among which was a vial of 'live C. botulinum Okra B from which a biological agent can be produced.' This revelation is later used by politicians to argue that the ISG has found weapons of mass destruction. US State Department press spokesman Richard Boucher says: '… botulinum kills people; it kills people in large quantities. That is a weapon—botulinum is a weapon of mass destruction, yes.'[145] However, it later emerges that the vial had been in the scientist's house since 1993 and that it is not of the more lethal type A strain which Iraq had weaponized in the past.[146] In addition, the botulinum was likely to have been supplied to Iraq from the American Type Culture Collection during the 1980s and David Franz, a former UNSCOM biological weapons inspector and commander of Fort Detrick, says there is no evidence of Iraq or any other country having successfully weaponized botulinum B: 'The Soviets dropped it [as a goal] and so did we, because we couldn't get it working as a weapon.'[147]

Regarding the trailers which had earlier been identified as mobile biological production facilities, Kay says: 'We have not yet been able to corroborate the existence of a mobile BW production effort. Investigation into the origin of and intended use for the two trailers found in northern Iraq in April has yielded a number of explanations, including hydrogen, missile propellant, and BW production, but technical limitations would prevent any of these processes from being ideally suited to these trailers. That said, nothing we have discovered rules out their potential use in BW production. We have made significant progress in identifying and locating individuals who were reportedly involved in a mobile program, and we are confident that we will be able to get an answer to the questions as to whether there was a mobile program and whether the trailers that have been discovered so far were part of such a program.'

The following day, President George Bush says that the report vindicates the invasion of Iraq: 'The [ISG] report states that Saddam Hussein's regime had a clandestine network of biological laboratories, a live strain of deadly agent botulinum, sophisticated concealment efforts and advanced design work on prohibited longer-range missiles. … These findings already make clear that Saddam Hussein actively deceived the international community, that Saddam Hussein was in clear violation of United Nations Security Council resolution 1441 and that Saddam

[145] US, Department of State, 3 Oct 03, 'State Department regular briefing'.

[146] Julian Borger, *The Guardian* (London), 7 Oct 03, p 1, 'Revelation casts doubt on Iraq find'.

[147] Bob Drogin, *Los Angeles Times* (internet edition), 17 Oct 03, 'Experts downplay bioagent'.

Hussein was a danger to the world.'[148] UK Secretary of State for Foreign and Commonwealth Affairs Jack Straw also defends the invasion saying that the ISG report confirmed 'how dangerous and deceitful the [Iraqi] regime was and how the military action was indeed both justified and essential to remove the dangers.'[149]

2 October The US Senate Foreign Relations Committee convenes a hearing on *Challenges for US Policy Toward Cuba*. Although he makes no mention of it in his prepared statement, Assistant Secretary of State for the Western Hemisphere Roger Noriega responds to a subsequent question by saying: 'We continue … to believe that Cuba has at least a limited, developmental, offensive biological weapons research and development effort and is providing dual-use biotechnology to other rogue states.' Cuban Foreign Minister Felipe Perez Roque later calls the charges a 'bald-faced lie' and challenged the United States to supply proof.[150] Four days later, the Cuban Foreign Relations Ministry releases an official note rejecting the accusation.[151]

8 October In the US, the National Research Council publishes the report of its Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology, *Biotechnology Research in an Age of Terrorism: Confronting the Dual Use Dilemma*.[152] The Committee, chaired by Gerald Fink of the Whitehead Institute for Biomedical Research at MIT, held six meetings between 1 April 2002 and 29 January 2003 to consider the issue and to prepare its report. The Committee's work was supported by the Nuclear Threat Initiative and the Alfred P Sloan Foundation. The Committee makes seven recommendations in its report under the following headings: Educating the scientific community; Review of plans for experiments; Review at the publication stage; Creation of a National Science Advisory Board for Biodefense within the Department of Health and Human Services; Additional ele-

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[148] US, White House, Office of the Press Secretary, 3 Oct 03, 'President Bush, Police Commissioner Kerik discuss police force in Iraq'.

[149] Jonathan Steele, *The Guardian* (London) (internet edition), 3 Oct 03, 'Straw seizes on proof of 'dangerous and deceitful' Saddam'.

[150] Reuters from Washington, as in *Washington Post* (internet edition), 2 Oct 03, 'US accuses Cuba of germ weapons program'.

[151] *Granma* (Havana) (internet edition), 6 Oct 03, 'Cuba rejects imperial threats of Mr Noriega'; EFE (Madrid) from Havana, 6 Oct 03, 'Cuba rejects renewed US charges about bioweapons'; Reuters from Havana, 1917 hrs ET 6 Oct 03, 'Cuba says Bush official lied about bioweapons'; AP from Havana, 7 Oct 03, 'Biological warfare capability is denied'.

[152] National Academy of Sciences, 8 Oct 03, press release, 'Balanced approach needed to mitigate threats from bioterrorism without hindering progress in biotechnology'; Randolph Schmid for AP from Washington, as in *The Guardian* (London) (internet edition), 8 Oct 03, 'NIH may review biological research'; Steve Sternberg from Washington, *USA Today* (internet edition), 8 Oct 03, 'Researchers urged to guard biotechnology from terrorism'; Maggie Fox for Reuters from Washington, 8 Oct 03, 'Biotech researchers urged to consider potential misuse of work'; David Ruppe for Global Security Newswire from Washington, 8 Oct 03, 'Report on screening US biological research draws mixed reviews'; Nicholas Wade, *The New York Times* (internet edition), 9 Oct 03, 'Science panel urges review of research terrorists could use'; John Dudley Miller, *The Scientist* (internet edition), 9 Oct 03, 'National Academy proposes scientists self-police'; Erika Check from Washington, *Nature*, vol 425 no (16 October 2003) p 647, 'Health chiefs poised to step up US scrutiny of microbe research'; David Malakoff and Martin Enserink, *Science*, vol 302 no (17 October 2003) pp 368-369, 'Researchers await government response to self-regulation plea'; *Arms Control Today*, vol 33 no 9 (November 2003), pp 44-45, 'National Academy of Sciences releases key report on biomedical research liabilities'.

ments for protection against misuse; A role for the life sciences in efforts to prevent bioterrorism and biowarfare; and Harmonized international oversight.[153]

10 October In the USA, CBS television reports that al-Qaeda may be trying to weaponize *Bacillus anthracis* for use as a biological weapon. CBS has had access to transcripts of the interrogation by US agents of Jemaah Islamiyah leader Riduan Isamuddin (otherwise known as 'Hambali') who is regarded as al-Qeada's main connection in the Far East.[154] According to the interrogation documents seen by CBS, Isamuddin revealed that he had been 'working on an al-Qaeda anthrax program in Khandahar' with another Jemaah Islamiyah member, Yazid Sufaat, a Malaysian who trained as a lab technician in the US and who was arrested in December 2001 in Malaysia where he is still being held.[155] Isamuddin reportedly tells his interrogators that Sufaat was recruited to help al-Qaeda set up an anthrax production facility in Indonesia.[156] However, Sufaat's attempts to purchase anthrax in 2001 were apparently unsuccessful.[157]

15 October In the UK, the Foreign and Commonwealth Office states that 'if the wider international context proves more favourable, then the UK would most certainly wish to be at the forefront of any renewed effort to strengthen the BTWC through agreement on a verification protocol.' The statement is contained in correspondence between the FCO and the House of Commons Foreign Affairs Committee following the Government's response to the Committee's report on the Biological Weapons Green Paper. The Committee had sought reassurance that 'the Government will not abandon all hope of agreement, and that it will be in a position to respond quickly and positively to any new development or change of heart elsewhere.'[158]

17 October In London, Sudan deposits its instrument of accession to the BTWC, thus becoming—in thirty days—the 151st state party to the treaty.

21–22 October In Geneva, there is a conference on *Smallpox Biosecurity: Preventing the Unthinkable* sponsored by smallpox vaccine manufacturer Acambis. Among the speakers are Donald Henderson, the Principal Science Advisor at the US Department of Health and Human Services, Ken Alibek now of George Mason University but formerly of the USSR biological weapons programme and Peter Jahrling of the US Army Medical Research Institute of Infectious Diseases. Henderson, Alibek and Jahrling all agree that smallpox presents a real threat but Henderson and Jahrling, and other participants, disagree on whether the WHO-recommended policy of tar-

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[153] National Research Council, Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology, *Biotechnology Research in an Age of Terrorism: Confronting the Dual Use Dilemma*, as posted on the internet at <http://books.nap.edu/html/biotechnology_research/0309089778.pdf>.

[154] Bill Sanderson, *New York Post* (internet edition), 10 Oct 03, 'Qaeda man discloses 'thrax plan'; Lincoln Wright, *Sunday Herald Sun* (Melbourne) (internet edition), 12 Oct 03, 'Hambali's taunt: We'll kill again'.

[155] CBS, 9 Oct 03, 'Is al Qaeda making anthrax?'.

[156] Detikcom (Jakarta) (website), 12 Oct 03, as translated from the Indonesian in BBC-WWM, 13 Oct 03, 'Indonesian terror suspect Hambali says Jemaah Islamiyah still receiving funds'.

[157] Maria Ressa for CNN.com from Manila, 10 Oct 03, 'Reports: Al Qaeda operative sought anthrax'; AP from Washington, 10 Oct 03, 'Official: Al Qaeda may have sought anthrax'.

[158] UK, Foreign and Commonwealth Office, 15 Oct 03, 'Letter to the Clerk of Committee from the Parliamentary Relations and Devolution Department, Foreign and Commonwealth Office, 15 October 2003'.

geted post-exposure vaccination or pre-exposure mass vaccination is the appropriate strategy.[159]

Also during the conference, St Louis University scientist Mark Buller presents research on 'the potential use of genetic engineering to enhance the use of orthopoxviruses as bioweapons'. In his research, Buller has engineered a strain of mousepox virus that killed 100 per cent of mice exposed, even those which had been vaccinated, according to *New Scientist*. Buller's research takes forward that conducted by an Australian team by inserting IL-4 into the mousepox genome. Buller has also used a similar method to engineer a cowpox virus which is soon to be tested on animals at the US Army Medical Research Institute of Infectious Diseases. The research raises concerns among conference participants, much as the earlier Australian research did, but this is also heightened by the fact that cowpox can infect humans, although Buller says that the IL-4 gene is species-specific. One of the team of Australian scientists, Ian Ramshaw, criticizes the research saying: 'I have great concern about doing this in a pox virus that can cross species'. He also doubts the need for the cowpox experiments, as his group's work had already shown that the method worked on other pox viruses.[160]

23 October At UN headquarters, the NGO Committee on Peace, Disarmament and Security, in cooperation with the Department for Disarmament Affairs, organizes a panel discussion on *Reducing the Risks Posed by Biological Weapons*. The panellists are: Terence Taylor of the International Institute for Strategic Studies; Barbara Rosenberg of the Federation of American Scientists; and Elisa Harris of the University of Maryland. Much of the discussion focuses on designing a way in which the expertise of UNMOVIC can be kept in being, particularly in the field of biology and missiles which currently lack any international institutional mechanism. Participants refer to an 'embryonic organization' dealing with the whole range of weapons of mass destruction issues under the authority of either the UN Secretary-General or the Security Council. Jan Rozing of UNMOVIC's Biological Section says that of the 354 trained scientists currently on UNMOVIC's roster, 90 are biologists from 30 different countries and UNMOVIC's core biology staff is about 8 to 10.

The discussion reflects a debate earlier today in the First Committee during which Canada, France and Sweden all raise the issue of UNMOVIC's future. The French representative recalls President Chirac's call for a permanent corps of disarmament inspectors under the UN Security Council.[161] The Swedish representa-

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[159] Reuters from Geneva, 1251 hrs ET 20 Oct 03, 'Smallpox still an ideal bioterror agent, experts say'; David McGlinchey for Global Security Newswire from Geneva, 22 Oct 03, 'Soviet Union once deployed smallpox-tipped ICBMs'; David McGlinchey for Global Security Newswire from Geneva, 22 Oct 03, 'US health officials, experts, debate smallpox vaccination response'; UN Wire, 22 Oct 03, 'Former WHO officials warn smallpox could return'; Steve Conner from Geneva, *The Independent* (London), 22 Oct 03, p 8, 'Deadly smallpox not eradicated, scientist warns'; Clare Kapp, *The Lancet*, vol 362 no 9393 (25 October 2003), 'Conference highlights bioterrorist threat'; Fiona Fleck from Geneva, *British Medical Journal*, vol 327 no 7421 (25 October 2003) p 948, 'Smallpox bioterrorist conference highlights divisions over vaccines'; Steve Connor, *The Independent* (London), 29 Oct 03, p 8 [review section], 'Man versus microbe'.

[160] Debora MacKenzie from Geneva, *New Scientist* (internet edition), 29 Oct 03, 'US develops lethal new viruses'; Catherine Lyst, *The Herald* (Glasgow) (internet edition), 30 Oct 03, 'Doomsday fears over new pox virus'; William Broad, *The New York Times* (internet edition), 1 Nov 03, 'Bioterror researchers build a more lethal mousepox'; Rick Weiss, *Washington Post*, 1 Nov 03, p A1, 'Engineered virus related to smallpox evades vaccine'.

[161] France, 23 Oct 03, Intervention by HE Ambassador Francois Rivasseau, Permanent Representative of France to the Conference on Disarmament, 'Création d'un Corps d'inspection du disarmament au sein des Nations Unies', as posted on the internet at <www.reachingcriticalwill.org/political/1com/1com03/themestate03/Francepermcorps.pdf>.

tive suggests two possible options: to make UNMOVIC a permanent resource of the UN Secretariat; or to transform UNMOVIC into a regular subsidiary organ of the Security Council along the lines of the Counter-Terrorism Committee.[162]

There is also a panel on *The Future of Disarmament and Arms Control: Civil Society's Role* at which the panellists are: UN Under Secretary-General for Disarmament Affairs Nobuyasu Abe; Henrik Salander, formerly the Permanent Ambassador of Sweden to the Conference on Disarmament, currently the Secretary-General of the new International Independent Commission on Weapons of Mass Destruction; and Rebecca Johnson, Executive Director of the Acronym Institute for Disarmament Diplomacy.[163]

28 October In Mexico City, foreign ministers of the 34 members countries of the Organization of American States (OAS) declare that making 'the Americas a region free of biological and chemical weapons' is an objective of the Organization. The objective is included in a *Declaration on Security in the Americas* adopted by the Special Conference on Hemispheric Security. The declaration also includes the following: 'We emphasize the commitment of the states in the region to arms control, disarmament and the nonproliferation of all weapons of mass destruction and to the full implementation by all states parties of the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, and the Treaty on the Non-Proliferation of Nuclear Weapons. … We shall prevent the proliferation of weapons of mass destruction and their means of delivery by, inter alia, resolutely supporting the International Atomic Energy Agency (IAEA), including the universal application of the Agency's safeguards system, and the Organization for the Prohibition of Chemical Weapons, and by establishing national standards and controls on exports of specialized materials, technology, and expertise that could contribute to the preparation, production, or use of weapons of mass destruction and their means of delivery.'[164]

November 2003

1 November Portuguese Health Secretary Carlos Martins announces that Portugal has recently purchased a stockpile of smallpox vaccine as a precautionary measure against bioterrorist acts during the UEFA Euro 2004 [football] Championship.[165]

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[162] Sweden, 23 Oct 03, 'Statement by HE Ms Elisabet Borsiin Bonnier, Ambassador Extraordinary and Plenipotentiary Permanent Representative of Sweden to the United Nations and Other International Organizations in Geneva', as posted on the internet at <www.reachingcriticalwill.org/political/1com/1com03/themestate03/swedenverify.pdf>.

[163] Reaching Critical Will, *The First Committee Monitor*, October 20-24, 2003: Week Three.

[164] Organization of American States, Special Conference on Hemispheric Security, 28 Oct 03, document CES/DEC. 1/03 rev.1, 'Declaration on security in the Americas'; Organization of American States, 28 Oct 03, press release no E-212/03, 'OAS countries affirm shared commitment to meet security challenges'.

[165] Lusa news agency web site (Lisbon) from Lisbon, 1207 hrs GMT 1Nov 03, as translated from the Portuguese in BBC-WWM, 'Portugal buys smallpox vaccines as Euro 2004 precaution against bioterrorism'.

5 November From Geneva, the World Health Organization (WHO) is unprepared to deal with a global bioterrorist attack involving an agent such as smallpox because of a severe lack of funding for surveillance and front-line defences, according to project manager for the WHO's Global Alert and Response Network Patrick Drury. He says—as reported in the *Washington Post*— that the recent bioterrorism exercise, Global Mercury, underlined the drawbacks of defending against bioterrorism threats on a nation-by-nation basis. 'We'd like to see the United States engage in this as a multilateral effort', says Drury. 'They seem to be unilateral or bilateral in what they are doing'. US health officials refute the charge, saying that the USA is trying to balance domestic and international strategies.[166]

10–14 November In Geneva, delegates from 92 states parties to the BTWC convene under the 'new process' to discuss the strengthening of national implementation measures, following consideration of the matter by experts from 83 states at the recent experts' meeting.[167] 'In our view, the primary task of this meeting of states parties should be the adoption of an agreed final document, identifying those common elements and recommending them for national implementation,' says German Ambassador Volker Heinsberg, in comments similar to those by New Zealand, Sweden and others. A statement issued by Pakistan states 'It is our desire and hope that by the end of this week we would have arrived at some common understandings on the basis of the best practices, to be pursued on a voluntary basis.' The US delegation, however, views the conference principally as an opportunity for exchanging information and encouraging states to take action at home regarding specific issues. 'We do not believe we should try to negotiate an agreement by the parties at this annual meeting on sets of 'common elements' or 'best practices' relating to national implementing measures and/or biosecurity,' says head of the US delegation Ambassador Donald Mahley. He says the conference should produce two outcomes: a determination to review, update or implement national measures and a commitment to help treaty parties meet their obligations.[168] The final report adopted by the meeting reads thus:

> 'At the Meeting of States Parties, States Parties noted that notwithstanding the differing legal and constitutional arrangements among the 151 States Parties to the Convention, States have adopted similar basic approaches and share common principles. The States Parties stressed the need for undertaking activities at the national level in keeping with their obligations and responsibilities to strengthen and implement the Convention. The States Parties agreed, to that end, on the value of the following:
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> 'To review, and where necessary, enact or update national legal, including regulatory and penal, measures which ensure effective implementation of the prohibition of the Convention, and which enhance effective security of pathogens and toxins.

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166 S.Vedantam, *Washington Post* (internet edition), 5 Nov 03, 'Coordination of defenses poor in simulation; US support for agency questioned'.

167 BTWC/Information paper No.2, BTWC Meeting of States Parties, 10-14 November 2003, 'Collation of Contributions—10 November: Agenda Item 4, General Debate/Discussion.

168 D.Ruppe, *Global Security Newswire (NTI)*, as posted at: www.nti.org, 10 Nov 03, 'US faces off with other nations on biological treaty'; D.Ruppe, *Global Security Newswire (NTI)*, as posted at: www.nti.org, 18 Nov 03, 'Biological Weapons Convention meeting ends without recommendations'.

'The positive effect of cooperation between States Parties with differing legal and constitutional arrangements. States Parties in a position to do so may wish to provide legal and technical assistance to others who request it in framing and/or expanding their own legislation and controls in the areas of national implementation and biosecurity.

'The need for comprehensive and concrete national measures to secure pathogen collections and the control of their use for peaceful purposes. There was a general recognition of the value of biosecurity measures and procedures, which will ensure that such dangerous materials are not accessible to persons who might or could misuse them for purposes contrary to the Convention.

'States Parties considered that agreement on the value of these measures discussed at the Meeting constitutes an essential effort to facilitate more effective implementation and enforcement of the Convention, as well as providing a basis for review of progress at the 2006 Review Conference.'

The report also states that 'a complete list of documents of the [meeting], including the working papers submitted by States Parties, is contained in [its] Annex I'.[169]

11 November In Geneva, at the Palais des Nations, there is a symposium on *Moving Beyond Treaty Regimes: The UNMOVIC Model*, which is being sponsored by the American Scientists Working Group on Biological and Chemical Weapons. Making presentations are Frank Ronald Cleminson, UNSCOM Commissioner, and former Senior Advisor on Verification for the Canadian Department of Foreign Affairs; and Kay Mereish, head of UNMOVIC's Biological Planning Operations, and former UNSCOM biological weapons inspector.[170]

11 November At the New York Academy of Sciences, there is a symposium on *National Security and Biological Research: Where are the Boundaries?* Participants debate the changing relationships between science and law enforcement, and major initiatives to preserve scientific integrity whilst maintaining security interests, thereby facilitating better cooperation between scientists and government agencies. There is a consensus that regulations and institutional policies, as well as oversight from funding agencies, are already affecting laboratories involved in sensitive research.[171] Ronald Atlas, co-director of the Center for the Deterrence of Biowarfare and Bioterrorism at the University of Louisville, Kentucky, and former president of the American Society of Microbiology says: 'We need to take a bottom-up approach—looking at what we're doing and deciding how we, as scientists, can best protect society while preserving scientific integrity.' He endorses the recently released National Research Council (NRC) report *Biotechnology Research in an Age of Terrorism*—also known as the Fink Report—which concluded that existing regulations and self-monitoring by scientists are sufficient to protect against misuse of

[169] Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, doc no BTWC/MSP/2003/4 (Vol.I), 26 Nov 2003, *Report of the Meeting of States Parties, Vol I*, First Meeting Geneva, 10-14 Nov 03..

[170] Invitation notice, 11 Nov 03, 'Moving Beyond Treaty Regimes: The UNMOVIC Model'.

[171] M.Larkin, New York Academies of Science, web site, as posted at: http://www.nyas.org/ebriefreps/main.asp?intSubsectionID=550, 12 Jan 04, 'National Security and Biological Researsh: What are the Boundaries?—Overview';

research findings by 'hostile individuals'.[172] However, Elisa Harris, senior research scholar at the Center for International and Security Studies at Maryland (CISSM), says that the NRC approach has a number of 'shortcomings'. Harris—who together with her colleagues at CISSM has been involved in the development of a biological research security system—says there is a need for national licensing of researchers and institutions involved in potentially dangerous research; a global, rather than US-based regulatory scheme; and more powers of enforcement as opposed to guidelines. Other speakers address the difficulties in deciding whether to publish research that might be useful to bioterrorists, and the importance of a team approach—researchers working with public health officials and law enforcement—in identifying and containing potentially harmful outbreaks. William Zinnakis, Weapons of Mass Destruction Coordinator for the FBI's New York office says that academic researchers need to 'come out of their ivory towers' and be more aware of the possible real-world consequences of their work.[173]

15 November The US Central Intelligence Agency releases a document (dated 3 November 2003)[174] compiled by a panel of life-science experts—for the Strategic Assessment Group—warning that recent advances in biotechnology could give life to 'designer' biological weapons. Such weapons, the document says, could be made to target selected groups of people, to activate after a given period of time has elapsed, and to be activated by subsequent prophylaxis. The meeting of the experts was held in private at an undisclosed location and was organized by the National Research Council of the National Academy of Sciences at the behest of the CIA. The object of the meeting was to devise strategies for dealing with the dangerous by-products of the so-called 'genomic revolution'. The document warns, 'the effects of some of these engineered biological agents could be worse than any disease known to man', and that explosive growth in knowledge about genes and their functions could make traditional means of monitoring weapons of mass destruction obsolete, e.g., by the use of binary biological agents. 'A particularly insidious example would be a mild pathogen that when combined with its antidote becomes virulent,' it says. The document cites, as an example, the possibility of designing a virus which, acting alone, would cause flu-like symptoms but that would turn deadly when its target takes an aspirin with the intention of relieving a headache. Other 'designer' biological weapons could be created to resist antibiotics, evade an immune response and permanently destroy a person's genetic make-up, according to the panellists.[175]

17–18 November In Como, Italy, the Landau Network-Centro Volta and the Russian-American Nuclear Advisory Council (RANSAC) convene a conference on *Building a Global Agenda for Bio Proliferation Prevention: Current Status and Future of Russian Biotechnology*. The conference brings together US, European, Russian and other former Soviet experts from government, international organizations, NGOs, industry and academia. The purpose of the conference is to debate the issues and assess the feasibility and potential scope of an intensified global approach to

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[172] R.Atlas, PowerPoint presentation, as posted at: http://roundtable.healthsafe.uab.edu/pages/resources/nationalsecurityandbio.ppt, 'Biotechnology research in an age of terrorism: Confronting the dual-use dilemma'

[173] M.Larkin, Reuters Health, 12 Nov 03, 'Need to regulate 'dangerous' research debated'.

[174] Reuters, as appearing at: http://english.aljazeera.net, 15 Nov 03, ''Darker bioweapons future' forecast'.

[175] US Central Intelligence Agency, doc: OTI SF 2003-108 (Unclassified), 3 Nov 03, 'The darker bioweapons future'.

bio-threat-reduction in Russia and the former Soviet states. Eight months subsequently, RANSAC releases *Advancing Bio Threat Reduction: Findings from an International Conference*, which summarizes the proceedings of the conference, and sets out a list of ten findings which, in the opinion of RANSAC, require future consideration.[176]

24 November In Washington DC, an EU-US conference on *Transatlantic Co-operation on Combating Bioterrorism* is organized under the auspices of the Italian EU presidency by the Embassy of Italy and the US Departments of State and Health & Human Services. A subsequent private account of the proceedings includes the following: 'One of the most striking issues that became evident during the conference was the difference in approach taken by Europe and the US to the threat of bioterrorism. The likelihood of a bioterrorist attack is remote but the consequences could be catastrophic. It would appear that Europe is more focused on the former aspect, whereas the US is focusing on the latter. Therefore either Europe is under-prepared or the US is very over prepared for a potential attack. The truth probably lies in the middle. Of course the anthrax attacks that took place in the US just after 9/11, and which have spurred the huge growth in interest in this area, have no equivalent in Europe, which goes some way to explaining the difference in approach. Nevertheless, it should be remembered that, contrary to initial speculation, the most likely source of the anthrax used in the US attacks was domestic […] The view of the participants was that this conference was a positive first step and there is a clear interest for transatlantic R&D co-operation. As the SARS outbreak showed, microbes cannot be tackled by one country alone; it takes an international approach. The issue of risk assessment and communication is a crucial one also. It seems that it is difficult to carry out a meaningful risk assessment since there are so few examples of deliberate release of infectious agents. The objective of bioterrorism is terror to frighten a population into submission. As one of the participants asked -- how do you find the balance between hyping the probability of a bioterrorist attack to obtain more funds and instilling unreasonable fear in people and thereby helping the enemy achieve their objectives? A follow-up conference was announced for 2004, to be hosted by the European Parliament.'[177]

25 November The UK and France, with help from Russia, Canada and the European Union, are working on a way to convert UNMOVIC into an international inspection team for biological weapons and missiles, according to the Associated Press, quoting unidentified diplomats and UN officials. The USA is, however, said to oppose the idea along with some other states such as Pakistan and Syria. 'We think the Iraq experience has helped Americans recognize the potential utility of having someone other than themselves do this kind of work,' said one senior Western diplomat. 'The costs are high, the work is hard and even Congress has said the UN inspectors had some better intelligence than the CIA did'. Details of the initiative were discussed on 23 October during a meeting of the UN General Assembly's First Committee on Disarmament and International Security and are loosely based on a declaration by the European Union on weapons of mass destruction. Some countries, including Britain, have suggested a possible name change and relocating UNMOVIC from New York

[176] RANSAC, *Advancing Bio Threat Reduction: Findings from an International Conference*, released July 2004.

[177] Personal communication, 12 December 2003.

to Vienna where the IAEA is based. Pakistan and Syria, in opposing the idea, argue that UNMOVIC was created to deal with Iraq and that it should now be disbanded.[178]

December 2003

2–6 December In Geneva, during the 28th International Conference of the ICRC there takes place a workshop on Biotechnology, Weapons and Humanity. The workshop analyses the risks posed by the advances being made in the life sciences; identifies steps that could be taken to prevent their use for hostile purposes, including greater awareness and support for the ICRC initiative on biotechnology, weapons and humanity; and addresses the need to establish effective controls and national implementation measures to ensure that weapons were in conformity with international humanitarian law.[179]

3–4 December The US National Institute of Allergy and Infectious Diseases (NIAID) sponsors a workshop in Bethesda on *Aerosol Challenge Technology and Applications in Biodefense*. The presentations, including ones from Fort Detrick and Porton Down, are later posted on the NIAID website.[180]

11 December Sweden announces that it is to finance a new, independent, International Commission on Weapons of Mass Destruction, to be headed by former Executive Chairman of UNMOVIC Hans Blix. The Swedish government has committed the equivalent of EUR 1.4 million to the Commission, which is set to spend the next two years working on ways of limiting the proliferation of chemical, biological and nuclear weapons.[181]

11 December *Nature* magazine carries a news feature on problems being created by the huge influx of funding into US biodefence research: some $1800 million has been allocated by the National Institute of Allergy and Infectious Diseases (NIAID) alone since October 2001. The influx has 'allowed scientists … to pursue work that should make the world a safer place', but 'signs of trouble in the biodefence bonanza' are visible. The feature's introduction continues: 'Some researchers fear that it will distort priorities in infectious-disease research, sucking money away from work to understand and counter natural disease outbreaks that ultimately pose a greater threat to public health. Experts in weapons proliferation, meanwhile, are concerned that the expansion of labs working on potential bioweapons agents will increase the risk of these pathogens getting into terrorists' hands. And many microbiologists are confused and worried by the regulatory framework put in place to reduce this risk—they now fear being dragged through the courts by overzealous fed-

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[178] D.Linzer, AP, as posted at: www.washingtonpost.com, 25 Nov 03, 'AP: Britain, France secretly plan agency'.

[179] International Committee of the Red Cross, Biotechnology, 6 Dec 03, as posted at: http://www.icrc.org/Web/Eng/siteeng0.nsf/iwpList515/59C850428D1D1B2AC1256E..., 'Weapons and Humanity (workshop 4), 28th International Conference of the Red Cross and Red Crescent, Geneva, 2 to 6 December 2003'.

[180] <www2.niaid.nih.gov/biodefense/research/aerosol.htm>.

[181] AFP, as posted at: lexisnexis@prod.lexisnexis.com, 0953 ET 11 Dec 03, 'Blix is back as head of new commission on weapons of mass destruction'.

eral investigators over an innocent administrative slip-up. Indeed, these worries have been stoked to fever pitch by the prosecution, for alleged breaches of biosafety regulations, of plague researcher Thomas Butler.' The article goes on to review the main items of NIAID biodefence expenditure.[182]

19 December Libya announces that—after negotiations between itself and the UK and USA—it is to abandon all of its weapons of mass destruction programmes.[183] At a press briefing in Washington later in the day, an unidentified 'senior Bush administration official' speaks of events that had led up to the Libyan announcement. The official says that teams of British and US intelligence experts had visited Libya in October and early December and had been given access to many sites. They had found the CW programme to be the most advanced of the Libyan WMD programmes. As for biological weapons, the official states: 'Libya admitted to past intentions to acquire equipment and develop capabilities related to biological weapons. At the team's request, Libya took our experts to a number of medical- and agriculture-related research centers that have dual use potentials to support BW-related work. The team was given access to scientists at these facilities, and Libya has committed not to pursue a biological weapons program and to accept the necessary inspections and monitoring to verify that undertaking.'[184] In other press contacts, US officials say, so the *Washington Post* reports, that British and US scientists had found no concrete evidence of an existing biological weapons effort'. The *Post* continues: 'They questioned the Libyans about equipment and research that could be applied to the production of germ warfare, but the Libyans denied that such a program had ever existed'.[185]

January 2004

28 January In London, Lord Hutton's report into the circumstances surrounding the death of Dr David Kelly is delivered to the Secretary of State for Constitutional Affairs and published.[186] There is widespread surprise at the decisiveness which with Lord Hutton exonerates the Government and with which he criticizes the BBC.

30 January In Geneva, there is an International Committee of the Red Cross (ICRC) Meeting with States on a Ministerial-level Declaration in Support of the BTWC, tentatively entitled *On Preventing the Misuse of the Life Sciences for Hostile Purposes*. The aim of the meeting, hosted by ICRC President Jakob Kellenberger, is to begin a process to draft a ministerial level declaration, and follows on from the

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[182] Erika Check (from Washington), *Nature* (London), vol 426, pp 598-601, 11 Dec 03, 'Boom, or bust?'.

[183] BBC (internet version), 0011 hrs GMT 20 Dec 03, 'Libyan WMD: Tripoli's statement in full: Announcing its decision to abandon its weapons of mass destruction, Libya issued the following statement'.

[184] A transcript of the press briefing is published by US Dept of State, International Information Programs, 'White House hails Libyan decision to dismantle weapons program', 19 December 2003, as posted at http://usinfo.state.gov/topical/pol/terror/texts/03121924.htm, accessed 5 Jan 04.

[185] Peter Slevin and Walter Pincus, *Washington Post*, 21 Dec 03, p A01, 'Libya made progress in nuclear goal'.

[186] UK, The Hutton Inquiry, *Report of the Inquiry into the Circumstances Surrounding the Death of Dr David Kelly CMG*, HC 247, order by the House of Commons to be printed 28 January 2004, as posted on the internet at <www.the-hutton-inquiry.org.uk/content/report/index.htm>.

launch of the ICRC's Appeal on Biotechnology, Weapons and Humanity. The first drafting meeting with States will be held on 27th February.

In his statement to the meeting, Kellenberger says: 'For many years, practical efforts to prevent hostile use of the life sciences have been viewed by many not as universal responsibilities, but as something arranged by government experts at the Palais des Nations in Geneva. Although such efforts are essential, there has been a certain lack of urgency to effectively reduce the risk of hostile use. High-level political understanding and commitment has been fleeting, at best. We need to turn this situation around. The stark truth is that broader and deeper commitment is needed at a senior political level to tackle the difficult challenges involved in reducing the risk of hostile use of the life sciences. And, political leaders need to engage science and industry in this effort if preventive measures are to be successful. That's why the ICRC proposed a Ministerial level Declaration. It's clear that the Ministerial level Declaration and its preparatory process could (and should) reinforce efforts in the Biological Weapons Convention process. This understanding was well reflected in the Agenda for Humanitarian Action adopted by the 28th International Conference of the Red Cross and Red Crescent last December, including by all States party to the Geneva Conventions represented at the Conference. This exercise is not—and must not—become a parallel exercise to the Biological Weapons Convention. With this in mind, the question we have asked ourselves—and which we urge your authorities to consider—is the following: Is the BTWC expert process more or less likely to succeed if it's accompanied by a high level affirmation of its noble purpose, and increased ministerial attention is paid to the challenges that the BTWC regime faces? Our proposal is for a short, politically binding document to be adopted by Ministers at a well-publicised side-event during the 2004 UN General Assembly that would reaffirm existing international law norms, recognise the challenges they face and commit States to a range of preventive actions.'[187]

February 2004

3–4 February In Brussels, the European Commission hosts a conference on the ethical implications of research on bio-weapons and prevention of bio-terrorism in the context of research to develop vaccines and drugs designed to mitigate the effects of a biological attack. Discussion also focuses on ethical concerns, both in terms of the ultimate applications of such research and the methods used to validate the products. Participants include Professor Emilio Mordini, the coordinator of an EU funded project on the bioethical implications of globalisation; Dr Charles Penn, from the UK Centre for Applied Microbiology and Research; and Professor Reidar Lie, from the University of Bergen in Norway. Participants concur that even in the case of classified bio-defence research, the ethical standards that govern human medical trials should still apply. Moreover, it is noted that according to the Council of Europe's convention on human rights and biomedicine, even if a country is facing war or conflict, the defence of its economic well-being, or a threat to national security, no exceptions are granted to these standards. Most participants agree on the necessity of

[187] International Committee of the Red Cross, 30 Jan 04, Official Statement by Jakob Kellenberger: International Committee of the Red Cross (ICRC) Meeting with States on a Ministerial level Declaration in Support of the 1972 Biological Weapons Convention, tentatively entitled *On Preventing the Misuse of the Life Sciences for Hostile Purposes*

maintaining an international dialogue on the issue in order to make any progress, and felt that discussions such as these would help to answer the challenges posed by this most scientific form of modern warfare.[188] A detailed report on the conference is later published by its sponsor, Directorate E (Biotechnology, Agriculture and Food Research) of the Commission's Research DG.[189]

9–20 February In Kuala Lumpur, States Parties to the 1992 Convention on Biological Diversity agree—during the Seventh Meeting of the Conference of State Parties—to establish a Programme of Work on Technology Transfer and Co-operation, which will include consideration of systems that 'present obstacles that impede transfer of relevant technologies from developed countries', a reference to, amongst other things, the Australia Group. Under the Programme of Work, the Secretariat of the Convention, working with a regionally-balanced group of experts, will prepare informational and technical studies of developed-country obstacles to technology transfer, such as export controls.[190]

26 February Azerbaijan accedes to the BTWC, thereby becoming—in thirty days—the 152nd party thereto.[191]

March 2004

4 March US Department of Health and Human Services (DHHS) Secretary Tommy Thompson announces the creation of the National Science Advisory Board for Biosecurity (NSABB). This follows last year's recommendation by the National Research Council Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology, chaired by Gerald Fink, that an advisory board be created given the potential misuse of the 'tools, technology or potential knowledge base of research for offensive military or terrorist purposes'. Managed by the NIH and advising the DHHS, the National Institutes of Health (NIH) and all federal departments and agencies conducting or supporting life sciences research, the NSABB will specifically:

> i. advise on strategies for local and federal biosecurity oversight for all federally funded or supported life sciences research;
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> ii. advise on the development of guidelines for biosecurity oversight of life sciences research and provide ongoing evaluation and modification of these guidelines as needed;

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[188] Cordis news service, 5 Feb 04, 'Assessing the ethical implications into the prevention of bioterrorism'.

[189] Line Matthiessen-Guyader (editor), *Report* [on Conference on *Ethical Implications of scientific research on bioweapons and prevention of bioterrorism*, Brussels, 3-4 February 2004], European Commission, DG Research, Directorate E, July 2004

[190] Convention on Biological Diversity, Technology Transfer and Cooperation, as posted at: http://www.biodiv.org/programmes/cross-cutting/technology/default.asp, last updated 31 Mar 04; The Sunshine Project, news release, as posted at: www.sunshine-project.org, 21 Feb 04, 'New talks: Technology transfer, biodiversity and security'.

[191] United Nations Department of Disarmament Affairs, as posted at: http://disarmament.un.org:8080/TreatyStatus.nsf, 'BTWC (in chronological order by deposit)', web site accessed on 27 September 2004.

iii. advise on strategies to work with journal editors and other stakeholders to ensure the development of guidelines for the publication, public presentation and public communication of potentially sensitive life sciences research;

iv. advise on the development of guidelines for mandatory programs for education and training in biosecurity issues for all life scientists and laboratory workers at federally funded institutions; and

v. provide guidance on the development of a code of conduct for life scientists and laboratory workers that can be adopted by federal agencies as well as professional organizations and institutions engaged in the performance of life sciences research domestically and internationally.[192]

John Gordon, the President's special assistant for homeland security, says the new initiative would not directly regulate scientific research. 'Our response must be carefully measured lest we do more harm than good in the name of biosecurity, and lest we somehow stifle the needed research that is so important to all of us,' says Gordon. 'Heavy-handed government regulation isn't the answer, but I think there is a very appropriate government role,' he adds.[193]

10 March In the US Senate, Armed Services Subcommittee on Emerging Threats Capabilities conducts a hearing on *The Defense Nuclear Nonproliferation Programs of the Department of Energy and the Cooperative Threat Reduction Programs of the Department of Defense in Review of the Defense Authorization Request for Fiscal Year 2005*. Deputy Under-Secretary of Defense for Technology Security Policy and Counterproliferation Lisa Bronson is one of two witnesses testifying before the committee. Of the CTR programme in Russia, she says: '[W]e estimate that there are approximately 40 institutes that were part of the Soviet biological weapons program. These institutes often contain extensive collections of dangerous pathogens. They face threats from within: underemployed experts, and from without: poorly secured facilities and weak inventory controls. We address this former Soviet BW threat by balancing carefully the risks of proliferation against Russia's compliance with international commitments… In the area of biological weapons proliferation, we have asked the Russians to go ahead and sign with us a specific BW implementing agreement. The BW area is the only area where we don't have a specific implementing agreement. To date, the Russians have been intransigent and will not go ahead and sign that agreement. We are unable to go ahead and pursue additional funding to biological weapons proliferation issues with Russia until we get better assurances concerning their BW compliance.'[194]

The next day, Deputy-head of the Russian Munitions Agency Valery Spirande rejects Bronson's claims thus. 'This is an old song. The United States attributes all of our medical institutions that work with pathogenic organisms to facilities that allegedly worked with weapons in the past. We need these pathogenic or-

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[192] US Department of Health and Human Services, press release, as posted at: http://www.hhs.gov/news/press/2004pres/20040304.html, 4 Mar 04, 'HHS Will Lead Government -Wide Effort to Enhance Biosecurity in 'Dual Use' Research'

[193] Marina Malenic, Global Security Newswire, as posted at: www.nti.org, 5 Feb 04, 'New board to advise US scientists on dual-use research'.

[194] US Federal News Service, Hearing of the Emerging Threats and Capabilities Subcommittee of the Senate Armed Services Committee, The Defense Nuclear Nonproliferation Programs of the Department of Energy and the Cooperative Threat Reduction Programs of the Department of Defense in Review of the Defense Authorization Request for Fiscal Year 2005, 10 Mar 04.

ganisms to make vaccines, diagnostic, preventive and medical preparations. They have nothing to do with weapons… An official statement to this effect has been made at the United Nations. We supply information about facilities to international organizations every year. Such facilities are well known, and there is nothing secret about them.'[195]

16–18 March In Geneva, the World Health Organization hosts a meeting to consider global preparedness for a possible future influenza pandemic. The purpose of the meeting is to assess the current situation and to analyse possible public health interventions before and during an influenza pandemic. WHO Director-General Lee Jong-wook says: 'As long as avian and human flu viruses are circulating in the environment, the ingredients for a human pandemic still exist. When the next pandemic emerges, we will be able to respond properly only if we prepare properly'.[196]

25 March The Office of Inspector-General of the US Department of Health and Human Services issues a *Summary Report on Select Agent Security at Universities* which reveals 'serious weaknesses' compromising select agent security at all 11 universities reviewed.[197] In early 2002, the OIG had initiated a programme to review select agent security at 11 unidentified universities that received National Institutes of Health funding for research involving select agents. The objectives of the review were to assess: physical security at the locations where select agents were used, stored, or planned to be used or stored; compliance with the select agent transfer regulation; controls over select agent access by 'restricted persons' as defined by the USA PATRIOT Act; and controls over information technology resources that process, store, or transmit select agent information.

The report states: 'Serious weaknesses compromised the security of select agents at all universities reviewed. Physical security weaknesses at all 11 universities left select agents vulnerable to theft or loss, thus elevating the risk of public exposure. Inadequate inventory and record-keeping procedures at all 11 universities prevented us from concluding that universities had complied with select agent transfer requirements. In the area of restricted persons, at least half of the universities had inadequate procedures to identify persons barred from accessing select agents under the USA PATRIOT Act. Finally, at five universities that used information technology resources for select agent data, we noted control weaknesses that could compromise the security and integrity of that data.'

The OIG issued individual reports to each university reviewed containing recommendations with which the universities generally agreed and have begun to implement, although this has not been verified by OIG. The report notes that new requirements regarding select agent security were introduced by the *Public Health Security and Bioterrorism Preparedness and Response Act of 2002* after the field-

[195] Interfax-AVN military news agency (Moscow) from Moscow in English, 1204 hrs GMT 11 Mar 04, as transcribed in BBC-WWM, 11 Mar 04, 'Russian official denies biological facilities unsafe'.

[196] World Health Organization, 12 Mar 04, press release, 'World Health Organization to host influenza pandemic preparedness meeting'; UN Wire, 19 Mar 04, 'WHO warns world is ill-prepared for inevitable flu pandemic'; Reuters from Geneva, 16 Mar 04, 'Experts warn of possible human flu pandemic'; BBC News Online, 1934 hrs GMT 18 Mar 04, 'Prepare for flu pandemic, says UN'

[197] Mark Sherman for AP from Washington, as in *Boston Globe* (internet edition), 20 Apr 04, 'Fed inspectors find lax security at university labs'; Global Security Newswire, 26 Apr 04, 'Weak security found at US university biological laboratories'.

work was completed. It states that OIG will conduct further university reviews in 2004 to assess compliance with these new requirements.[198]

26 March In Brussels, the European Commission adopts a working paper on *Community Influenza Pandemic Preparedness and Response Planning*.[199] The introduction to the paper says that it 'should serve as a launchpad for a debate on co-ordinating preparedness against influenza and on recommendations that can be made in this respect. This will be done in parallel with the development of a general plan for public health emergencies that the Health Ministers requested following the SARS outbreak, and will provide the basis for a specific component of this general plan in order to fine-tune measures in respect of an influenza pandemic.'[200]

28 March US claims that Iraq possessed mobile biological weapons production facilities were based mainly on intelligence from a now-discredited Iraqi defector code-named 'Curveball', so the *Los Angeles Times* reports.[201] US officials did not have direct access to the defector as he was an asset of the *Bundesnachrichtendienst* (BND), the German Federal Intelligence Service, whom he had approached after arriving in Germany as a refugee in 1998. The newspaper reports that 'Curveball', a young chemical engineer and a brother of one of Ahmed Chalabi's top Iraq National Congress aides, was probably coached to provide false information confirming existing Western suspicions that Iraq had mobile BW production facilities. He first came to the attention of Western intelligence after UNSCOM inspectors had asked Chalabi to help search for intelligence on suspected mobile facilities. 'Curveball' told the BND that he was the head of the mobile laboratory programme and gave seemingly credible details of the programme during his debriefing sessions. However, after his staff visited 'Curveball's' family and workplaces in Baghdad, then leader of the Iraq Survey Group, David Kay, came to the conclusion that the informant was an 'out-and-out fabricator'.[202]

Later, unidentified security sources in Germany reject the allegations that they provided false information that may have contributed to the case for the invasion of Iraq. They claim that they informed the CIA of their concerns about 'Curveball's' credibility as early as August 2002 and that they had 'various problems' with his account, which they had shared with the US long before Colin Powell's presentation to the UN Security Council in February 2003.[203] Later still, it

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198 US, Department of Health and Human Services, Office of Inspector-General, 25 Mar 04, *Summary Report on Select Agent Security at Universities*, A-04-04-02000, as posted at: <http://oig.hhs.gov/oas/reports/region4/40402000.pdf>.

199 European Union, Commission of the European Communities, 31 Mar 04, press release IP/04/432, 'Influenza—and how the EU should respond to a pandemic'.

200 European Union, Commission of the European Communities, 26 Mar 04, *Commission Working Paper on Community Influenza Pandemic Preparedness and Response Planning*, as posted on the internet at <http://europa.eu.int/comm/health/ph_threats/com/Influenza/com_2004_201_en.pdf>.

201 Bob Drogin and Greg Miller, *Los Angeles Times* (internet edition), 28 Mar 04, 'Iraqi defector's tales bolstered US case for war'.

202 Bob Drogin and Greg Miller, *Los Angeles Times* (internet edition), 28 Mar 04, 'Iraqi defector's tales bolstered US case for war'; Andrew Gumbel from Los Angeles, *The Independent* (London), 29 Mar 04, p 24, 'Iraqi defector behind America's WMD claims exposed as out-and-out fabricator''; Jonathan S Landay and Drew Brown for Knight Ridder, as in *San Jose Mercury News*, 4 Apr 04, p 18, 'Bioweapons statements linked to Iraqi exile group'.

203 Jochen Bittner, *Die Zeit* (Hamburg) (internet edition), 1 Apr 04, 'Der Bumerang-Spion'; Luke Harding from Berlin, *The Guardian* (London), 2 Apr 04, 'Germans accuse US over Iraq weapons claim'; *Der Spiegel* (Hamburg), 5 Apr 04, as translated from the German in BBC-WWM, 6 Apr 04, 'Magazine: Did false German

is reported that the CIA and DIA are each blaming the other for the handling of 'Curveball'.[204]

April 2004

2 April US Secretary of State Colin Powell, during a press briefing en route from Europe to Washington DC, casts doubt upon the intelligence behind his assertion to the UN Security Council that Iraq possessed mobile BW production facilities.[205]

5 April Al-Qaeda attention to CBW weapons has been the subject of an investigation by the US weekly *Newsweek*.[206]

7 April In Johannesburg, the BioWeapons Prevention Project (BWPP) organizes a regional seminar on international networking. Its general purpose is to inform southern African non-governmental organizations about BWPP and its goals and to introduce the principles upon which the organization has been established. More specifically, the meeting identifies the areas of overlap between the goals of southern African NGOs and those of the BWPP and explores opportunities for collaboration. Participating in the seminar are representatives from the African Centre for Biosafety (South Africa), Catholic Commission for Justice and Peace (Zimbabwe), Centre for Conflict Resolution (South Africa), Centre for Human Rights and Rehabilitation (Malawi), Institute for Security Studies (South Africa), International Physicians for the Prevention of Nuclear War (Zambia), Safer Africa (South Africa), South African Institute for International Affairs (South Africa), South African Police Service (South Africa) and Transformation Resource Centre (Lesotho).[207]

15 April The deadline for the submission to the UN Department for Disarmament Affairs of the 2004 returns under the confidence-building measures agreed by BTWC states parties in 1987. For the first time, the US return is posted on the internet, as was Australia's 2002 return.[208]

19 April In London, the Royal Society, which is the British national academy of science, releases a report on *The Individual and Collective Roles Scientists Can Play*

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information contribute to outbreak of Iraq war?'; Friedrich Kuhn for DDP from Washington, 1150 hrs GMT 6 Apr 04, as translated from the German in BBC-WWM, 6 Apr 04, 'German intelligence 'not amused' by CIA allegations over Iraqi WMD'.

[204] Global Security Newswire, 13 Apr 04, 'CIA, DIA trade blame over handling of 'Curveball''.

[205] US, Department of State, 2 Apr 04, 'Press briefing en route to Washington'; Christopher Marquis from Washington, *The New York Times* (internet edition), 2 Apr 04, 'Powell blames CIA for error on Iraq mobile labs'; Glenn Kessler, *The Washington Post*, 3 Apr 04, p A19, 'Powell expresses doubts about basis for Iraqi weapons claims'; Nicholas Kralev, *The Washington Times*, 3 Apr 04, p A6, 'Powell recants UN statement on Iraq mobile labs'; David Rennie from Washington and George Jones, *The Daily Telegraph* (London), 5 Apr 04, p 4, 'Powell casts doubt on his WMD intelligence'; Global Security Newswire, 5 Apr 04, 'Iraqi mobile biological facilities claims may be wrong, Powell says'.

[206] Mark Hosenball, *Newsweek*, vol 143 no 5 (12 April 2004) p 8, 'Al Qaeda and anthrax'.

[207] BioWeapons Prevention Project, [undated], seminar report no 2, 'International networking to prevent the misuse of biology for hostile purposes'.

[208] US, Department of State, 15 Apr 04, 'Report of the United States of America to the United Nations Department for Disarmament Affairs', as posted on the internet at <www.state.gov/documents/organization/32486.pdf>.

in Strengthening International Treaties.[209] In the paper, to be presented at an experts' roundtable on biological threats to security later today in Washington, the Royal Society calls for the formation of an international scientific advisory panel to keep up with the rapid pace of technological advance relevant to the BTWC. It also urges the research community to 'exercise judgement in the publication of their work and raise awareness of the ethical and legal requirements related to their research.' With respect to the existing national and international legal constraints against the development of biological weapons, the paper says that consideration should be given to 'what needs to be done to strengthen such laws and how they can be built in to an enforceable code of practice.'[210]

26–27 April In Singapore, the US Office of the International Institute for Strategic Studies (IISS) and the Chemical and Biological Arms Control Institute (CBACI) co-host a meeting on *The Future of the Biotechnology Industry: Safeguarding the Opportunities and Managing the Risks* as part of a joint three-year project.[211]

28 April At UN headquarters, the Security Council unanimously adopts a resolution on the proliferation of weapons of mass destruction to non-state actors, following weeks of consultations.[212] Despite opposition from Pakistan and others, resolution 1540 is adopted under Chapter VII of the UN Charter, potentially allowing for military enforcement of its provisions. The resolution is sponsored by France, Romania, Russia, Spain, the UK and the US.

Resolution 1540 affirms that the proliferation of nuclear, biological and chemical weapons and their means of delivery constitutes a threat to international peace and security and reaffirms the Council's 1992 presidential statement on non-proliferation. All 191 UN member states are required 'in accordance with their national procedures' to 'adopt and enforce appropriate effective laws which prohibit any non-State actor to manufacture, acquire, possess, develop, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery, in particular for terrorist purposes'. All member states are additionally required to 'take and enforce effective measures to establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate controls over related materials'. Only for the purposes of the resolution, 'related materials' are defined as 'materials, equipment and technol-

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[209] Royal Society, 19 Apr 04, media release, 'Research should be vetted to prevent biological weapons development'; BBC News Online, 1318 hrs GMT 19 Apr 04, 'Caution urged over bio research'; Chris Schneidmiller from Washington for Global Security Newswire, 19 Apr 04, 'Group calls for BTWC monitoring panel'; David Firn, *Financial Times*, 19 Apr 04, p 9, 'Royal Society to seek watchdog for bio-weapons'; Jamie Wilson, *The Guardian* (London) (internet edition), 22 Apr 04, 'Preventing test-tube terrorism'; Alok Jha, *The Guardian* (London) (internet edition), 23 Apr 04, 'Science with responsibility'.

[210] Royal Society, 19 Apr 04, 'The individual and collective roles scientists can play in strengthening international treaties', as posted on the internet at <www.royalsoc.ac.uk/files/statfiles/document-256.pdf>.

[211] AFP from Singapore, 28 Apr 04, 'Biological weapons threat spurs need for ethics code in life sciences'; Global Security Newswire, 29 Apr 04, 'Experts call for better security in the life sciences'.

[212] UN, Security Council, document S/RES/1540 (2004) dated 28 April 2004; Anton La Guardia, *The Daily Telegraph*, 29 Apr 04, 'UN moves to prevent spread of WMD black market'; Susannah Price for BBC News Online from New York, 0010 hrs GMT 29 Apr 04, 'UN bans WMD sales to terrorists'; Warren Hoge, *The New York Times* (internet edition), 29 Apr 04, 'Ban on weapons of doom is extended to Qaeda-style groups'; Maggie Farley, *Los Angeles Times* (internet edition), 29 Apr 04, 'UN approves resolution to curb spread of illicit arms'; Jim Wurst from New York for Global Security Newswire, 29 Apr 04, 'UN Security Council approves WMD resolution'; US, Department of State, press release, 29 Apr 04, 'UN Security Council unanimously approves WMD ban'; Colum Lynch, *Washington Post*, 29 Apr 04, p A21, 'Weapons transfers targeted'.

ogy covered by relevant multilateral treaties and arrangements, or included on national control lists, which could be used for the design, development, production or use of nuclear, chemical and biological weapons and their means of delivery.' The resolution also establishes a Security Council Committee made up of all Council members to report on its implementation. States have to submit a first report on steps taken or planned to implement the resolution nationally within six months. The resolution stresses that none of its obligations 'shall be interpreted so as to conflict with or alter the rights and obligations of State Parties to the Nuclear Non-Proliferation Treaty, the Chemical Weapons Convention and the Biological and Toxin Weapons Convention or alter the responsibilities of the International Atomic Energy Agency or the Organization for the Prohibition of Chemical Weapons'. The resolution also grants a degree of legitimacy to the Proliferation Security Initiative (PSI) by calling upon states, 'in accordance with their national legal authorities and legislation and consistent with international law, to take cooperative action to prevent illicit trafficking in nuclear, chemical or biological weapons, their means of delivery, and related materials'.[213]

28 April In Washington DC, at a joint press briefing Secretary of Health and Human Services Tommy Thompson, Secretary of Homeland Security Tom Ridge and Deputy Secretary of Defence Paul Wolfowitz unveil unclassified details of Homeland Security Presidential Directive 10, entitled *Biodefense for the 21st Century*.[214] President George Bush had signed HSPD-10 on 21 April, following a 10-month review of national biodefence initiatives by the Homeland Security Adviser, John Gordon.[215] According to a White House fact sheet, the classified directive 'builds on past accomplishments, specifies roles and responsibilities, and integrates the programs and efforts of various communities—national security, medical, public health, intelligence, diplomatic, agricultural and law enforcement—into a sustained and focused national effort against biological weapons threats.' The directive outlines four pillars of the US biodefence programme: Threat awareness; Prevention and protection; Surveillance and detection; and Response and recovery.[216] The plan calls for the Department of Homeland Security to undertake a national risk assessment every two years on new biological threats and to perform a 'net assessment' of biodefence effectiveness and vulnerabilities every four years.[217]

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[213] UN, Security Council, document S/RES/1540 (2004) dated 28 April 2004.

[214] US, White House, Office of the Press Secretary, 28 Apr 04, press briefing transcript, 'Media briefing with Secretary of Homeland Security Tom Ridge; Secretary of Health and Human Services Tommy Thompson; and Deputy Secretary of Defense Paul Wolfowitz'.

[215] AP from Washington, 1315 hrs EDT 27 Apr 04, 'Bush approves presidential directive on biodefense'; Judith Miller, *The New York Times*, 28 Apr 04, p 17, 'Bush issues directive to bolster defense against bioterrorism'.

[216] US, White House, Office of the Press Secretary, 28 Apr 04, 'President Bush signs biodefense for the 21st century'.

[217] Judith Miller, *The New York Times*, 28 Apr 04, p 17, 'Bush issues directive to bolster defense against bioterrorism'.

May 2004

7 May In London, a roundtable—convened jointly by the International Committee of the Red Cross and the British Red Cross—on *Preventing Hostile Use of the Life Sciences* brings together around forty representatives from the UK life-science community, government agencies, industry, scientific and medical associations and academic researchers. The purpose of the meeting is to engage participants from the various sectors on the issues raised by the ICRC appeal on *Biotechnology, Weapons and Humanity*.[218]

12 May The US Department of State releases a fact sheet on the *Bio-Chem Redirect Program*, which forms part of its BioIndustry Initiative. The programme is designed to engage former Soviet biological and chemical weapons scientists in open and sustainable civilian research projects with US collaborators. Amongst other things, the fact sheet states that the programme has 'received from Congress a total of $85 million from its inception through Fiscal Year 2004'.[219]

13–14 May In London, VERTIC convenes a workshop on *Strengthening Tools and Mechanisms for Verifying BW Compliance*, which brings together around twenty participants. Topics of discussion include BTWC non-compliance scenarios; verification challenges; on-site investigations: the Trilateral experience, UNSCOM–UNMOVIC, and trial inspections; BTWC mechanisms; UN Secretary-General investigations; and alternative mechanisms for verifying compliance with BW norms.[220]

16 May US Secretary of State Colin Powell says that the intelligence upon which he based his presentation to the UN Security Council on 5 February 2003 on Iraqi possession of mobile biological weapons facilities was 'inaccurate and wrong and in some cases, deliberately misleading'. He says: '[The presentation] was based on the best information that the Central Intelligence Agency made available to me. We studied it carefully; we looked at the sourcing... There was multiple sourcing for that…'[221]

June 2004

June From the USA, researchers at the Biosecurity Center of the University of Pittsburgh Medical Center report that the US government has spent almost $14.5 billion in the years since 11 September on measures to combat bioterrorism. The report, published in *Biosecurity and Bioterrorism: Biodefense Strategy, Practice,*

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[218] International Committee of the Red Cross, as posted at: www.icrc.org, 7 May 04, 'Biotechnology weapons and humanity: ICRC outreach to the life science community on preventing the hostile use of the life sciences'.

[219] US Department of State, Bureau of Nonproliferation, as posted at: http://usinfo.state.gov/is/Archive/2004/May/12-6060.html, 12 May 04, 'Bio-Chem Program a link to former Soviet scientists: collaborative program is a targeted US-funded nonproliferation program'.

[220] VERTIC, arms control and disarmament projects, as posted at: http://www.vertic.org/programmes/BTWC_strengthen.html, 'Strengthening tools and mechanisms for verifying biological weapons compliance'; personal communication dated 21 April 2004.

[221] MSNBC News, Meet the Press with Time Russert, transcript, 16 May 04.

and Science, does not include federal spending by law enforcement agencies such as the FBI and most of the bioterrorism-prevention money spent by the Departments of Defense, Energy or Justice. Federal bioterrorism spending has increased 13-fold, from $414 million in 2001 to an estimated $5.5 billion in 2004, according to the report. Under President Bush's budget request for next fiscal year, bioterrorism spending would increase to $7.6 billion.[222]

2 June From London, the journal *Nature* reports that researchers from the New Mexico Institute of Mining and Technology have devised a way to analyse the publications of particular laboratories for signs of covert biological weapons research. The method is based on studying the networks of scientific collaborations and literature citations produced by laboratories and analysing whether the results match predetermined 'good' or 'bad' patterns. As reported in *Nature*, the researchers applied the technique to the State Research Centre for Applied Microbiology at Obolensk in Russia from the early 1970s to the mid-1990s. The researchers found that Obolensk became a very good match for the 'bad' pattern around 1980 but that its published papers converged again with the 'good' pattern after 1990. Rich Colbaugh is quoted as saying that the technique 'would increase international confidence that treaties are being respected.'[223]

2 June In Tampa, Florida, prospective Democratic presidential candidate John Kerry announces his plans to prevent bioterrorism.[224]

3 June In the USA, the Department of Homeland Security issues a notice of intent to prepare an Environmental Impact Statement for the National Biosecurity Analysis and Countermeasures Center (NBACC) at Fort Detrick. The notice states that the EIS will analyse a number of issues, including: safety of laboratory operations; public health and safety; handling, collection, treatment, and disposal of research wastes; and analysis of other risks, as well as concerns for pollution prevention and impacts of the proposed action on air quality, biological resources, cultural resources, water resources, land use, and socioeconomic resources. The EIS will also address several alternatives, including siting the proposed NBACC facility at another location on the grounds of Fort Detrick; locating the proposed NBACC facility on other existing government-owned property outside of Fort Detrick; siting the proposed NBACC facility on privately-owned property outside Fort Detrick; and a no-action alternative, under which the proposed NBACC facility would not be built. The notice of intent states that: 'The research conducted at NBACC will be solely defensive in nature, serving to understand and attribute the threats that may be used against the United States in a biological attack.'[225]

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[222] Ari Schuler, *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, vol 2 no 2 (June 2004) pp 86-96, 'Billions for biodefense: Federal agency biodefense funding, FY2001 - FY2005'; Mike Crissey for AP from Pittsburgh, 24 Jun 04, 'Researchers: Bioterrorism price tag tops $14 billion'; Global Security Newswire, 25 Jun 04, 'Bioterrorism spending at $14 billion since attacks'.

[223] Philip Ball, *Nature*, 2 Jun 04, 'Bioweapons labs outed by own research'.

[224] John Kerry for President, 2 Jun 04, 'Kerry outlines key steps to prevent bioterrorism'; Maria Newman, *The New York Times* (internet edition), 2 Jun 04, 'Kerry vows to work with allies on bioweapons ban'; Mike Nartker for Global Security Newswire from Washington, 2 Jun 04, 'Kerry outlines nuclear nonproliferation, bioterrorism prevention strategies'.

[225] USA, *Federal Register*, vol 69 no 109 (7 June 2004) pp 31830-31831, 'Department of Homeland Security, Science and Technology Directorate; Notice of intent to prepare an environmental impact statement'.

During June, criticism of the proposed activities of the NBACC's Biothreat Characterization Center is published in *Politics and the Life Sciences*. The commentary, by Milton Leitenberg of the University of Maryland, Ambassador James Leonard, the head of the US delegation to the BTWC negotiations in 1972, and Dr Richard Spertzel, a former deputy director of USAMRIID and senior UNSCOM biologist, states: 'The rapidity of elaboration of American biodefense programs, their ambition and administrative aggressiveness, and the degree to which they push against the prohibitions of the Biological Weapons Convention (BTWC), are startling. The production and stockpiling of biological-weapons agents are not the only criteria by which an offensive biological weapons (BW) program is defined. They are only such a program's most obvious terminal expressions. Taken together, many of the activities detailed above—most particularly the ''Store, Stabilize, Package, Disperse'' sequence and the ''Computational modelling of feasibility, methods, and scale of production'' item—may constitute development in the guise of threat assessment, and they certainly will be interpreted that way. Development is prohibited by the Biological Weapons Convention.'[226]

7–10 June In Paris, the Australia Group meets for its annual plenary session.[227] Reflecting the recent enlargement of the European Union, the Group welcomes five new participants (Estonia, Latvia, Lithuania, Malta and Slovenia) bringing its total membership to 38 countries plus the European Commission.

According to the press release, participants note the 'growing acceptance of Australia Group measures as the international benchmark in relation to export controls directed at chemical and biological weapons, owing in large part to the Group's ongoing outreach activities.' They therefore agree 'strategies for better targeted training and assistance, particularly at a regional level, to assist key supplier and transhipping countries and other interested countries outside the Group to enhance their export controls.' The participants also agree to consider the issue of brokering controls. The press release also states that 'the work of the Australia Group will play a key role in international efforts' to implement the recently-adopted [see 28 Apr] United Nations Security Council resolution 1540 and that 'discussions dealing with information sharing and enforcement provided clearer insights into proliferation behaviour by state and non-state actors and mechanisms for more effectively enforcing export controls.'

Participants agree to add five plant pathogens to the Group's control lists. These are two viruses (Potato Andean latent tymovirus and Potato spindle tuber viroid) and three additional bacteria (*Xanthomonas oryzae* pv. Oryzae (*Pseudomonas campestris* pv. Oryzae); *Clavibacter michiganensis* subsp. Sepedonicus (*Corynebacterium michiganensis* subsp. Sepedonicum or *Corynebacterium sepedonicum*); and *Ralstonia solanacearum* Races 2 and 3 (*Pseudomonas solanacearum* Races 2 and 3 or *Burkholderia solanacearum* Races 2 and 3)). These are the first additions to the lists of plant pathogens since 1993.

The next plenary meeting will be held in Australia in 2005 to mark the Group's twentieth anniversary.

8 June In Quito, during its ongoing thirty-fourth regular session, the General Assembly of the Organization of American States (OAS) adopts a resolution on *The*

[226] Milton Leitenberg, James Leonard and Richard Spertzel, *Politics and the Life Sciences*, vol 22 no 2 (June 2004) pp 1-2, 'Biodefense crossing the line'.

[227] Australia Group, document AG/Jun04/Press/Chair/27 dated 10 June 2004.

Americas as a Biological and Chemical-Weapons-Free Region. Under the resolution, OAS member states resolve to 'concretely fulfil the shared commitment of member states to make the Americas a region free of biological and chemical weapons' and 'reaffirm member states' commitment to arms control, disarmament, and the nonproliferation of all weapons of mass destruction', particularly the CWC, BTWC and Geneva Protocol. On the BTWC, OAS member states welcome states parties' efforts to 'promote measures for national implementation and strengthen the Convention in order to stem the threat of biological weapons.'[228]

22 June In the USA, the Council for Responsible Genetics launches a campaign for the peaceful development of the biological sciences. A petition, to which signatures are encouraged, begins: 'We, the undersigned scientists, physicians, public health specialists, corporate officers, lawyers and peace advocates, are deeply concerned by the current expansion of United States research on biological weapons agents. … We believe that the current biodefense expansion has the potential to seriously threaten public safety, international security, and the vitality of open biomedical research, and to drain scarce resources from key public health programs.' The signatories of the petition call for a moratorium on the current proliferation of new biological defence laboratories in the USA, a prohibition against the development of novel biological and toxic agents, or the modification of biological agents, to enhance virulence, pathogenicity, or transmission characteristics, for any purposes, including biological defence and a reaffirmation of commitment to the BTWC and to the Nuremberg Principles.[229]

23–27 June In Barcelona, there is a conference entitled *Towards a World Without Violence* organized by Fundació per la Pau, International Peace Bureau and Forum Universal de les Cultures Barcelona 2004. On 25 June, under the conference's disarmament strand, there are various panels including 'Containing a Shadowy Threat: Reinforcing Biological and Chemical Weapons Treaties' and 'Weapons of Mass Destruction: The Threat From States, Non-State Actors and Terrorists'. John Borrie of the ICRC speaks at the former panel and Jean Pascal Zanders of the BioWeapons Prevention Project speaks to both panels.[230]

July 2004

2 July In Jakarta, on the fourth and final day of the 37th ASEAN Ministerial Meeting, the chairman of the ASEAN Regional Forum (ARF) issues a statement on non-proliferation of WMD. The statement reads: 'ARF participants decided that they will … encourage the ARF Chair to explore with the ASEAN Secretariat, or, if established, and ARF Unit, whether it would be willing to record requests from ARF participants for assistance in implementing measures to strengthen their respective

[228] Organization of American States, General Assembly, 34th regular session, 4th plenary session, 8 Jun 04, document no AG/RES. 2000 (XXXIV-O/04), 'The Americas as a Biological and Chemical-Weapons-Free Region'; OPCW document S/439/2004 dated 21 July 2004.

[229] Council for Responsible Genetics, 22 Jun 04, 'Campaign for the Peaceful Development of the Biological Sciences', as posted on the internet at <www.gene-watch.org/Campaign/Campforpeacefulbiology.pdf>.

[230] Forum 2004, *Towards a World Without Violence* website, programme as posted on the internet at <www.dialegpau2004.org/docs/programme_english.pdf>.

WMD national authorities and other mechanisms against proliferation of WMD, their delivery systems and related materials and technologies.'[231]

6 July In Lyon, France, Interpol announces it has launched a 'comprehensive' two-year programme to counter the threat of bio-terrorism, following the award of a grant of $943,000 from the Alfred P Sloan Foundation. The aims of the programme include raising awareness of the threat from bio-terrorism among members of the international law enforcement community; developing police training programmes; and helping to strengthen the enforcement of existing legislation.[232]

14 July In Johannesburg, the BioWeapons Prevention Project (BWPP) convenes a workshop—attended by thirty-two representatives from civil society organizations and government agencies—the purpose of which is to discuss biological weapons issues pertaining to southern Africa. It marks the final stage of a six-month BWPP pilot project—funded by the Norwegian government—the purpose of which has been to initiate discussion in South Africa and other states in southern Africa on the state of the norm against biological weapons.[233]

14 July In the UK, the Butler Inquiry releases its *Review of Intelligence on Weapons of Mass Destruction*. Comprising 196 pages, it states that MI6 did not check its sources well enough, and sometimes relied on third hand reports. It also states that the government's dossier on Iraqi WMD should not have included the claim that Iraq could use WMD within 45 minutes without explaining that it was referring to battlefield munitions.[234]

19–30 July In Geneva, the second Meeting of Experts under the new process established by the 5th BTWC Review Conference takes place. Eighty-seven States Parties participate—four more than in the first such meeting—as twelve (Belarus, Bolivia, Congo, Costa Rica, El Salvador, Iraq, Mauritius, Nicaragua, Portugal, Singapore, Sudan, and Togo) participate whilst eight (Afghanistan, Benin, Bhutan, Cyprus, Ghana, Jordan, Mongolia, and Yemen) do not. Four signatory states also participate: Egypt, Madagascar, Myanmar and United Arab Emirates. Two States, Israel and Kazakhstan, participate as observers. The Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the World Organization for Animal Health (OIE) make presentations and also participate throughout the meeting on the invitation of the Chairman, Peter Goosen.[235]

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[231] ASEAN Regional Forum Statement on Non-Proliferation, Jakarta, as posted at: http://www.aseansec.org/16248.htm, 2 Jul 04,

[232] Interpol, press release, as posted at: http://www.interpol.int/Public/ICPO/PressReleases/PR2004/PR200425.asp, 6 Jul 04, 'Interpol launches police training programme on bio-terrorism: Major grant from Sloan Foundation to fund global initiative'.

[233] BioWeapons Prevention Project, *Seminar Report #3*, 14 Jul 04, 'International Networking to Prevent the Misuse of Biology for Hostile Purposes—Part 2'.

[234] Report of a Committee of Privy Counsellors, *Review of Intelligence on weapons of mass destruction*, HC898, transmitted to the House of Commons on 14 July 2004; *The Review of Intelligence on Weapons of Mass Destruction*, Press conference: Opening statement by the Chairman, the Right Honourable the Lord Butler of Brockwell, 14 July 2004, as posted at; http://www.butlerreview.org.uk/news/launchstatement.pdf.

[235] BTWC/MSP/2004/MX/3, 'Report of the Meeting of Experts to the Biological Weapons Convention', dated 11 August 2004.

The three background papers—prepared in advance by the Secretariat—on current mechanisms for disease surveillance[236] current mechanisms for response to outbreaks of disease[237] and existing mechanisms to investigate the alleged use of biological or toxin weapons and to provide assistance in such cases[238] had been circulated prior to the meeting.

Two public meetings take place on the first and last days of the session, and seventeen working sessions take place during the two-week period. During the first week—in accordance with the programme of work[239]—the experts focus on strengthening and broadening national and international institutional efforts, and existing mechanisms, for the surveillance, detection, diagnosis and combating of infectious diseases affecting humans, animals, and plants.

During the second week, attention switches to the enhancing of international capabilities for responding to, investigating and mitigating the effects of cases of alleged use of biological or toxin weapons or suspicious outbreaks of disease. Participants fail to have regard to the agreed procedures for the investigation of the alleged use of toxin weapons under the Chemical Weapons Convention; this was not mentioned in the background paper on investigations[240] nor is it mentioned in the lists of items in Annex II to the Report of the Meeting of Experts. The UK proposes updating the guidelines and procedures—last refined in 1989—to the 1982 UN General Assembly resolution[241] [see also 871130] that enables the UN Secretary-General to conduct investigations [see 870506] of alleged violations of the 1925 Geneva Protocol. The resolution, however, does not authorize the investigation of alleged development or stockpiling of biological weapons. Richard Lennane, secretary of the Meeting of Experts, describes reaction to the proposal as 'cautious'. Guy Roberts, acting head of the US delegation says the available mechanisms under the BTWC and the UN 'remain viable and that revisions to their scope or procedures are neither necessary nor appropriate.' He adds that any discussions relating thereto should in any event take place within the UN.[242]

Chairman Goosen prepares a paper listing considerations, lessons, perspectives, recommendations, conclusions and proposals drawn from the presentations, statements, working papers and interventions made by delegations on the topics under discussion at the meeting. Participants note that this paper has no status; that it had not been discussed; that it could not be considered as being complete; that the appearance of any consideration, lesson, perspective, recommendation, conclusion or proposal in the paper did not in any way indicate or imply that States Parties agreed with it; and that it should not necessarily form a basis for future deliberations. They further note, that it was the Chairman's view that the paper could assist delega-

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[236] BTWC/MSP/2004/MX/INF.1, 'Mechanisms being implemented for disease surveillance by intergovernmental organizations (WHO, FAO, OIE) and significant mechanisms being implemented for disease surveillance by non-governmental organizations', dated 1 July 2004.

[237] BTWC/MSP/2004/MX/INF.2, 'Mechanisms being implemented for response to outbreaks of disease by intergovernmental organizations (WHO, FAO, OIE)', dated 1 July 2004.

[238] BTWC/MSP/2004/MX/INF.3, 'Mechanisms available to states parties to investigate the alleged use of biological or toxin weapons and to provide assistance in such cases', dated 1 July 2004.

[239] BTWC/MSP.2004/MX/2/Rev.1, 'Revised provisional agenda of work for the meeting of experts', dated 14 Jul y 2004.

[240] BTWC/MSP/2004/MX/INF.3, 'Mechanisms available to states parties to investigate the alleged use of biological or toxin weapons and to provide assistance in such cases', dated 1 July 2004.

[241] UN General Assembly resolution A/RES/37/98, *Chemical and Bacteriological (Biological) Weapons*, 13 December 1982.

[242] Michael Nguyen, *Arms Control Today*, September 2004, 'UK proposes boosting UN bio probes'.

tions in their preparations for the Meeting of States Parties in December and in its consideration of how best to 'discuss, and promote common understanding and effective action on' the two topics in accordance with the decision of the Fifth Review Conference.[243]

21 July US President George Bush signs the *Project BioShield Act of 2004*. The Senate had finally approved the Bill in May,[244] followed last week by the House of Representatives.[245]

[243] BTWC/MSP/2004/MX/3, 'Report of the Meeting of Experts to the Biological Weapons Convention', dated 11 August 2004.

[244] Sheryl Gay Stolberg, *The New York Times* (internet edition), 20 May 04, '$5.6 billion for antiterror drugs wins passage in the Senate'.

[245] US House of Representatives Committee on Homeland Security, Chairman Christopher Cox, press release, as posted at: http://homelandsecurity.house.gov/release.cfm?id=230, 14 Jul 04, 'Chairman Cox hails final passage of Project Bioshield'.