9. Reducing security threats from chemical and biological materials

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I. Introduction

Chemical and biological warfare (CBW) prevention and response measures are evolving away from state-based CBW programmes to encompass more diffuse, less quantifiable, non-state and sometimes speculative threat scenarios—such as those involving improvised devices that contain toxic chemicals or pathogens. Actors that were traditionally on the periphery of efforts to prohibit CBW, such as public health providers, are now routinely included in threat perceptions and risk analyses.

The increasing involvement of the security sector in scientific research into the prevention of CBW has also continued to raise concern about the free pursuit and dissemination of peaceful scientific research. In the absence of effective security (e.g. bio-security) the expanded bio-preparedness research in some states may also pose an inherent threat.[1] The growing number of high-level containment laboratories and the greater range of pathogens studied are promoting the spread of potentially sensitive data and expertise. This is exacerbating the dilemma posed by the dual-purpose nature of the biological and chemical materials handled.

Section II of this chapter discusses the assessment and control of the security threats posed by chemical and biological material, the meeting of the states parties to the 1972 Biological and Toxin Weapons Convention (BTWC) and the 12th Conference of the States Parties (CSP) to the 1993 Chemical Weapons Convention (CWC).[2] Allegations of violations of these treaties and of past CBW programmes are described in section III. Past CBW activities in Iraq and the disbanding of the United Nations Special Commission on Iraq (UNMOVIC) are discussed in section IV. Developments in CBW prevention, response and remediation—including international non-proliferation and dis-

[1] This chapter uses the World Health Organization definition of bio-security: 'the principles, technologies and practices implemented to secure pathogens, toxins and sensitive technology from unauthorized access, loss, theft, misuse, diversion or intentional release'. World Health Organization (WHO), *Biorisk Management: Laboratory Biosecurity Guidance* (WHO: Geneva, Sep. 2006), <http://www.who.int/resources/publications/biosafety/WHO_CDS_EPR_2006_6/en/>.

[2] For summaries of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction and of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction see annex A in this volume.

armament assistance, bio-security and bio-safety,[3] chemical security and scientific and technological developments—are analysed in section V. The conclusions are presented in section VI. Appendix 9A addresses international public health diplomacy and the global surveillance of avian influenza.

II. The assessment and control of security threats posed by chemical and biological material

Arms control and disarmament regimes have traditionally addressed threats posed by state-run CBW programmes. Despite some uncertainty about the evaluations, the number of known and suspected programmes listed in major 'status of proliferation' reports has fallen in recent years.[4] Much of the uncertainty is due to a lack of agreement on the dividing line between offensive and defensive work and concern that offensive CBW standby capacities might be maintained under the guise of so-called protective or defence research programmes, including counterterrorism and peacekeeping programmes.[5] The difficulties in determining the difference between offensive and defensive work are also at the centre of discussions to implement effective oversight of scientific research and development (R&D) work.

Since the 11 September 2001 terrorist attacks in the United States, defence planners and analysts have placed greater emphasis on the development of threat scenarios involving non-state actors. The number of publications and reports on these threats, particularly those concerning bioterrorism (some of which are repetitive and use secondary sources), continues to rise. Some are based on information that considers specific events and developments, while others are more general, open-ended vulnerability assessments. Information on the effects of a release of pathogens is inadequate (mainly due to the limited number of cases of the accidental release of pathogens or bioterrorism), and it is difficult to predict whether a given bioterrorism incident would cause numerous casualties and deaths.

[3] Bio-safety is safety while working with pathogens. See Kuhlau, F., *Countering Bio-threats: EU Instruments for Managing Biological Materials, Technology and Knowledge*, SIPRI Policy Paper no. 19 (SIPRI: Stockholm, Aug. 2007), <http://books.sipri.org/>.

[4] E.g. Milton Leitenberg observes that, although it can be argued that the number of states claimed by the USA to possess biological weapons (BWs) has (since the mid-1980s) remained more or less stable at 12–13, there has been a notable reduction of states cited since the mid-1990s. Leitenberg, M., 'Evolution of the current threat', eds A. Wenger and R. Wollenmann, *Bioterrorism: Confronting a Complex Threat* (Lynne Rienner: London, 2007), pp. 39–76. A comparative analysis of US 'status of proliferation' assessments is difficult partly because they are not consistently made public; the agencies involved sometimes arrive at differing conclusions; and the assessments that are made public generally contain caveats that leave open the possibility that the state does not possess BWs or an offensive BW programme, but rather a 'BW-capability'.

[5] See Hart, J. D., 'The ALSOS Mission, 1943–1945: a secret US scientific intelligence unit', *International Journal of Intelligence and CounterIntelligence*, vol. 18, no. 3 (fall 2005), pp. 508–37; Leitenberg, M., 'Biological weapons arms control', *Contemporary Security Policy*, vol. 17, no. 1 (Apr. 1996), pp. 1–79; and Roffey, R., 'Biological weapons and potential indicators of offensive biological weapon activities', *SIPRI Yearbook 2004: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2004), pp. 557–71.

Much of the current focus on efforts to evaluate and meet possible security threats posed by chemical and biological material deals with disparate possibilities concerning actors and institutions that have traditionally not been directly involved in CBW arms control and disarmament efforts. Some efforts encompass the chemical industry; the possible challenges posed to the BTWC and the CWC by biological and chemical incapacitants; the monitoring and oversight of scientific research, material and equipment; effectively extending state-based legal obligations to individuals and groups;[6] disease surveillance and response; and the consideration of ethics and codes of conduct for life science and chemistry practitioners, including researchers and students.[7] Various procedural and legal aspects of the implementation of arms control regimes also continue to be addressed.

Biological weapon arms control and disarmament

International biological warfare prevention efforts in 2007 included consideration of effective national implementing legislation, codes of conduct and ethics, disease surveillance and response, and bio-safety and bio-security.

In 2007 the UN Office for Disarmament Affairs (ODA) started to develop a Bio-incident Database, as called for by the 2006 UN Global Counter-Terrorism Strategy.[8] The ODA requested that the UN member states provide an updated list—last compiled in 1989—of qualified experts and laboratories to support the UN Secretary-General's authority to investigate alleged chemical and biological weapon use.[9] The ODA also organized two meetings of technical experts to review the technical guidelines and procedures for carrying out such inspections.[10] The groups of experts updated the technical part of the guidelines in order to ensure that scientific and technological changes are reflected, including an increased focus on the biological field.

The International Criminal Police Organization (Interpol) continued to implement a Biocriminalization Project, an initiative launched by its Bioterrorism Prevention Program in September 2006, which includes the development of a Biocriminalization Database.[11]

[6] This is required by Article IV of the BTWC and Article VII of the CWC.

[7] E.g. Miller, S. and Selgelid, M. J., 'Ethical and philosophical consideration of the dual-use dilemma in the biological sciences', *Science and Engineering Ethics*, vol. 13, no. 4 (Dec. 2007), pp. 523–80.

[8] UN Global Counter-Terrorism Strategy, <http://www.un.org/terrorism/>.

[9] UN General Assembly, 'Chemical and bacteriological (biological) weapons', Report of the Secretary-General, UN document A/44/561, 4 Oct. 1989. The UN documents cited here are available from <http://documents.un.org/>.

[10] United Nations, 'UN action to counter terrorism, implementing the Global Counter-Terrorism strategy', Fact sheet, Dec. 2007, p. 3. See also Littlewood, J., *Investigating Allegations of CBW Use: Reviving the UN Secretary-General's Mechanism*, Compliance Chronicles, no. 3 (Canada Centre for Treaty Compliance: Ottawa, Dec. 2006). The current ODA activities focus primarily on the requirements to support investigations of alleged biological weapon use because the Organisation for the Prohibition of Chemical Weapons would have primary responsibility for investigation of alleged chemical weapon use.

[11] Interpol, 'Bioterrorism, biocriminalization', Public information sheet, <http://www.interpol.int/Public/BioTerrorism/bioC/default.asp>.

In 2007 states considered further the appropriate division of responsibility for bioterrorism efforts. This included discussion of how the Interpol and ODA database projects relate to each other. The ODA database is meant to operate in nearly real time and the data sets would be provided directly from governments. If a bio-incident were determined to be hoax, the incident would be deleted from the ODA database. Interpol's database, in contrast, is a criminal police data set that cannot be fully released until or unless a prosecution is final or the member state providing the information allows it to be shared with the public. Such efforts are meant to assist capacity building by states to meet bio-threats.[12]

The importance has also been noted of distinguishing at least eight categories of biological weapon-related events: hoaxes, threats, the consideration or discussion of use, product tampering, the purchase of material, attacks on facilities, attempts to produce agents or to use them, and actual use.[13]

Implementation of the BTWC

As of 31 December 2007, 159 states had ratified or acceded to the BTWC.[14] In December 2006 the Sixth Review Conference to the convention agreed an inter-sessional process for 2007–10 which consists of four annual meetings to 'discuss, and promote common understanding and effective action' on four areas.[15] Of these, the inter-sessional—one expert, one political—meetings in 2007 considered: (*a*) ways and means to enhance national implementation, including enforcement of national legislation, strengthening of national institutions and coordination among national law enforcement institutions; and (*b*) regional and subregional cooperation on BTWC implementation.[16]

In 2007 the temporary three-person Implementation Support Unit (ISU), established by the Sixth Review Conference, also began to operate. The ISU, which became fully operational on 2 August and is located at the UN Office at Geneva, provides support for inter-sessional meetings and receives and distributes politically binding information exchanges meant to serve as confidence-building measures (CBMs) among the BTWC parties.[17] In 2007 it

[12] See Kellman, B., *Bioviolence: Preventing Biological Terror and Crime* (Cambridge University Press: New York, 2007).

[13] Leitenberg (note 4), p. 48.

[14] The states that had signed but not ratified the BTWC were Burundi, Central African Republic, Côte d'Ivoire, Egypt, Guyana, Haiti, Liberia, Madagascar, Malawi, Myanmar (Burma), Nepal, Somalia, Syria, Tanzania and United Arab Emerates. The UN member states that had neither signed nor ratified the convention were Angola, Cameroon, Chad, Comoros, Cook Islands, Djibouti, Eritrea, Guinea, Israel, Kiribati, Marshall Islands, Mauritania, Micronesia, Mozambique, Namibia, Nauru, Niue, Samoa, Tuvalu and Zambia. For a list of signatories see annex A in this volume.

[15] For information on the Sixth Review Conference see Hart, J. and Kuhlau, F., 'Chemical and biological weapon developments and arms control', *SIPRI Yearbook 2007: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2007), pp. 578–83.

[16] Sixth BTWC Review Conference, 'Final document', document BWC/CONF.VI/6, Dec. 2006, p. 21.

[17] UN Office at Geneva, Disarmament, restricted area for States Parties [to the BTWC], <http://www.unog.ch/bwc/restricted>. The annual, politically binding information exchanges are meant to serve as CBMs to help strengthen the treaty regime.

produced a CD-ROM containing all CBM returns for the period 1987–2007 (available to BTWC parties only) and established a website (only accessible to BTWC parties) as the principal method for the dissemination of BTWC-related information and access to a National Implementation Database.[18]

A 2007 study of CBM returns from 10 states from three geographic groupings concluded that there is great variation between states in terms of their authority to obtain required information due to differences in respective levels of available resources and type of legal authority. The study also found that there was uncertainty among the parties on the type of information to be declared between and within states, and that a subjective element is present in the evaluation of what information is relevant and should therefore be declared.[19]

The European Union (EU) extended until April 2008 the implementation of a Council joint action to support the BTWC by promoting universal membership to the convention and national implementation of its provisions. It did so partly by convening five regional workshops in 2006–2007 to explain the benefits of joining the convention to non-parties and offering states technical assistance to join and implement the treaty. A survey of national legislation and the extent to which the convention is effectively implemented was also carried out.[20] A number of the parties, including Australia, Indonesia and the USA, continued to host and carry out regional activities on BTWC implementation, bio-safety and bio-security.

More specific information on the status of achieving universal membership to the BTWC also became available. An Israeli government representative stated in 2007 that Israel agrees that 'the threat of biological warfare is indeed an ominous one' but that 'regional circumstances . . . cannot be overlooked' and 'it is our sincere hope that the future will yield improved regional circumstances which would allow a renewed consideration of this issue'.[21] According to Masood Khan, the chairman of the 2007 inter-sessional meetings of BTWC states parties, the preparations to accede to or ratify the BTWC in five states were 'well advanced',[22] while efforts to do the same in a further eight states,

[18] The database is password accessible at <http://www.unog.ch/bwc/NID>. See UN Office at Geneva, Implementation Support Unit, Report of the Implementation Support Unit, document BWC/MSP/2007/3*, 4 Dec. 2007.

[19] Lentzos, F. and Woodward, A., *National Data Collection Processes for CBM Submissions: Revisiting the Confidence Building Measures (CBM) of the Biological and Toxin Weapons Convention (BTWC) after Twenty Years of CBM Submissions* (London School of Economics and Verification Research, Training and Information Centre: London, Dec. 2007). On CBM-related issues see also the publications of the Hamburg Research Group for Biological Arms Control, <http://www.biological-arms-control.org/Publications.htm>.

[20] Council of the European Union, 'EU Joint Action in support of the Biological and Toxin Weapons Convention', <http://www.euja-btwc.eu/euja>; and Council Joint Action 2006/184/CFSP of 27 February 2006 in support of the Biological and Toxin Weapons Convention, in the framework of the EU Strategy against the Proliferation of Weapons of Mass Destruction, *Official Journal of the European Union*, L65 (7 Mar. 2006), pp. 51–55.

[21] Khan, M., 'Biological Weapons Convention: Meeting of Experts 2007, interim report by the Chairman, Ambassador Masood Khan (Pakistan), on universalization activities', 24 Aug. 2007, Geneva, document circulated to Meeting of Expert participants.

[22] The states were Burundi, Comoros, Madagascar, Mozambique and Myanmar (Burma).

while positive, were at an earlier stage.[23] He also listed states for which he had little indication about the time frame for their joining the BTWC,[24] while three states indicated that they did not intend to join the regime in the near future because of 'regional security circumstances'.[25] An additional eight states provided no feedback to his request for information.[26]

The 2007 meetings of the parties to the BTWC

The Meeting of Experts took place on 20–24 August 2007, and the Meeting of States Parties was held on 10–14 December.[27] Both were conducted under the chairmanship of Masood Khan of Pakistan and consisted of exchanges of information, views and consideration of offers for cooperation and assistance.

The Meeting of Experts circulated and considered papers describing the parties' experiences in implementing the BTWC and measures to improve cooperation among national agencies. A consolidated list of the BTWC parties' key texts from national papers and statements was also produced.[28] Khan identified the following themes of the meeting: (*a*) approaches to national implementation should be tailored to meet the specific cases (i.e. to avoid the 'one size fits all' approach),[29] (*b*) the ISU should be used as 'a catalyst in better coordinating and managing activities', and (*c*) the parties need to assist each other with building capacity to better implement the convention. He also thanked the EU, India, Pakistan and the USA for their readiness to provide national implementation assistance.[30] The parties considered information on broad approaches to national implementation as well as detailed descriptions of such issues as law enforcement and cooperation between and within states.

[23] The states were Cameroon, Côte d'Ivoire, Guinea, Namibia, Nepal, Tanzania, United Arab Emirates and Zambia.

[24] The states were Angola, Central African Republic, Chad, Cook Islands, Guyana, Liberia, Malawi, Marshall Islands, Micronesia, Nauru and Nieue.

[25] The states were Egypt, Israel and Syria.

[26] The states were Djibouti, Eritrea, Haiti, Kiribati, Mauritania, Samoa, Somalia and Tuvalu. BTWC Meeting of States Parties, 'Obtaining universality for the Biological Weapons Convention, introducing the Report of the Chairman', 11 Dec. 2007, Geneva; and BTWC Meeting of States Parties, 'Report of the Chairman on universalization activities, submitted by the Chairman', document BWC/MSP/2007/4, 11 Dec. 2007.

[27] The BioWeapons Prevention Project (BWPP) produced daily briefing papers on the work of the meetings. See the BWPP website <http://www.bwpp.org/>. See also the UN Office at Geneva website, <http://www.unog.ch/bwc/>; and the 'Biological and Toxin Weapons Convention' website <http://www.opbw.org/>.

[28] BTWC Meeting of Experts, 'Considerations, lessons, perspectives, recommendations, conclusions and proposals from the presentations, conclusions and proposals drawn form the presentations, statements, working papers and interventions on the topics under discussion at the meeting (as of 15:30 on 23 August)', document BWC/MSP/2007/MX/CRP.2, 24 Aug. 2007.

[29] This point was also made in 2005 regional BTWC implementation workshops and the 2005 meetings of BTWC parties in Geneva.

[30] BTWC Meeting of Experts, 'Biological Weapons Convention: Meeting of Experts 2007, closing remarks of the Chairman, Ambassador Masood Khan (Pakistan)', 24 Aug. 2007, Geneva. National legislation can be divided into 3 types of activity: (*a*) legislation to transpose convention obligations into national law, (*b*) methods for monitoring relevant work with biological agents and toxins under the jurisdiction or territory of a state, and (*c*) the means for enforcing legislation once a violation is suspected. Lentzos, F., 'Representation from the trenches: ongoing monitoring for implementing the BWC', *Disarmament Diplomacy*, no. 85 (summer 2007), p. 54.

The meeting of experts also produced a concluding draft factual report for possible inclusion in the final document of the Meeting of States Parties.[31]

At the start of the Meeting of States Parties Khan tabled a synthesis paper which itemized measures developed by the Meeting of Experts to implement the 2007 mandate. The measures were organized as lists of steps to: (*a*) translate BTWC obligations into effective national measures, (*b*) manage and coordinate the operation of national measures, (*c*) enforce national measures, and (*d*) review the efficacy and efficiency of national measures. Khan also listed measures that could be taken to maximize the effectiveness of efforts to implement regional and subregional cooperation on BTWC implementation.[32] Although the parties expressed positive views of the work and importance of the ISU, the USA sounded a note of diplomatic caution when it expressed 'deep concern over recommendations encouraging support for increased responsibilities' for the ISU and emphasized that voluntary contributions by BTWC parties 'must not in any way undermine the strict delineation of the ISU operations that was the basis for the compromise text [agreed by the 2006 Sixth Review Conference] of the mandate'.[33] This statement was prompted by a working paper tabled by the Netherlands on behalf of the EU which listed measures that could be taken to support the ISU.[34] For example, one measure proposed that the ISU could be provided with additional financial resources to organize a forum similar to the Organisation for the Prohibition of Chemical Weapons (OPCW) Academic Forum, but to do so would be difficult given that the ISU's staff is currently limited to three people.[35] An underlying US concern was that the ISU not evolve towards becoming a de facto permanent institutional structure.[36]

The Meeting of States Parties issued a final report that provides factual information about the agenda, the organization of the meeting, a list of participants, and the statements and measures considered.[37] In closing the meeting,

[31] BTWC Meeting of Experts, 'Draft report of meeting of experts', document BWC/MSP/2007/MX/CRP.1, 24 Aug. 2007.

[32] BTWC Meeting of States Parties, 'Synthesis of considerations, lessons, perspectives, recommendations, conclusions and proposals drawn from the presentations, statements, working papers and interventions on the topics under discussion at the Meeting of Experts', document BWC/MSP/2007/L.1, 9 Nov. 2007.

[33] US Mission to International Organizations, Geneva Switzerland, 'Statement by H. E. Ambassador Christina Rocca, U.S. representative, Biological Weapons Convention, 2007 Meeting of States Parties', Geneva, 10 Dec. 2007. On the institutional issue see Hart, J., Kuhlau, F. and Simon, J., 'Chemical and biological weapon developments and arms control', *SIPRI Yearbook 2003: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2003), pp. 646–50.

[34] BTWC Meeting of Experts, 'Netherlands: supporting the BTWC Implementation Support Unit', document BWC/MSP/2007/WP.3, 7 Dec. 2007.

[35] BioWeapons Prevention Project, 'The Meeting of States Parties: the opening day', MSP report no. 2, 11 Dec. 2007.

[36] For background on the question of whether an institutionalized body should be established to oversee BTWC implementation see Zanders, J. P., 'Verification of the BTWC: seeking the impossible or impossible to seek?', ed. G. Lindstrom, *Enforcing Non-Proliferation: The European Union and the 2006 BTWC Review Conference*, Chaillot Paper no. 93 (EU Institute for Security Studies: Paris, Nov. 2006), pp. 50–54.

[37] BTWC Meeting of States Parties, 'Report of the Meeting of States Parties', 14 Dec. 2007, advance copy.

Khan stated that the conference had been productive and represented a 'good start on our goal of moving from adjacency to synergy' in the parties' efforts to strengthen the convention.[38]

Chemical weapon arms control and disarmament

As of 31 December 2007, 183 states had ratified or acceded to the CWC, the principal international legal instrument against chemical warfare; an additional six states had signed but not ratified the convention, and seven states had neither signed nor ratified it.[39]

The Conference of the States Parties

The 12th Session of the Conference of the States Parties to the CWC met on 5–9 November 2007. The ability of the OPCW to fulfil its mandate depends on its receiving funds from the states parties in a timely manner. A number of adjustments were made by the CSP to regularize the payment status of those parties in arrears and to improve the organization's captial flow. The CSP approved the OPCW's programme and budget of €75 025 734 ($109 million) for 2008.[40] It is the third consecutive 'zero nominal growth' budget. The CSP also approved, for the first time, a multi-year payment plan for two parties that were in arrears in their payments to the OPCW and authorized the Executive Council to approve similar payment plans for other parties in 2008. The mechanism is meant to permit parties with unpaid advances to the OPCW Working Capital Fund (WCF) or annual contributions to regularize their payment status over periods of more than one year. It is another in a series of adjustments the parties have taken to improve capital flow so as to avoid situations, such as that which occurred in 2001, when some scheduled inspections were cancelled for lack of funding.[41] A number of the parties have not paid their annual contributions in full for several years.[42] The underpay-

[38] BTWC Meeting of States Parties, 'Biological Weapons Convention: Meeting of States Parties 2007, Chairman's closing remarks', 14 Dec. 2007, Geneva.

[39] Barbados and the Republic of the Congo became parties to the CWC in 2007. The states that have signed, but not ratified the CWC are Bahamas, Dominican Republic, Guinea-Bissau, Israel and Myanmar (Burma). The states that had not signed or acceded to the CWC as of Dec. 2007 were Angola, Egypt, Iraq, North Korea, Lebanon, Somalia and Syria.

[40] OPCW, 'Decision, programme and budget of the OPCW for 2007', document C-12/DEC.4, 7 Nov. 2007, para. 3.

[41] OPCW, 'Decision, proposals for a multi-year payment plan to regularise the payment of outstanding annual contributions', document C-12/DEC.7. For a discussion of previous OPCW budgetary and planning challenges see Zanders, J. P., Hart, J. and Kuhlau, F., 'Chemical and biological weapon developments and arms control', *SIPRI Yearbook 2002: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2002), pp. 683–85.

[42] As of Oct. 2007, the OPCW was owed €36 034 468 ($52 million) in unpaid annual contributions for the period 1993–2007. As of Nov. 2007, the OPCW had received approximately 80% of the 2007 assessed contributions from member states. OPCW, 'Report of the Director-General, OPCW income and expenditure for the financial year to 30 June 2007', document C-12/DG.8, 17 Oct. 2007; and OPCW, 'Opening statement by the Director-General to the Conference of the States Parties at its Twelfth Session', document C-12/DG.11, 5 Nov. 2007, p. 7, para. 98. As of early 2008 about half of the total shortfall had been paid.

ment or non-payment of annual dues and contributions to the WCF has the potential to undermine programme delivery and to reduce the influence of such parties on OPCW policy- and decision making.[43]

The CSP also stressed that it was 'imperative' that further efforts be made to ensure that all the parties fully implement the provisions of Article VII of the CWC (National Implementation Measures) and that the parties should notify the OPCW of the designation or establishment of a national authority and inform the OPCW of steps they have taken to enact legislation and administrative measures to implement the convention.[44]

The CSP also extended the OPCW Plan of Action on universality of the CWC until 2009.[45] The OPCW's Director-General summarized, by region, the status of efforts to achieve universality in which he noted that Iraq and Lebanon have completed the necessary parliamentary procedures to accede to the CWC.[46] He also stated that the OPCW had engaged in dialogue with Egypt, Israel and Syria to discuss their possible accession to the convention and that North Korea had not responded to any of the OPCW's initiatives.[47] As of August 2007, 173 parties (95 per cent) had established or designated a national authority; 120 parties (66 per cent) had reported to the Technical Secretariat the adoption of legislative and administrative measures to implement the CWC; and 77 parties (42 per cent) had adopted and reported on national legislation covering all key areas required by the CWC.[48]

A broader consideration of the appropriate measures that the OPCW should take in the field of economic and technological cooperation, including the balance of organizational resources that should be devoted to implementing the various parts of the OPCW's programme and budget. Some parties wish to conclude Article X and Article XI 'action plans',[49] but the parties have not been able to agree the specific measures to be included in such plans.

[43] For provisions on voting rights in case of non-payment of dues see CWC, Article VIII, para. 8.

[44] OPCW, 'Decision, regarding the implementation of Article VII obligations', documentC-12/DEC.9, 9 Nov. 2007.

[45] OPCW, 'Decision, universality of the Chemical Weapons Convention and the further implementation of the universality action plan', document C-12/DEC.11, 9 Nov. 2007.

[46] OPCW, 'Opening statement by the Director-General to the Conference of the States Parties at its Twelfth Session', document C-12/DG.11, 5 Nov. 2007, p. 14, para. 84.

[47] OPCW (note 46), pp. 14–15, paras 87–88. A number of states in the Middle East have indicated that they are not willing to accede to the CWC unless Israel accedes to the 1968 Treaty on the Non-proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT). Israel, a signatory to the CWC, has indicated a need to agree other regional political and security concerns before a Middle East free of weapons of mass destruction can be achieved. UN Security Council Resolution 1718, 14 Oct. 2006, decided that North Korea must verifiably abandon all of its WMD programmes.

[48] OPCW, 'Note by the Director-General, Report to the Conference of the States Parties at its Twelfth Session on the status of implementation of article VII of the Chemical Weapons Convention as at 22 August 2007', document C-12/DG.6, 9 Oct. 2007, p. 6.

[49] E.g. OPCW, 'Delegation of South Africa, Statement on behalf of the African States Parties to the CWC during the Twelfth session of the Conference of States Parties, 5 to 9 November 2007', The Hague, 5 Nov. 2007. The OPCW has 7 programmes on cooperation in the peaceful uses of chemistry: (*a*) associate programme, (*b*) analytical skills development course, (*c*) conference support programme, (*d*) research projects programme, (*e*) internship support programme, (*f*) laboratory assistance programme, and (*g*) equipment exchange programme.

The CSP also considered site-selection methodologies for chemical industry inspections and related matters such as the appropriate geographic distribution of such inspections, particularly for 'other chemical production facilities'.[50] The outcome of such considerations—both in terms of specific decisions taken and CWC implementation practice—will increasingly shape the future CWC regime as chemical weapon stockpiles are eliminated and OPCW resources and political attention are increasingly directed towards other 'core' CWC objectives.[51]

In 2007 the EU agreed a Joint Action of €1.7 million ($2.4 million) for seven projects to support OPCW activities to implement the 2003 EU Strategy against Proliferation of Weapons of Mass Destruction (WMD): (*a*) universality of the CWC, (*b*) national implementation of the CWC, (*c*) international cooperation in the field of chemical activities, (*d*) assistance and protection against chemical weapons, (*e*) the update of the OPCW's scheduled chemicals database for verification purposes, (*f*) the OPCW Industry and Protection Forum, and (*g*) provision of financial support to OPCW visit teams to chemical weapon destruction facilities.[52] The OPCW also organized a number of regional workshops and visits to support universalization and effective national implementation.[53]

Essentially all CWC implementation issues have been considered in some form since the 1993–97 Preparatory Commission which elaborated the specific procedures and structures to allow the OPCW to implement the CWC immediately once it entered into force.[54] As the destruction of chemical weapon stockpiles approaches completion, the OPCW will increasingly become more of a non-proliferation and technical assistance organization (rather than a disarmament organization).[55] This shift in focus will include further attention to verify that chemical weapons are not produced (including by the chemical industry). This implies improving implementation of the CWC's provisions on chemical transfers. There is also a growing expectation that further steps will be taken to ensure effective verification, including through comprehensive national implementation. Given the fact that chemical

[50] As of 19 Dec. 2007, 5177 industrial facilities were liable to OPCW inspection.

[51] For background on CWC chemical industry verification see Hart, J. and Sutherland, R. G., 'Chemical industry verification under the CWC: scientific and technological developments and diplomatic practice', Paper presented at OPCW Academic Forum, The Hague, 18–19 Sep. 2007, <http://www.opcwacademicforum.org/>.

[52] Council Joint Action 2007/185/CFSP of 19 March 2007 on support for OPCW activities in the framework of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction, *Official Journal of the European Union*, L85 (27 Mar. 2007), pp. 13–21. The visits were agreed by the 11th Conference of the States Parties to the OPCW. See Hart and Kuhlau (note 15), p. 586.

[53] E.g. on 14–15 Apr. the OPCW organized a subregional workshop for customs authorities in South East Europe on technical aspects of the CWC's chemical transfers regime in Croatia.

[54] See Kenyon, I. R. and Feakes, D. (eds), *The Creation of the Organisation for the Prohibition of Chemical Weapons: A Case Study in the Birth of an Intergovernmental Organisation* (TMC Asser Press: The Hague, 2007). See also proceedings of the IUPAC/OPCW International Workshop: Impact of Advances in Science and Technology on the Chemical Weapons Convention, 22–25 Apr. 2007, Zagreb, Croatia, <http://www7.nationalacademies.org/IUPAC-OPCW_Workshop/>.

[55] Some parties object to the term 'non-proliferation', although it does appear in official OPCW documentation.

weapons produced before 1 January 1946 will continue to be recovered, the OPCW Working Group for the Preparation of the Second Review Conference has suggested that the Second Review Conference might consider the practicality of setting a deadline for the destruction of such weapons as they are recovered over the coming decades. In order to consider such issues and help mark the 10th anniversary of the entry into force of the CWC, a series of meetings were held in a number of CWC member states and at the UN. Academics, policymakers, diplomats and industry officials attended the OPCW Academic Forum 2007 and the OPCW Industry Protection Forum 2007. Both are intended to function as ongoing open-ended mechanisms to facilitate the exchange of information and views on CWC implementation through dedicated websites.[56]

Destruction of chemical weapons[57]

As of 19 December 2007, of approximately 71 330 agent tonnes of declared chemical weapons, about 26 296 agent tonnes had been verifiably destroyed; of approximately 8.67 million declared items, about 2.85 million munitions and containers had been destroyed.[58] As of the same date, 12 states had declared 65 chemical weapon production facilities of which 42 had been destroyed and 19 converted for peaceful purposes not prohibited under the CWC.[59] The declared possessors of chemical weapons are Albania, India, South Korea, Libya, Russia and the USA. On 22–23 October 2007 the first of the special visits to Russia and the USA that were agreed by the 11th CSP were conducted when the chairman of the Executive Council, the Director-General and designated Executive Council representatives visited the Anniston Chemical Agent Disposal Facility.[60] A similar visit is planned to be carried out in Russia in 2008. These visits reflect the concern of the parties that destruction deadlines should be met and allow Russia and the USA to signal the seriousness with which they will attempt to meet these deadlines.

On 11 July the OPCW confirmed that Albania had completed the destruction of its chemical weapon stockpile (totalling 16 678 kilograms of mostly sulphur mustard)—the first possessor of stockpiled chemical weapons to do

[56] Papers and presentations from the forums are available at <http://www.opcwacademicforum.org/> and <http://www.opcwipf.org/>.

[57] For further information on chemical weapon stockpiles (e.g. cost, type and quantity) see previous SIPRI CBW Yearbook chapters.

[58] OPCW, 'The chemical weapons ban: facts and figures', <http://www.opcw.org/factsandfigures/>.

[59] OPCW (note 58). The states are Bosnia and Herzegovina, China, France, India, Iran, Japan, South Korea, Libya, Russia, Serbia, the UK and the USA. The CWC defines a chemical weapon production facility as a facility that has produced chemical weapons at any time since 1 Jan. 1946. CWC, Article II, para. 8. For quantity and type of chemical weapon stockpiles and associated destruction programmes see CBW chapters in previous SIPRI Yearbooks.

[60] OPCW (note 46), para. 15.

so.[61] In 2007 Albania provided details of its destruction programme, including outside assistance, and publicly described the composition of its stockpile.[62]

India received an extension to 28 April 2009 of the deadline by which it must destroy all of its Category 1 chemical weapons.[63] As of 30 September 2007, India had destroyed 86.03 per cent of its Category 1 chemical weapon stockpile and all of its declared Category 2 and 3 chemical weapons.[64]

Libya received an extension of the deadline by which it must destroy all of its Category 1 chemical weapons to 31 December 2010.[65] As of 30 September 2007, Libya had destroyed all of its Category 3 chemical weapons and 39 per cent of its Category 2 chemical weapons.[66] Libya is obligated to destroy all of the Category 2 chemical weapons by 31 December 2011. On 18 June 2007 Libya withdrew from an agreement with the USA to share the costs of destroying its chemical weapon stockpile. Among the possible reasons cited for this were that Libya wanted the USA to pay more than $45 million (of a total estimated cost of $60 million), to cover liability for damage or destruction of US-provided equipment and to retain US-provided equipment.[67]

The Russian chemical weapon stockpile is stored at six locations.[68] Russian officials continued to indicate that they receive less destruction assistance than promised and that a lack of multi-year funding commitments is complicating its destruction planning. Russia has received an extension of the deadline by which it must complete the destruction of its Category 1 stockpile to 29 April 2012. As of 30 September 2007, Russia had destroyed more than 8000 tonnes (more than 23 per cent) of its Category 1 stockpiles. Russia has also completed the destruction of all of its Category 2 and 3 chemical weapons.[69] France pledged support through the British chemical weapon destruction

[61] 'Verification, Albania [is] the first country to destroy all of its chemical weapons', *Chemical Disarmament*, vol. 5, no. 3 (Sep. 2007), p. 9.

[62] Albania declared to the OPCW 580 canisters of sulphur mustard (HD) weighing 13.71 tonnes, 49 canisters or glass containers of lewisite (L) weighing 0.97 tonnes, 4 canisters of sulphur mustard/lewisite (HD-L) mixture weighing 0.4 tonnes, 33 canisters of adamsite (DM) weighing 0.33 tonnes, and 80 canisters of chloroacetophenone (CN) weighing 1.04 tonnes. Vucaj, F., 'Albania, Republic of Albania: world leader in chemical disarmament', *Chemical Disarmament*, vol. 5, 10th anniversary special edition (May 2007), pp. 6–10.

[63] The definition of chemical weapon categories, which is partly based on what schedule a chemical may be listed under in the CWC's Annex of Chemicals, is given in CWC, Verification Annex, Part IV(A), para. 16.

[64] OPCW (note 46), p. 4, para. 19.

[65] For information on Libya's stockpile and background on its accession to the CWC see Hart, J. and Kile, S. N., 'Libya's renunciation of NBC weapons and longer-range missile programmes', *SIPRI Yearbook 2005: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2005), pp. 629–48.

[66] OPCW (note 46), p. 4, para. 20.

[67] Bollfrass, A., 'Libya backs out of CW destruction agreement', *Arms Control Today*, vol. 37, no. 6 (July/Aug. 2007), p. 29.

[68] The locations are Kambarka, Udmurtia Republic; Kizner, Udmurtia Republic; Maradikovsky, Kirov oblast; Pochep, Bryansk oblast; Leonidovka, Penza oblast; and Shchuchye, Kurgan oblast. For background on Russian chemical weapon destruction see 'Unichtozhenie khimicheskogo oruzhiya v R.F.' [Destruction of chemical weapons in the R[ussian] F[ederation]], *Rossiiskaya Gazeta*, <http://www.rg.ru/ximiya.html>; and *Khimicheskoe Razoruzhenie: Otkrity Elektronny Zhurnal* [Chemical Disarmament: Open Electronic Journal], <http://www.chemicaldisarmament.ru/>.

[69] OPCW (note 46), p. 3, para. 17.

assistance framework with an offer (of approximately €6 million) being allocated to the stockpile at Shchuchye. Italy has bilaterally offered up to €360 million to Pochep.

One party to the CWC, widely understood to be South Korea, has declared possessing a chemical weapon stockpile but has declined to identify itself publicly. It has received an extension to 31 December 2008 of the deadline to complete the destruction of its chemical weapon stockpiles. As of 30 September 2007 it had destroyed over 85 per cent of its Category 1 chemical weapons and all of its Category 2 and 3 chemical weapons.[70]

As of 10 December the USA had destroyed 50 per cent of its stockpiled chemical weapons, currently stored at five locations.[71] There was further concern about the transport and off-site treatment of caustic VX—an organophosphorus nerve agent—hydrolysate from the Newport chemical weapon destruction facility.[72] The USA has received an extension for the completion of the destruction of its Category 1 stockpile to 29 April 2012. As of 19 December 2007, the USA had destroyed more than 45 per cent of its Category 1 chemical weapons and had destroyed 100 per cent of its Category 3 chemical weapons.[73]

As of 19 December 2007, three countries had declared that abandoned chemical weapons (ACWs) are present on their territories, and 13 countries had declared that they posses old chemical weapons (OCWs).[74] Starting in 2010, Nord Stream, a German–Russian business consortium, plans to operate a 1200-kilometre gas pipeline that will link Viborg, Russia, and Greifswald, Germany, and pass through the Swedish economic zone east of the Swedish island of Gotland. Some European and Swedish officials and environmentalists have expressed concern that the pipeline could disturb World War II-era munition dump sites in the Baltic Sea, including chemical weapons.[75]

China and Japan have until 2012 to complete the destruction of recovered chemical weapons abandoned by Japan in China during World War II. In 2007

[70] OPCW (note 46), p. 4, para. 19. In this speech the Director-General refers to the country as 'a state party'.

[71] US Army Chemical Materials Agency, 'U.S. Army destroys 50 percent of U.S. chemical agent stockpile', Press release, 10 Dec. 2007. The stockpile locations are Alabama, Arkansas, Indiana, Oregon and Utah.

[72] For background see US Government Accountability Office (GAO), *Chemical Demilitarization: Actions Needed to Improve the Reliability of the Army's Cost Comparison Analysis for Treatment and Disposal Options for Newport's VX Hydrolysate*, GAO-070240R (GAO: Washington, DC, 26 Jan. 2007).

[73] OPCW (note 58).

[74] The countries that have declared ACWs to the OPCW are China, Italy and Panama. The countries that have declared OCWs to the OPCW are Austria, Australia, Belgium, Canada, France, Germany, Italy, Japan, Russia, Slovenia, Solomon Islands, the UK and the USA. ACWs are defined as chemical weapons that were abandoned by a state after 1 Jan. 1925 on the territory of another state without the permission of the latter. CWC, Article II, para. 6. OCWs are defined as chemical weapons that were produced before 1925 or chemical weapons produced between 1925 and 1946 that have deteriorated to such an extent that they are no longer usable in the manner in which they were designed. CWC, Article II, para. 5. For information on countries not discussed in this chapter see CBW chapters in previous editions of the SIPRI Yearbook.

[75] 'Nord Stream reviderar gasledning' [North Stream modifies gas line], *Svenska Dagbladet*, 9 Nov. 2007. See also Nord Stream's website, <http://www.nord-stream.com/>.

Japan announced its intention to introduce a mobile destruction system (probably an explosive containment chamber) to complement the planned construction of a fixed chemical weapon destruction facility in Haerbaling, Jilin Province in north-east China. Approximately 300 000–400 000 ACWs are estimated to be located in the province, of which approximately 38 000 have been recovered and are awaiting destruction. Since 1991 the two countries have jointly conducted approximately 75 fact-finding missions or site investigations of suspected ACW sites and, since 2000, have carried out 16 excavation and recovery operations.[76]

In March 2007 the United Kingdom completed the destruction of all of its OCWs, totalling 3812 munitions, at a cost of £10 million ($20 million).[77]

III. Violations and past programmes

No major 'status of proliferation' reports on CBW activities appear to have been released in 2007. Such reports all tend to list similar states, and it is generally not possible to evaluate their accuracy since the information on which they are based is classified. They also usually contain caveats that leave open the possibility that a state is not developing or seeking to acquire CBW. When asked whether any states were currently developing biological weapons, the head of Russia's Radiation, Chemical and Biological Defence Troops, Colonel-General Vladimir Ivanovich Filippov, replied: 'At the current time there is no available official evidence that any country is developing biological weapons'.[78]

One of the few official public indications that al-Qaeda is seeking to acquire chemical or biological weapons is contained in a partial transcript released by the US Department of Defense of a tribunal hearing that was conducted at the US Naval Base at Guantánamo Bay, Cuba. Khalid Sheikh Muhammed, a US-designated enemy combatant accused of having served as the head of al-Qaeda's military committee and of being Osama bin Laden's principal operative responsible for directing the 11 September 2001 attacks on the USA, is quoted as stating: 'I was directly in charge, after the death of Sheikh Abu Hafs Al-Masri Subhi Abu Sittah, of managing and following up on the Cell for the Production of Biological Weapons, such as anthrax and others, and following up on Dirty Bomb Operations on American soil'.[79]

[76] Nishi, M., 'Abandoned chemical weapons in China: efforts for early destruction', Presentation at 10th International Chemical Weapons Demilitarisation Conference: CWD2007, Brussels, 14–18 May 2007.

[77] British Ministry of Defence, 'Britain completes destruction of old chemical weapons', *Defence News*, 27 Mar. 2007, <http://www.mod.uk/DefenceInternet/DefenceNews/DefencePolicyAndBusiness/BritainCompletesDestructionOfOldChemicalWeaponHoldings.htm>.

[78] Tikhonov, A., 'Voiska vysokikh tekhnologii' [High technology forces], *Krasnaya Zvezda*, 13 Nov. 2007.

[79] US Department of Defence, 'Unclassified, verbatim transcript of combatant status review tribunal hearing for ISN 10024', 2007, <http://www.defenselink.mil/news/transcript_ISN10024.pdf>, p. 17. Muhammed also admitted responsibility for decapitating US journalist Daniel Pearl in Pakistan.

In 2007 a series of chlorine attacks occurred in Iraq which caused many of those who were not injured or killed by the associated explosives to become ill. Some attacks appear to have been designed to cause harm through both explosives and the chemical, while other attacks were attempts to explosively disseminate chlorine. There was concern that insurgents might refine their dispersal techniques. The OPCW and the UN issued statements condemning the attacks. The use of chlorine was also a factor in discussions in the USA on how to protect its municipal water supplies and whether to replace chlorine with other chemicals.[80]

In June 2007 an Iraqi court sentenced Ali Hassan al-Majid ('Chemical Ali') and two associates to death for their role in the 1988 Anfal campaign against the Kurdish population in northern Iraq, including the town of Halabja, in which Iraqi military units employed chemical weapons.[81]

IV. Iraq: closing the file?

On 29 June 2007 the UN Monitoring, Verification and Inspection Commission was disbanded when the UN Security Council adopted Resolution 1762. This immediately ended the mandates of UNMOVIC and the International Atomic Energy Agency (IAEA) under relevant UN resolutions concerning Iraq that were passed following Iraq's 1990 invasion of Kuwait. Resolution 1762, which was passed by a vote of 14–0 with Russia abstaining, requested the UN Secretary-General to 'take all necessary measures' to provide for the 'appropriate disposition' of UNMOVIC's archives and other property under arrangements that ensure that 'sensitive proliferation information' and information provided in confidence by UN member states are 'kept under strict control'.[82] UN member states had, since the 2003 US–British-led attack on Iraq, periodically considered whether and how to dismantle UNMOVIC or transform it.[83] For example, Iraq wished to recover the remaining funds in the UNMOVIC account, while some states, including Russia, argued that UNMOVIC should formally assess whether Iraq was free of weapons of mass destruction and WMD programmes. These states expressed concern that, without such confirmation within the UN framework, uncertainty would remain on whether remnants of Iraq's WMD programmes posed a continuing threat to international peace and security.[84]

[80] The New Jersey District Water Commission switched from using chlorine to sodium hypochlorite. Wright, J., 'Plant hit for use of chlorine', *The Record* (Hackensack), 28 May 2007.

[81] See Hiltermann, J. R., *A Poisonous Affair: America, Iraq, and the Gassing of Halabja* (Cambridge University Press: New York, 2007).

[82] UN Security Council Resolution 1762, 29 June 2007, paras 1, 5.

[83] E.g. it has been proposed that UNMOVIC's assets be transferred to support the UN Secretary-General's mechanism to investigate alleged CBW use.

[84] UNMOVIC was not allowed to operate in Iraq and the USA did not brief UNMOVIC on its classified findings of its WMD survey work in Iraq. Kerr, P., 'Security Council ends UNMOVIC', *Arms Control Today*, vol. 37, no. 7 (Sep. 2007), pp. 40–41; and Kerr, P., 'Security Council may close Iraq inspection unit', *Arms Control Today*, vol. 37, no. 5 (June 2007), pp. 27–28.

In a letter to the Security Council, the UK and the USA stated that the coalition occupying Iraq had taken 'all appropriate steps' to 'secure, remove, disable, render harmless, eliminate or destroy' all of Iraq's known WMD and ballistic missiles with a range greater than 150 km, as well as 'all known elements of Iraq's programmes established to research, develop, design, manufacture, produce, support, assemble and employ such weapons and delivery systems, subsystems and components thereof'.[85] Iraq's constitution obligates it to 'respect and implement' its international obligations in the field of nuclear, biological and chemical (NBC) weapons.[86] The Iraqi Monitoring Directorate, which oversees the transfer of dual-use substances, is also working to harmonize its export control legislation according to international standards, including within the framework of UN Security Council Resolution 1540.[87]

The UNMOVIC Acting Executive Chairman, Dimitri Perricos, presented to the Security Council UNMOVIC's 29th (and final) quarterly report of its activities. He also briefed the Security Council on the work of UNMOVIC and its predecessor body (the UN Special Commission on Iraq, UNSCOM), in part by referring to an unclassified compendium report totalling more than 1000 pages on Iraq's WMD programmes that UNMOVIC released on 27 June.[88] UNMOVIC also included a special appendix in its final quarterly report describing the challenges associated with verifying small quantities of CBW agents, partly in order to inform consideration of the issue of non-state actors seeking to acquire toxic chemical agents or their precursors—a matter of some concern for UN member states because of the 2007 use of toxic industrial chemicals by insurgents in Iraq.[89]

UNMOVIC's 'substantive' records have been transferred to the UN archive with restricted access until further notice. According to an UNMOVIC spokesman, Ewen Buchanen, most of the documents are 'sprinkled in some way'

[85] Letter from the Secretary of State for Foreign and Commonwealth Affairs of the United Kingdom of Great Britain and Northern Ireland and Secretary of State of the United States of America to the United Nations addressed to the President of the Security Council, Appendix I, United Nations Security Council Resolution 1762, 29 June 2007, p. 3.

[86] The Iraqi constitution states: 'The Iraqi Government shall respect and implement Iraq's international obligations regarding the non-proliferation, non-development, non-production and non-utilization of nuclear, chemical and biological weapons, and shall prohibit associated equipment, materiel, technologies and communications systems for use in the development, manufacture, production and utilization of such weapons'. Letter dated 8 April 2007 from the Minister for Foreign Affairs of Iraq addressed to the President of the Security Council [original in Arabic], UN Security Council Resolution 1762, 29 June 2007, para. 2.

[87] UN Security Council Resolution 1540, 28 Apr. 2004; and Letter dated 8 April 2007 from the Minister for Foreign Affairs of Iraq addressed to the President of the Security Council (note 86), appendix II, paras 5, 7. See also the 1540 Committee website, <http://disarmament2.un.org/Committee1540/>.

[88] The compendium was divided into: (*a*) building a UN verification system, (*b*) the structure of Iraq's proscribed weapon programmes, (*c*) chemical weapon programme, (*d*) missile programme, (*e*) biological weapon programme, (*f*) procurement issues, (*g*) the interconnections between Iraq's weapon programmes, and (*h*) observations and lessons learned. UNMOVIC, 'Twenty-ninth quarterly report on the activities of the United Nations Monitoring, Verification and Inspection Commission in accordance with paragraph 12 of Security Council Resolution 1284 (1999)', UN document S/2007/314, 29 May 2007; and UNMOVIC, *Compendium* [Report] (United Nations: New York, June 2007).

[89] Perricos, D., 'Acting Executive Chairman's speaking notes—Security Council, 29 June 2007', <http://www.unmovic.org/>.

with proliferation sensitive information.[90] Part of the archive, which reportedly has just under 460 metres of paper files and 1 terabyte (1 million megabytes) of electronic data, would also be of interest to those wishing to keep NBC weapon programmes secret.[91] The UN ODA has hired a number of former UNSCOM and UNMOVIC staff. UNMOVIC's material and residual expertise could also be used to further develop an authoritative record to help inform future analyses of arms control and disarmament issues or to support the UN Secretary-General's authority to investigate allegations of chemical and biological weapon use.

Concern about bioterrorism was highlighted on 29 August when gram quantities of phosgene in metal and glass containers placed in sealed plastic bags were found in an UNMOVIC office in New York when staff were packing material for long-term storage. The samples probably originated from an analytical laboratory at the al-Muthanna Chemical Weapons Complex and had been removed by inspectors in 1996.[92]

The 2003 attack against Iraq was justified partly on the basis of discredited information provided by a then anonymous Iraqi engineer named Rafid Ahmed Alwan living in Germany (codenamed 'Curveball'), who maintained that Iraq possessed mobile biological weapon production facilities. Despite suspicion by Germany's Federal Intelligence Service (Bundesnachrichtendienst) and other analysts, including in the USA, regarding Curveball's credibility, US officials decided to use his information to support the case for attacking Iraq in 2003.[93] Subsequent investigations, including by the Iraq Survey Group,[94] failed to uncover any such facilities.[95] In 2007 a US investigative news agency broadcast a segment devoted to Curveball,[96] and the National Security Archive—an independent non-governmental research institute and library located at George Washington University—published collected pri-

[90] Kerr, P., 'Security Council ends UNMOVIC', *Arms Control Today*, vol. 37, no. 7 (Sep. 2007), pp. 40–1.

[91] Kulish, N., 'End looms for Iraq arms inspection unit', *New York Times*, 18 June 2007.

[92] United Nations, 'Daily press briefing by the Office of the Spokesperson for the Secretary-General', 30 Aug. 2007, <http://www.un.org/News/briefings/docs/2007/db070830.doc.htm>.

[93] The White House, 'Iraq, denial and deception, US Secretary of State Colin Powell addresses the UN Security Council', New York, 5 Feb. 2003, <http://www.whitehouse.gov/news/releases/2003/02/print/20030205-1.html>.

[94] The ISG was a fact-finding mission sent to the country by the US–British-led coalition forces that attacked Iraq in order to find UN-prohibited NBC weapons and ballistic missiles having a range of more than 150 km.

[95] Guthrie, R., Hart, J., Kuhlau, F. and Simon, J., 'Chemical and biological warfare developments and arms control', *SIPRI Yearbook 2004* (note 5), pp. 683–91; Guthrie, R., Hart, J. and Kuhlau, F., 'Chemical and biological warfare developments and arms control', *SIPRI Yearbook 2005* (note 65), pp. 616–26; and Guthrie, R., Hart, J. and Kuhlau, F., 'Chemical and biological warfare developments and arms control', *SIPRI Yearbook 2006: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2006), pp. 724–25.

[96] CBS News, *Sixty Minutes*, 'Faulty intel source "Curve Ball" revealed', 4 Nov. 2007, transcript available at <http://www.cbsnews.com/stories/2007/11/01/60minutes/main3440577.shtml>. See also Drogin, B., *Curveball: Spies, Lies and the Con Man Who Caused a War* (Random House: New York, 2007).

mary documents about Curveball.[97] It is not possible to remove all uncertainty regarding the fate of Iraq's former WMD programmes, but the case can be said to be closed.

V. CBW prevention, response and remediation

Governments and various international institutions continued to consider and develop a variety of overlapping initiatives in the field of CBW prevention and remediation in 2007.[98] Security specialists and governments also evaluated whether and how such initiatives and measures should be implemented, both in terms of general policy and in terms of specific technical or operational-level challenges. Much of the focus of these efforts has been on how to prevent and respond to acts of bioterrorism, bio-crimes, and chemical terrorism by non-state actors or attacks carried out without claims of responsibility, including with possible clandestine state involvement.[99]

The threat analyses and risk assessments associated with CBW terrorism prevention, response and remediation and their effective implementation are inherently more diffuse, uncertain and open-ended than for 'traditional' state-based military threats involving conventional weapons. This is partly because of the variety and type of actors involved in such activities (e.g. the public health and security sectors), and partly because of the lack of clear, quantifiable or otherwise 'objective' criteria to assess such threats and of operationally meaningful criteria with which to evaluate the effective implementation of measures to address them. These efforts are further complicated by a lack of authoritative public information with which to carry out such analyses. Finally, many states do not feel directly threatened by CBW terrorism and some of the consideration of measures to meet CBW terrorism threats can lack resonance with them especially when limited resources must be prioritized and implemented.

Efforts to identify and mitigate perceived CBW threats were carried out in such areas as: (*a*) scientific R&D to support response capabilities; (*b*) the consideration of measures to restrict 'sensitive' research or its public dissemination; (*c*) the improvement of disease surveillance and response; (*d*) the development of inventories of sensitive materials and high-level containment facilities—bio-safety level (BSL)-3 and BSL-4 level—and the implementation of measures to more safely secure them (e.g. through enhancing awareness of bio-security); (*e*) the improvement and expansion of infrastructure and other capacity to respond to CBW attacks, including the role of microbial forensics

[97] Prados, J. (ed.), *The Record on Curveball: Declassified Documents and Key Participants Show the Importance of Phony Intelligence in the Origins of the Iraq War*, National Security Archive Electronic Briefing Book no. 234 (George Washington University, National Security Archive: Washington, DC, 5 Nov. 2007), <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB234/>.

[98] E.g. Bonin, S., *International Biodefense Handbook 2007: An Inventory of National and International Biodefense Practices and Policies* (Swiss Federal Institute of Technology, Center for Security Studies: Zurich, 2007), <http://www.crn.ethz.ch/publications/crn_team/detail.cfm?id=31124>.

[99] For a review of the concept of bio-crimes or bio-incidents see Kellman (note 12).

(discussed below); (*f*) awareness raising; (*g*) generic scientific and technological developments; and (*h*) linking these factors with policymaking and implementation.

International non-proliferation and disarmament assistance

Some cooperative threat reduction activities involve the sharing of biological materials, including sample strains. In Russia the ability to do this was put in doubt when, on 28 May 2007, it was reported that the Russian Federal Customs Service had stopped the export of all human medical biological material from the country in accordance with Russia's export control regulations. The decision was reportedly the result of a Federal Security Service report to Russian President Vladimir Putin on bioterrorism which alleged that the West was developing genetic weapons against Russia. Concern was expressed that clinical trials of drugs involving international pharmaceutical companies would be ended.[100]

Other cooperative threat reduction measures have been directed towards facilities that were formerly part of the Soviet Anti-Plague System (APS), many focusing on the cataloguing and safe storage of pathogen strains. A report by the Monterey Institute describes the status of the facilities in 10 of the former Soviet republics and the effects of the economic crises that occurred following the dissolution of the Soviet Union.[101] To varying degrees, the administration of APS facilities was merged by the national authorities into their respective sanitary epidemiological system structures.[102] However, the APS was dismantled in Moldova, while it maintained its independence in Georgia. Continuing challenges face APS facilities, including a need to: improve safety conditions, research capacity, disease surveillance and response capacity; replace obsolete equipment, ensuring that pathogen strains are secure; and retain staff expertise.[103] A compendium of biological weapon-related studies written by Chinese biological weapon arms control and disarmament specialists, including a review of Chinese bio-safety and bio-security laws and regulations (e.g. for the shipment of pathogens), measures to strengthen bio-safety and bio-security in China, and Chinese views of biological weapon arms control and disarmament, was also published in 2007.[104] One analyst observed that while China has 'ample' regulatory rules

[100] 'Russia warily eyes human samples: in the name of fighting bioterrorism, export of biological materials prohibited', *Kommersant*, 30 May 2007.

[101] The 2 states with APS facilities not covered by the study are Russia and Turkmenistan (Estonia, Latvia and Lithuania were also not included because they did not possess such facilities).

[102] The sanitary epidemiological system was a Soviet-era organization with public health responsibilities but generally lacking experience with highly dangerous pathogens.

[103] Ouagrham-Gormley, S. B., Melikishvili, A. and Zilinskas, R., *The Anti-plague System in the Newly Independent States, 1992 and Onwards: Assessing Proliferation Risks and Potential for Enhanced Public Health in Central Asia and the Caucasus* (Monterey Institute, James Martin Center for Nonproliferation Studies: Monterey, Calif., 3 Jan. 2008), <http://cns.miis.edu/research/antiplague/>.

[104] Smithson, A. (ed.), *Beijing on Biohazards: Chinese Experts on Bioweapons Nonproliferation Issues* (Monterey Institute, James Martin Center for Nonproliferation Studies: Monterey, Calif., Aug. 2007), <http://cns.miis.edu/pubs/week/070917.htm>.

and laws dealing with bio-safety and bio-security, the country has 'a consistent problem of implementation' which may, in turn, be partly caused by a 'normative "top-down"' approach together with inadequate resources and training at the operational level.[105]

Biological security

Many countries, including the members of the EU, continued to consider critical infrastructure vulnerabilities partly in light of the terrorist attacks in Madrid in 2004 and London in 2005 and placed greater focus on the threat of bioterrorism and efforts to counter it. In July the European Commission issued a draft Green Paper on bio-preparedness in order to initiate a consultative process throughout Europe on how to reduce biological risks and enhance Europe's bio-preparedness capacity, including via proactive measures, emergency management of bio-related events and establishing investigative capabilities.[106] It also posed the question of whether publication restrictions should be applied when sensitive biological research with a dual use is concerned.[107]

The European Committee for Standardization (Comité Européen de Normalisation, CEN) organized an international bio-safety and bio-security laboratory workshop in association with the EBSA, the American Biological Safety Association and Det Norske Veritas, a consultancy firm. The meeting's objective was to draft a CEN agreement for internationally recognized bio-safety and bio-security management standards.[108] This was done because of concern over the international expansion of biological laboratories. These efforts complement the 2006 World Health Organization bio-safety and bio-security guidelines and existing national regulatory requirements.[109]

Following an endorsement by its member states, the Organisation for Economic Co-operation and Development (OECD) published best practice guidelines on bio-security for biological resource centres, irrespective of the types of materials in custody, use or transfer.[110] At the request of the Dutch Ministry of Education, *A Code of Conduct for Biosecurity* for life-science researchers was published as part of Dutch efforts to further implement the BTWC and as

[105] Gill, B., 'Reading the nonproliferation tea leaves from *Beijing on Biohazards* essays', ed. Smithson (note 104), pp. 137–41.

[106] European Commission, 'Green Paper on bio-prepardness', 11 July 2007, COM(2007) 399 final, p. 13 (draft).

[107] E.g. it asked whether research should be published in 2 versions: a public one with no sensitive content and a restricted one containing 'sensitive parts of the research with access only for relevant bio-stakeholders'. How and who would define and implement terms such as 'sensitive' and 'relevant' remains unclear. European Commission (note 106), p. 13. For information on EU instruments with possible application in the biological security field see Kuhlau (note 3).

[108] European Biosafety Association, American Biological Safety Association and Det Norske Veritas, 'Laboratory biorisk management standard: international biorisk standard development initiative', 25 July 2007. The working draft document is available at <http://www.biorisk.eu/>.

[109] World Health Organization (WHO), *Biorisk Management: Laboratory Biosecurity Guidance* (WHO: Geneva).

[110] Organisation for Economic Co-operation and Development (OECD), *OECD Best Practice Guidelines for Biological Resource Centres* (OECD: Paris, 2007).

a means to reduce the likelihood of bioterrorism.[111] The document was the result of surveys of measures already in place at governmental and academic institutions, including some in other countries, and of existing legislation and codes of conduct for biotechnology and microbiology. A follow-up workshop, attended mostly by the stakeholders, led to the release of an initial draft document.[112]

Chemical security

Some states continued to implement various critical infrastructure protection programmes in 2007, including through the identification of potential human and physical weaknesses at chemical facilities in order to 'harden' them against possible attack. Such programmes may include the adoption of alternate production routes that do not require the delivery of toxic chemicals from off-site or the longer-term storage of such chemicals on-site. Efforts may also be undertaken to modify production routes to ensure that any dangerous starter or intermediate chemicals are, where possible, consumed as rapidly as possible. Further consideration has been given to replacing toxic chemicals with others that are less risky if used in a chemical attack. For example, in the USA, policymakers further considered the risks associated with the continuing use of chlorine at water purification plants.[113]

In 2007 the US Department of Homeland Security (DHS) also began implementing the Chemical Facility Anti-Terrorism Standards (CFATS), which impose comprehensive security regulations for 'high-risk' chemical facilities. CFATS requires all chemical facilities to prepare security vulnerability assessments and to develop and implement site security plans according to DHS risk-based performance standards.[114] The DHS estimates that there are approximately 7000 high-risk chemical facilities in the USA. Facilities that do not comply with the regulations can be forcibly closed or fined up to $25 000 per day.[115]

Disease surveillance and response[116]

Disease surveillance and response is important to biological security partly in order to determine whether a disease outbreak is deliberate. In 2007 measures continued to be developed to assist in the evaluation, gathering and integration of information to improve international disease surveillance and response.

[111] Royal Netherlands Academy of Arts and Sciences (KNAW), *A Code of Conduct for Biosecurity: Report by the Biosecurity Working Group* (KNAW: Amsterdam, Aug. 2007).

[112] See Royal Netherlands Academy of Arts and Sciences (note 111).

[113] See Hart and Sutherland (note 51).

[114] See US Department of Homeland Security, 'Chemical facility anti-terrorism standards', 20 Nov. 2007, <http://www.dhs.gov/xprevprot/laws/gc_1166796969417.shtm>.

[115] Ember, L., 'Chemical plant security', *Chemical & Engineering News*, vol. 85, no. 15 (9 Apr. 2007), p. 13.

[116] On work by the World Health Organization (WHO) see appendix 9A.

There were further indications that global warming will have to be increasingly taken into consideration when assessing whether disease outbreaks are naturally occurring or deliberate.

Work continued under the EU's Project BIOSAFE to establish a European-wide disease surveillance network and database information system. The project is intended to strengthen the ability of public health and civil protection authorities to respond to both accidental and deliberate releases of biological agents.

In 2007 a US citizen flew from Atlanta to Paris and back again while knowing that he was infected with a multi-drug-resistant strain of tuberculosis. Because he had travelled against medical instructions and had placed the health of fellow travellers in jeopardy, the US Centers for Disease Control and Prevention (CDC) placed him in involuntary isolation, the first time the CDC had issued an isolation order since 1963. The incident sparked debate in the US Congress and elsewhere about domestic health and safety regulations, including how they may not take into account the speed of international travel. The case also highlighted the confusion over quarantine procedures and the authority of when and how to enforce them.[117]

Bio-incidents

Failures in bio-containment and bio-security received wide publicity in 2007, including at facilities where awareness and compliance with procedures were thought to be high. One such breach occurred on 3 August at a farm near Pirbright in Surrey, UK, where an outbreak of foot-and-mouth disease (FMD) was discovered. Pirbright houses the Institute of Animal Health (IAH), which uses small quantities of live FMD virus for experimentation, as well as two private biotechnology companies: Merial Animal Health Ltd and Stabilitech Ltd. The Merial facility was producing large quantities of FMD vaccine, while Stabilitech used only small quantities of live FMD virus—comparable to those used by the IAH. The initial outbreak at a neighbouring farm led to a rapid investigation on 5 August by the Department for Environment, Food and Rural Affairs, the Veterinary Medicines Directorate and the Environment Agency, headed by the Health and Safety Executive with support from local and governmental agencies.

On 7 August a second farm was infected with FMD. The strain of FMD was identified as an FMD reference strain that had been obtained from the 1967 FMD epidemic in the UK and is commonly used at reference laboratories and in the production of pharmaceuticals, as at the Pirbright site. The strain does not occur naturally. The investigation focused on the Pirbright facilities and the IAH's final report was submitted four weeks after the first confirmation of

[117] For legal background see Swendiman, K. S. and Elsea, J. K., US Congress, Congressional Research Service (CRS), *Federal and State Quarantine and Isolation Authority*, CRS Report for Congress RL33201 (CRS: Washington, DC, 23 Jan. 2007); and Jones, N. L. and Shimabukuro, J. O., US Congress, Congressional Research Service (CRS), *Quarantine and Isolation: Selected Legal Issues Relating to Employment*, CRS Report for Congress RL33609 (CRS: Washington, DC, 28 Feb. 2007).

an FMD outbreak.[118] It stated that breaches in bio-security procedures, recent high precipitation in the area and lack of maintenance (i.e. cracked wastewater piping due to tree root ingress) contributed to the release of live FMD virus, which subsequently led to the infection of animals at nearby farms. The bio-security breaches included: the incomplete inactivation of live virus through insufficient chemical effluent filtering; allowing some live virus to reach the public sewer system, and eventually the surrounding soil, through unsealed manholes; the lack of standard operating procedures for handling blockages in effluent drains; and the lack of control over human and vehicle movement in and around the facility premises because construction work was being performed at the time of the outbreak. The dissemination of the FMD virus to neighbouring farms occurred because the soil around the facility was contaminated by the overflowing sewer system and spread by vehicles entering and exiting the area.

In testimony before the US House of Representatives Committee on Energy and Commerce Subcommittee on Oversight and Investigations, Keith Rhodes, the chief technologist at the Center for Technology and Engineering, noted the increasing number of BSL-3 and BSL-4 laboratories in the USA.[119] Incidents at high-containment laboratories were cited to highlight the lessons learned, including the importance of good bio-safety and bio-security practices in conjunction with the expansion of such facilities. The British FMD outbreak illustrated the importance of continued financial commitment to ensure adequate maintenance. In 2007 several potential exposures to *Coxiella burnetii* (the causative agent of Q fever) also occurred at Texas A&M University but were not reported to the CDC, as required by law.[120] Among the lessons learned in these instances was the need for specialized training for staff working with 'select agents', and making the necessary adaptations of BSL level-specific procedures when working in these laboratories.[121] An additional incident cited in the testimony involved a one-hour power outage at the new CDC BSL-4 facility in June 2007, following lightning strikes that rendered both primary

[118] British Health and Safety Executive (HSE), *Final Report on Potential Breaches of Biosecurity at the Pirbright Site 2007* (HSE: 2007).

[119] See Government Accountability Office (GAO), *High-Containment Biosafety Laboratories; Preliminary Observations on the Oversight of the Proliferation of BSL-3 and BSL-4 Laboratories in the United States, Statement of Keith Rhodes, Chief Technologist, Center for Technology and Engineering, Applied Research and Methods*, GAO-08-108T (GAO: Washington, DC, 4 Oct. 2007).

[120] See the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, US public law 107-188, <http://www.fda.gov/oc/bioterrorism/bioact.html>, including its subpart, the Agricultural Bioterrorism Protection Act of 2002, <http://www.aphis.usda.gov/programs/ag_selectagent/ag_bioterr_Q&A.html>, and Title 42 Code of Federal Regulations, part 73.19, available at Centers for Disease Control and Prevention, Select Agent Program, <http://www.cdc.gov/od/sap>.

[121] Select agents are designated hazardous microorganisms or toxins that pose high risk to human, animal or plant health. Select agents have been identified as such because of their potential use as biological weapons, and their transfer and use in the scientific and medical community is regulated. For information and lists of pathogens see the websites of the Centers for Disease Control and Prevention (CDC), Select Agent Program (note 120); the CDC's National Select Agent Registry, <http://www.selectagents.gov/>; the US Department of Agriculture, Animal and Plant Health Inspection Service, <http://www.aphis.usda.gov/programs/ag_selectagent/>; and the Australia Group, 'Common control lists', <http://www.australiagroup.net/en/controllists.html>.

and backup power unavailable. This incident caused concern because it occurred at a top US laboratory facility operated by noted national experts. The event could have compromised the integrity of containment and could theoretically occur at other existing or planned high-containment facilities. It also demonstrated the need for redundant backup-to-backup power systems when building such facilities.

Scientific research

The scientific community and those involved in international security continue to consider possible CBW threats posed by scientific research and what measures should be taken to implement a reasonable, effective and balanced approach to bio-safety and bio-security. There is a widespread feeling among scientists that scientific research and information is 'value-free' (i.e. neither inherently harmful nor beneficial) and that any attempts to restrict their dissemination would damage scientific progress and, in any case, would be problematic because the work would be carried out elsewhere. Some researchers are also concerned that implementing restrictions will create another hurdle in the process of applying for grants and that their scientific work might not be published if deemed to be 'sensitive'. Partly for these reasons, some researchers are attempting to identify such research proposals and modify them before they are carried out in order to avoid attempts to classify or modify publication of the results.[122]

In 2007 the J. Craig Venter Institute, the Center for Strategic and International Studies and the Massachusetts Institute of Technology's Biological Engineering Department issued a report examining the safety and security concerns posed by synthetic genomics.[123] It identified three main points for possible policy intervention: (*a*) commercial firms that sell synthetic DNA (oligonucleotides, genes or genomes) to users; (*b*) owners of laboratory 'bench-top' DNA synthesizers, with which users can produce DNA; and (*c*) the users (consumers) of synthetic DNA and the institutions that support and oversee their work.[124]

To address the first point, the report suggests the following requirements: commercial firms must use approved software to screen orders; an institutional bio-safety officer or similar 'responsible official' must verify that those who order synthetic DNA from commercial firms are legitimate users; and commercial firms must store information about customers and their orders. In order to implement the second point, the report provides the following options: owners of DNA synthesizers must register their machines; owners of

[122] It may be possible, to an extent, to modify the parameters of the research proposal, perhaps informally, without undermining the integrity of the research objectives.

[123] Garfinkel, M. S. et al., 'Synthetic genomics: options for governance', Massachusetts Institute of Technology Department of Biological Engineering, J. Craig Venter Institute, Center for Strategic and International Studies, Oct. 2007, <http://www.jcvi.org/research/synthetic-genomics-report/>.

[124] Garfinkel et al. (note 123), p. ii.

DNA synthesizers must be licensed; and a licence must be required to own DNA synthesizers and buy reagents and services.[125]

Finally, the report suggests measures to address legitimate users of synthetic genomic technology. Education about risks and best practices should be incorporated in university curricula; a bio-safety manual for synthetic biology laboratories should be compiled;[126] a clearing house for best practices should be established; the responsibility of institutional biosafety committees (IBCs) should include evaluating 'risky' experiments; and, in order to evaluate such experiments, IBC review responsibilities should be broadened and combined with oversight by a national advisory group and enhanced enforcement of compliance with bio-safety guidelines.[127] The report presents a wide scope for interpreting and implementing the options identified.

On 1 November the UK introduced the Academic Technology Approval Scheme, which requires all postgraduate students from outside the European Economic Area and Switzerland who intend to study natural sciences to complete a questionnaire that is then vetted by British security services. The questionnaire is being used to assist with implementation of a programme to prevent the spread of sensitive knowledge.[128]

Scientific developments having implications for the prevention of CBW

Some scientific and technological developments can readily be incorporated into efforts to prevent CBW, while others suggest possibilities for carrying out CBW or defeating existing methods for detecting and treating those affected by CBW agents.

Microbial forensics is a developing field with some parallels to nuclear forensics.[129] It can be defined as 'a scientific discipline dedicated to analyzing evidence from a bioterrorism act, biocrime, or inadvertent microorganism/toxin release for attribution purposes'.[130] The related technical and political challenges include developing the parameters for sharing strains and database access. Health care providers are interested in treating the victims, not preserving the crime scene to support a prosecution. The importance of biological forensics was also illustrated during the 2007 outbreak of FMD in the UK.

In the arms control and disarmament context, synthetic biology increasingly appears to symbolize the difficulty of effective international control and over-

[125] Garfinkel et al. (note 123), p. ii.

[126] E.g. see International Biorisk Standard Development Initiative, 'Laboratory biorisk management standard', draft, 25 July 2007, <http://www.biorisk.eu/documents/draft_document.PDF>; and Clevestig, P., *Biosecurity Handbook: A Guide to Assessing and Managing Biorisks in a Laboratory Setting* (SIPRI: Stockholm, forthcoming 2008).

[127] Garfinkel et al. (note 123), p. ii.

[128] Brumfiel, G., 'Foreign students face extra UK security checks', *Nature*, 7 Nov. 2007. See also British Foreign and Commonwealth Office, 'Counter-proliferation: Academic Technology Approval Scheme (ATAS)', <http://www.fco.gov.uk/atas/>.

[129] See appendix 8D in this volume.

[130] Budowle, B. et al., 'Microbial forensics', eds R. G. Breeze, B. Budowle and S. E. Schutzer, *Microbial Forensics* (Elsevier: London, 2005), p. 9. See also Emanuel, P. et al. (eds), *Sampling for Biological Agents in the Environment* (ASM Press: Washington, DC, 2007).

sight over scientific and technological developments to ensure that they are not misused for CBW purposes. It has been defined as 'the design and construction of new biological parts, devices, and systems; and the re-design of existing, natural biological systems for useful purposes'. For example, a 2006 British Royal Society report notes that synthetic biology technology is available worldwide; genetic material can be ordered through the post; and DNA synthesis can be ordered over the Internet.[131] The Massachusetts Institute of Technology currently operates a 'Registry of standard biological parts' to further the development of synthetic biology.[132]

In 2007 the J. Craig Venter Institute succeeded for the first time in transplanting the genome of naked DNA from *Mycoplasma mycoides* (the causative agent for bovine contagious pleuropneumonia) into *Mycoplasma capricolum* cells, another known animal pathogen that can cause severe arthritis in cattle, goats and sheep.[133] Such developments represent potential bio-security and dual-use risks as there is insufficient understanding of the consequences under relevant national and international laws and regulations. The Australia Group, an informal arrangement of states that meets periodically to harmonize national export controls, is discussing how to capture synthetic biology in its guidelines.[134] A major related consideration is how best to confirm the identity and intention of the end-user.

If it becomes feasible, using bioinformatics to determine the morphology and behaviour of an organism that does not exist in nature would have security implications. In principle, this development would be possible provided that such efforts are able to account for the presence and absence of genes, their mutations and epigenetic factors and the function of non-encoding DNA that is associated with each gene.

Legal and regulatory implications of scientific developments

There are two broad aspects of scientific developments with legal and regulatory implications: physical materials and intangible technology. The legal implications of synthetic biology also remain uncertain and include how to establish and maintain effective oversight of the transfer of DNA segments that can be sent by post. Other difficulties include agreeing a usable legal definition of a pathogen, such as agreeing how much of a polynucleotide

[131] British Royal Society, *Report of the RS-IAP-ICSU International Workshop on Science and Technology Developments Relevant to the Biological and Toxin Weapons Convention* (Royal Society: London, Nov. 2006), pp. 3–4.

[132] Massachusetts Institute of Technology, 'Registry of standard biological parts', <http://parts.mit.edu/registry/>.

[133] J. Craig Venter Institute, 'JCVI scientists publish first bacterial genome transplantation changing one species to another', Press release, 28 June 2007, <http://www.jcvi.org/>; and Lartigue, C. et al., 'Genome transplantation in bacteria: changing one species to another', *Science*, 3 Aug. 2007, pp. 632–38.

[134] 'In recognition of rapid international developments in the field of synthetic biology, Australia Group members agreed to pay particular attention to synthetic biological agents with a view towards formulating an appropriate Group response'. Australia Group, 'Media release, 2007 Australia Group plenary', Press release, June 2007, <http://www.australiagroup.net/en/releases/press_2007.htm>. On the Australia Group see chapter 11 in this volume.

sequence should be present in order for it to meet the legal definition of a select agent or its equivalent. Other developments with policy implications for the prevention of CBW include how to achieve a better understanding and oversight of the international sale of turnkey (i.e. ready for immediate use) biological and chemical facilities and the outsourcing of biological and chemical R&D and production.

The increasing difficulty of maintaining oversight of transfers of knowledge and expertise was highlighted by a US report on 'deemed exports'.[135] The USA's long-term interest is to participate in the 'global creation of knowledge' rather than to take measures to 'protect the lesser body of knowledge' that it produces domestically. Otherwise, with overly restrictive controls, the USA risks being unable to participate in the 'body of scientific and technical knowledge' about which it is not aware. This, in turn, should therefore be the principal US concern. It also stated that researchers may be required to obtain an export licence before they can be authorized to share equipment when conducting a project that includes international students and the equipment being used is judged to have a 'military application'. Biological 'laboratory equipment designed to be used to produce various toxins' could therefore fall under the military application guideline if it is determined that terrorists could use the equipment for hostile purposes. Such an interpretation, if strictly and universally applied, could undermine research.

VI. Conclusions

Efforts to reduce the possible security threats posed by chemical and biological material continued in 2007. However, further steps will be needed to maintain and strengthen the international prohibition against CBW. For example, studies bridging the gap between political and technical issues should continue to be carried out. Such work would inform analyses of how dual-use technologies and equipment are handled in practice and would also promote better understanding of the derivation and use of information.

Advances in science and technology and their impact on CBW proliferation and control remain poorly understood. The developing field of microbial forensics is integral to national and international bio-preparedness planning. It is important that cooperation between a range of agencies, including law enforcement and public health authorities, is established and maintained (e.g. when identifying and responding to deliberate use of biological agents) and to facilitate prosecutions.[136]

[135] A deemed export is the release to a foreign national within the USA of technology or source code having both military and civilian applications. Deemed Export Advisory Committee, *The Deemed Export Rule in the Era of Globalization* (US Department of Commerce: Washington, DC, 20 Dec. 2007), pp. 3–5.

[136] See Mathews, R. J., 'WMD arms control agreements in the post-September 11 security environment: part of the "counter-terrorism toolbox"', *Melbourne Journal of International Law*, vol. 8 (2007), pp. 292–310.