

7. Chemical and biological weapons: developments and proliferation

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I. Introduction

The negotiations on the Chemical Weapons Convention (CWC) culminated in 1992; after approval by the 47th United Nations General Assembly (UNGA), the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction was opened for signature in January 1993. The disarmament community is now looking forward to the entry into force of the Convention in 1995. For more than a decade SIPRI has published studies evaluating the negotiations and recommending the CWC (chapter 14 of this volume presents a preliminary analysis of the CWC).

Although the conclusion of the CWC is clearly a positive achievement, it will not solve all of the problems related to chemical warfare. It may be useful for the reader to review the developments of 1992 bearing in mind that the CWC will outlaw the use, development and production of chemical weapons (CW). This chapter deals with matters related to chemical and biological warfare and relevant disarmament undertakings and addresses the following areas:

1. In 1992 several new allegations were made of CW and to a lesser extent biological weapon (BW) use and possession.

2. The future spread of chemical and biological weapons is one of the major concerns of the 1990s, and more effective measures to prevent such proliferation were discussed in 1992. As in the past there was public concern about this issue, and strong arguments were made that international efforts to stop proliferation should be strengthened. This public awareness was partially evoked by the new findings in 1992 of the United Nations Special Commission on Iraq (UNSCOM) concerning foreign support of the former Iraqi chemical and biological warfare (CBW) programme (chapter 13 deals with UNSCOM activities in 1992). New information about the involvement of foreign companies in the buildup of the Iraqi CW and BW capability led to trials and investigations in several countries.

3. The US CW destruction programme and the experience obtained by UNSCOM's CW disposal efforts in Iraq dramatically increased knowledge

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about related problems and techniques. Concern about the impact on the environment of such destruction is growing, and there is evidence that destruction costs will be enormous, in some cases 10 times greater than the cost of production. The US demilitarization programme has begun to place greater emphasis on alternative destruction technologies, while Russia is now undertaking the painful process of designing and establishing its destruction programme.

4. New discoveries and information about the former Soviet chemical warfare programme provided evidence that the military overestimated the importance of this aspect of the Soviet weapon programme.

5. The issue of old chemical and conventional ammunition, abandoned or dumped during past decades in the soil or the sea, gained public attention. The withdrawal of troops from bases in Europe brought to light the environmental contamination, particularly of soil and water, caused by former military activities. Redevelopment of areas where troops were formerly stationed will demand immense investment.

6. The experience of the 1991 Persian Gulf War and increasing public awareness of weapon proliferation gave new impetus to research and development (R&D) into nuclear, biological and chemical (NBC) protection.

7. Huge oil spills and oil fires in Kuwait were part of the aftermath of the Persian Gulf War and there was great public concern about their impact on the environment. However, the damage to the environment appears to have been less than initially feared.

8. New information about the former Soviet, now Russian, BW R&D programme confirmed that it had continued until the beginning of 1992, despite earlier official statements to the contrary.

9. The Third Review Conference of the Biological and Toxin Weapons Convention (BWC) was held in 1991, and 1992 was characterized by efforts to discuss future verification measures, especially through the *Ad Hoc* Group of Governmental Experts which was established after the Review Conference. In 1992 the expert group met twice in Geneva and discussed potential verification measures from a scientific and technical standpoint. The 1992 round of information exchange produced much new information, but the number of participants in the exchange did not increase.

II. Allegations of CW and BW use

In 1992 a number of allegations were made of the use of CW agents or weapons and, in a few cases, of the use of BW agents. These allegations concerned countries or regions of military conflict or high political tension such as the former Yugoslavia, the Middle East, Mozambique and the new independent republics of the former Soviet Union. In some cases it was later clarified that riot control agents had been used.

The new republics

In 1992 the press reported extensively on the alleged use of chemical weapons in the Nagorno-Karabakh region of Azerbaijan in April–August during the fighting between Armenian factions and Azerbaijani Armed Forces. The following cities or districts were mentioned with respect to the use of chemical warfare agents: (a) continuous allegation of CW use, including artillery shells with hydrogen cyanide and cyanogen chloride in the attacks on the city of Shusha,¹ later denied by officials from Nagorno-Karabakh;² (b) allegation of CW use in the battles of Stepanakert,³ Agdam, Terter,⁴ and the Zangelan, Kubatly and Kelbadjar districts; (c) alleged use of cyanide in missile warheads against the village of Mokhratag in the Mardakert district⁵ and in the Fizulinskiy district;⁶ and (d) use of chemical missiles and alleged use of mustard gas in the Nakhichevan Autonomous Republic in the village of Sadarak, close to the borders with Iran and Turkey.⁷ In May a representative of the Commonwealth of Independent States (CIS) Joint Armed Forces General Staff categorically denied both that the CIS Armed Forces had chemical weapons and that chemical warfare could be conducted by the use of weapons which are unaccounted for.⁸ In July a team of UN experts arrived in Baku to investigate the alleged CW use by the Armenian Armed Forces,⁹ but it was unable to confirm such use.¹⁰ The team consisted of three experts appointed by the UN Secretary-General from Belgium, Switzerland and Sweden and two UN staff members. They visited the towns of Fizuly and Kubatly, which had recently been attacked, and interviewed patients in several hospitals in Baku. Later in Yerevan the team reported its conclusions to the Armenians;¹¹ it interpreted the Azerbaijani discovery of cyanide in soil and other samples from combat areas not as traces of CW agent, but as possible degradation or combustion products from the use of conventional weapons.¹²

In March Azerbaijan alleged that Armenia had used material containing infectious agents of bacteriological origin in the Kelbadzharskiy and Lachinsky

¹ 'Armenians said to stage chemical attack', *Washington Post*, 27 Apr. 1992, p. A22; 'Armenia accused of using chemical weapons', in Foreign Broadcast Information Service, *Daily Report–Soviet Union (FBIS-SOV)*, FBIS-SOV-92-081, 27 Apr. 1992, p. 66; 'Armenia accused of using chemical weapons', in FBIS-SOV-92-091, 11 May 1992, p. 80; 'Evidence of chemical weapons use noted', in FBIS-SOV-92-095, 15 May 1992, p. 71; 'Baku hosts conference on weapons control', in FBIS-SOV-92-096, 18 May 1992, p. 3.

² 'Use of chemical weapons, aviation denied', in FBIS-SOV-92-091, 11 May 1992, p. 73.

³ 'Karabakh denies chemical weapons used', in FBIS-SOV-92-086, 4 May 1992, pp. 64–65.

⁴ 'Troops warned of chemical weapons', in FBIS-SOV-92-120, 22 June 1992, pp. 84–85.

⁵ 'Chemical weapons use noted', in FBIS-SOV-92-111, 9 June 1992, p. 85.

⁶ 'Chemical weapons use noted', in FBIS-SOV-92-117, 17 June 1992, pp. 64–65.

⁷ 'Chemical weapons use charged', in FBIS-SOV-92-098, 20 May 1992, pp. 65–66; 'Popular front reports chemical warhead tests', in FBIS-SOV-92-099, 21 May 1992, p. 98; 'Nakhichevan reports casualties, mustard gas use', in FBIS-SOV-92-105, 1 June 1992, p. 65.

⁸ 'Reports of chemical weapons in Karabakh denied', in FBIS-SOV-92-093, 13 May 1992, pp. 15–16.

⁹ 'UN chemical weapons experts to tour provinces', in FBIS-SOV-92-130, 7 July 1992, pp. 70–71.

¹⁰ 'Ministry accuses Armenia of using poison gas', in FBIS-SOV-92-181, 17 Sep. 1992, p. 53.

¹¹ 'UN chemical weapons experts arrive in Yerevan', in FBIS-SOV-92-135, 14 July 1992, p. 35.

¹² 'Azerbaijan accusations Armenian request', *ASA Newsletter*, no. 31 (12 Aug. 1992), p. 8.

districts of Azerbaijan.¹³ These allegations were later denied by the Armenian Defence Ministry.¹⁴ In October the reported use of CW shells by the Abkhazian Army against Georgian troops was officially denied.¹⁵ In the conflict between Ossetians and Ingushes the use of chemical shells was reported in November.¹⁶

Mozambique

In Mozambique allegations continued to be made that chemical weapons have been and are being used against army forces by Renamo (the Mozambican National Resistance, MNR).¹⁷ Renamo formally denied the allegations.¹⁸ A Mozambican–South African Joint Security Commission was set up to investigate allegations of the use of chemical weapons which affect the nervous system during a military operation at the end of January 1992.¹⁹ Mozambique asked for outside help to determine the nature of the weapons used,²⁰ and in February Swedish experts conducted an initial investigation. Based upon the results of that investigation an official request was made to the UN Secretary-General, and in March a team of experts from Sweden, Switzerland and the UK conducted investigations in Mozambique. In June the UN Secretary-General presented his report on the mission to the Security Council.²¹ Owing to the considerable delay between the previous attack and the investigation, the report pointed out that ‘it may not be possible to detect traces of agent if a chemical warfare agent had been used’. In July a somewhat controversial interpretation was presented in another press source, pointing out that ‘it can certainly be concluded as possible that an anti-nervous system chemical weapon was used’.²² This illustrates how difficult it is to provide clear evidence of chemical warfare agent use, especially if much time elapses between the attack and the investigation.

¹³ ‘Armenia “accused” of bacteriological warfare’, in FBIS-SOV-92-053, 18 Mar. 1992, p. 75; ‘Bacteriological warfare claimed in insect drop’, in FBIS-SOV-92-054, 19 Mar. 1992, pp. 82–83.

¹⁴ ‘Defence Ministry denies biological weapons use’, in FBIS-SOV-92-054, 19 Mar. 1992, p. 80.

¹⁵ ‘Abkhaz defence ministry denies using chemical weapons’, in FBIS-SOV-92-207, 26 Oct. 1992, p. 80.

¹⁶ ‘Abuse, chemical arms use alleged’, in FBIS-SOV-92-213, 3 Nov. 1992, p. 28.

¹⁷ ‘Possible Renamo chemical attack investigated’, in Foreign Broadcast Information Service, *Daily Report–Africa (FBIS-AFR)*, FBIS-AFR-92-015, 23 Jan. 1992, pp. 25–26; ‘Renamo “deserters” report use of chemical weapons’, in FBIS-AFR-92-024, 5 Feb. 1992, pp. 18–19; ‘Army chief affirms chemical weapons use by Renamo’, in FBIS-AFR-92-034, 20 Feb. 1992, pp. 21–22.

¹⁸ ‘Renamo denies reported use of chemical weapons’, in FBIS-AFR-92-018, 28 Jan. 1992, p. 19.

¹⁹ ‘Chemical attack “kills five”’, *The Guardian*, 28 Jan. 1992, p. 5.

²⁰ ‘Letter dated 27 Jan. 1992 from the Permanent Representative of Mozambique to the United Nations addressed to the Secretary General’, General Assembly, Security Council document A/47/87, S/23490, 29 Jan. 1992.

²¹ ‘Report of the mission dispatched by the Secretary-General to investigate an alleged use of chemical weapons in Mozambique’, United Nations Security Council document S/24065, 12 June 1992.

²² ‘Experts confirm Renamo use of chemical weapons’, in FBIS-AFR-92-140, 21 July 1992, pp. 19–20.

The former Yugoslavia

Reports of the use of chemical warfare agents or chemical weapons in the military conflict in Bosnia and Herzegovina continued, including allegations that regular Croatian forces might have used such weapons in the bombardment of Sarajevo and on the Trebinje battlefield.²³

In June a new dimension was added when it was feared that a chemical–industrial complex in Tuzla, north of Sarajevo, might be hit by Serbian artillery shells. Owing to the large quantities of chlorine and mercury stored there, scenarios worse than the Bhopal, India disaster were envisaged.²⁴ In October there was concern that Bosnian forces might use chlorine deployed in railcars to defend Gradacac,²⁵ and the use of chemical agents of the irritant type was reported at Gradacac.²⁶ During the October visit to Iran of President Alija Izetbegovic of Bosnia and Herzegovina, he stated that ‘if the arms embargo against Bosnia remains in force, the people of Bosnia—to defend themselves and to stop Serbian crimes—will be forced to use existing poisonous gases’.²⁷ In late November a gas alarm was sounded after Serbian artillery bombed Tuzla and destroyed some chlorine containers.²⁸

It is suspected that the tear-gas CS and the incapacitating chemical warfare agent BZ are being produced by Serbia in Kruselak, near Belgrade, and that CS has already been employed.²⁹

Iraq

In May there were reports that Iraq’s President Saddam Hussein might use chemical weapons against the Shiite Arab population in the marshlands district.³⁰ In light of the very stringent UNSCOM mandate and the plan for further monitoring of all Iraqi CBW activities such allegations seemed highly doubtful.

²³ ‘Press reports Croat-Muslim forces using nerve gas’, in Foreign Broadcast Information Service, *Daily Report—East Europe (FBIS-EEU)*, FBIS-EEU-92-116, 16 June 1992, p. 28; ‘Sarajevo suburbs under attack; poison gas suspected’, in FBIS-EEU-92-122, 24 June 1992, p. 23; ‘Sarajevo shelled: chemical agents reportedly used’, in FBIS-EEU-92-169, 31 Aug. 1992, p. 28; ‘Serbs accuse Croatian army of using poison gas’, in FBIS-EEU-92-172, 3 Sep. 1992, p. 18; ‘Izetbegovic and Karadzic stellen Friedensgespräche in Frage’, *Der Tagesspiegel*, 15 Sep. 1992, p. 1; ‘Croat army reportedly using poison gas’, in FBIS-EEU-92-178, 14 Sep. 1992, p. 23.

²⁴ Fitchett, J., ‘150, 000 are at risk if Serbian gunners hit chemical plant’, *International Herald Tribune*, 10 June 1992, pp. 1–2.

²⁵ AP/Reuters, ‘Bosniens UNO-Botschafter: Chlorgas-Einsatz möglich’, *Süddeutsche Zeitung*, 14 Oct. 1992, p. 2; ‘Serben bieten Abzug ihrer Luftwaffe aus Bosnien an’, *Frankfurter Allgemeine Zeitung*, 15 Oct. 1992, p. 1; AP, ‘Bosnia chief threatens the use of poison gas’, *International Herald Tribune*, 31 Oct.–1 Nov. 1992, p. 2; ‘Tuzla forces threaten chemical attacks’, in FBIS-EEU-92-198, 13 Oct. 1992, p. 27.

²⁶ ‘Use of chemical agents, napalm alleged’, in FBIS-EEU-92-185, 23 Sep. 1992, p. 23.

²⁷ ‘Threatens to use “poisonous gases”’, in Foreign Broadcast Information Service, *Daily Report—Near East & South Asia (FBIS-NES)*, FBIS-NES-92-211, 30 Oct. 1992, p. 34.

²⁸ ‘Serbischer Angriff auf Chemiefabrik Giftgasalarm für Stadt in Nordbosnien’, *Der Tagesspiegel*, 22 Nov. 1992, p. 1.

²⁹ Price, R., ‘The Balkan nightmare: an ASA CBW intelligence report’, *ASA Newsletter*, no. 32 (15 Oct. 1992), pp. 1, 10.

³⁰ ‘Opposition says Saddam to use chemical weapons’, in FBIS-NES-92-088, 6 May 1992, p. 14; ‘Iraq threatens Shiites with chemical attacks’, in FBIS-NES-92-091, 11 May 1992, p. 50.

III. Allegations of CW and BW possession

Even as the CWC was being finalized, allegations of CW acquisition programmes and possession, especially in the Middle East, continued to occur. How difficult it will be in the future to ensure that an individual country does not go the way of chemical armament is shown by the example of *Iraq*. Even with the special UN mandate concerning long-term monitoring and with the obligation to destroy all chemical weapons and CW-capable facilities, there are still many doubts about Iraq's total chemical disarmament.³¹

The specific allegations of CW or BW possession made in 1992 are summarized below.

Allegations continued that *Syria* is conducting a CW programme, in particular producing mustard gas and nerve agents and actively developing a CW missile capability.³² Two locations have been mentioned, one near the village of Safiya, in the north-east, close to the Turkish border, and the other to the south of the city of Homs, close to the main road to Damascus.³³ Concern about Syria's CBW programme mounted in August when a German vessel on the way to Syria was stopped in Cyprus with a shipment of 45 tonnes of trimethyl phosphite from Indian United Phosphorus Ltd.³⁴ Trimethyl phosphite is used in the production of the pesticide dichloro divinyl phosphate but can also be used for nerve gas production. After the USA alerted German authorities, the shipment was stopped in Cyprus and sent back to India. The Indian company had signed an agreement to export a total of 90 tonnes, and the first half of the order reached Damascus in May. An investigation by Indian customs authorities was launched, and after it was found that the company had exported chemicals without government clearance, the company was denied export licences for six months.³⁵

As in the past *Iran* was alleged to have an active chemical warfare programme.³⁶ In February Germany announced that a request by the Iranian Government to participate in the construction of a projected pesticide plant at Qazvin would be refused.³⁷ In July the Iranian Foreign Minister rejected categorically the allegation that Iran has an active chemical warfare programme and emphasized Iran's rejection of chemical and biological weapons.³⁸ This

³¹ Gaffney, F., 'U.S. foolishly strips capability to deter chemical weapon threat', *Defense News*, vol. 7, no. 9 (2 Mar. 1992); Rowe, T., 'U.N. still "concerned" about Iraq', *Washington Post*, 4 Apr. 1992, p. A19.

³² Waller, D., 'Sneaking in the Scuds', *Newsweek*, vol. 119, no. 25 (22 June 1992), pp. 20–24; 'Baraq on nuclear, chemical buildup by Syria, Iraq', in FBIS-NES-91-237, 10 Dec. 1991, p. 47; Hoffman, D., 'Israelis say Syrians test-fired new Scud', *Washington Post*, 14 Aug. 1992, p. A25.

³³ 'Syria's secret poison-gas plants', *Foreign Report*, 10 Sep. 1992.

³⁴ Gordon, M. R., 'India tied to poison gas deal', *International Herald Tribune*, 22 Sep. 1992, p. 5; Rotem, M., 'Indian chemical company won't stop shipment to Syria', *Jerusalem Post*, international edn, 22 Aug. 1992, pp. 1–4;

³⁵ 'India to prosecute chemical firm', *International Herald Tribune*, 24 Sep. 1992, p. 2.

³⁶ Timmerman, K. R., *Weapons of Mass Destruction: The Cases of Iran, Syria and Libya*, A Simon Wiesenthal Center Special Report, Aug. 1992.

³⁷ Hoffmann, W., 'German-Iranian trade: no weapons, says Möllemann', *German Tribune*, no. 1505 (28 Feb. 1992), p. 7.

³⁸ 'Iran entwickelt keine Nuklearwaffen', *Frankfurter Allgemeine Zeitung*, 31 July 1992, p. 1.

was repeated a few days later by Iran's representative to the UN, who pointed out that Iran does not intend to produce chemical weapons.³⁹

Libya was again very much in the public eye in 1992 as regards its CBW programme.⁴⁰ Libya is alleged to have cleaned up the ruins of its alleged CW production facility at Rabta and to have built a second plant on a site outside Sheba, about 650 km south of Tripoli.⁴¹ However, there is disagreement among experts as to whether a second plant exists. In response to allegations and under pressure from the UN, Colonel Muammar Qadhafi stated that Libya was prepared to consider outside inspection of alleged nuclear and CW sites.⁴²

Allegations continued that *North Korea* is conducting a CW programme which may include several facilities for production of nerve gas, blood agents and mustard gas.⁴³ The annual production capacity of nine plants is said to be approximately 5000 tonnes. The allegations, which have also cited a supposed BW programme, were strongly rejected by North Korean officials,⁴⁴ who responded with allegations of South Korean CBW activities and stockpiling.⁴⁵

It was claimed that *Pakistan* is attempting to acquire chemical and biological weapons,⁴⁶ but it categorically denied the allegation.⁴⁷

In January the chief of the *Russian* delegation to the Conference on Disarmament (CD) pointed out that all chemical weapons produced in the former Soviet Union are now within the boundaries and under the control of the Russian Federation.⁴⁸ However, there may still be some stockpiles of irritants (riot control agents) outside Russia, and certainly the choking gas chloropicrin could still be deployed by chemical defence units of the Russian forces in areas of conflict.⁴⁹ In May in Tashkent at the summit meeting of the heads of the CIS states, an agreement on chemical weapons was signed by Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, the Russian Federation, Tajikistan, Turkmenistan and Uzbekistan.⁵⁰ The agreement reaffirms that all CW storage and production facilities are on the territory of the Russian Federation. In early July the Russian Parliament adopted a resolution 'On Russia's international obligations on chemical and biological weapons'. Under the resolution Russia assumes responsibility as the legal successor to the Soviet Union

³⁹ 'UN envoy denies "rumors" on CW production', in FBIS-NES-92-151, 5 Aug. 1992, p. 36.

⁴⁰ See Timmerman (note 36).

⁴¹ Sciolino, E. and Schmitt, E., 'U.S. says Tripoli is augmenting and hiding poison weapons', *International Herald Tribune*, 23 Jan. 1992, p. 1.

⁴² Drozdiak, W., 'Libya launches bid to boost Western ties', *Washington Post*, 26 Jan. 1992, p. A21; 'Khadhafi: Libyen produziert keine Chemie-Waffen', *Süddeutsche Zeitung*, 6 Feb. 1992, p. 7.

⁴³ Starr, B., 'DIA warning over North Korean CW', *Jane's Defence Weekly*, vol. 17, no. 2 (11 Jan. 1992), p. 47; 'N. K. building up biochemical arms: NSP', *Korea Newsreview*, 31 Oct. 1992, p. 7.

⁴⁴ 'Foreign Ministry rejects chemical weapons charge', in Foreign Broadcast Information Service, *Daily Report-East Asia (FBIS-EAS)*, FBIS-EAS-92-212, 2 Nov. 1992, p. 12; 'Ministry denies stockpiling chemical weapons', in FBIS-EAS-92-211, 30 Oct. 1992, p. 16.

⁴⁵ 'ROK charge of chemical weapons use condemned', in FBIS-EAS-9-221, 16 Nov. 1992, pp. 14-16.

⁴⁶ 'U.S. says Pakistan stockpiling chemical weapons', in FBIS-NES-92-054, 19 Mar. 1992, p. 35.

⁴⁷ 'Spokesman denies Delhi report on chemical weapons', in FBIS-NES-92-054, 19 Mar. 1992, p. 41.

⁴⁸ 'C-Waffen-Einigung in Sicht', *Frankfurter Rundschau*, 10 Jan. 1992, p. 2; *Pacific Research*, vol. 5, no. 1 (Feb. 1992), p. 25.

⁴⁹ 'Chemical agents confined to Russian territory', in FBIS-SOV-92-044, 5 Mar. 1992, p. 6.

⁵⁰ For the text of the agreement, see *Military News Bulletin*, vol. 1, no. 5 (1992), pp. 2-3; see also entry for 15 May in the chronology in this volume.

with respect to the BWC, the June 1990 bilateral agreement between the former USSR and the USA,⁵¹ and the former Soviet commitment to adhere to the CWC.⁵² In August the Ukrainian Foreign Ministry stated that there were no CW stockpiles on Ukrainian territory.⁵³

Despite the May 1992 agreement in Tashkent, allegations continued that there are still chemical weapons outside Russia in other CIS states. In May Armenia requested the removal of chemical weapons from a Nagorno-Karabakh CIS troop depot in Azerbaijan.⁵⁴ However, earlier in February an official spokesman had stated that the former Soviet troops deployed in Nagorno-Karabakh do not possess a single chemical weapon.⁵⁵

In September a report was published in *Moscow News* by two Russian chemists about the development of a new toxic agent at GSNIIOCT (the State Union Scientific Research Institute for Organic Chemistry and Technology), a chemical technology research institute in Moscow.⁵⁶ The *Baltimore Sun* published an expanded version of the article, based on an interview with one of the scientists. According to the two scientists⁵⁷ the new agent, Novichok-8 (Russian for 'newcomer'), may considerably surpass the well-known gas VX in toxicity (it may be five to eight times more toxic⁵⁸) and could serve as the basis for a binary weapon—in contrast to the US approach to binary chemical weapons, one component is already a toxic compound. The two components of the binary system are not on the CWC's schedules of controlled chemicals (see chapter 14). The first industrial batch of the agent (5–10 tonnes)⁵⁹ was manufactured at the Khimprom plant in Volgograd, and field tests were completed in the first quarter of 1992 at a chemical test site on the Ustyurt plateau near Nukus in Uzbekistan. Both scientists were officially accused of revealing state secrets, and one was arrested and charged with unauthorized disclosure of state secrets. Neither had released the chemical formula of the new agent. The arrested scientist was released after 10 days, but criminal charges against him have not been dropped.⁶⁰ The other scientist, who was not arrested, pointed out that they wanted to draw attention to the fact that 'only the production has been stopped, not the research'.⁶¹ The international scientific com-

⁵¹ For the text of the agreement, see SIPRI, *SIPRI Yearbook 1991: World Armaments and Disarmament* (Oxford University Press: Oxford, 1991), pp. 536–39.

⁵² 'Resolution adopted on chemical, biological arms', in FBIS-SOV-92-132, 9 July 1992, pp. 55–56.

⁵³ 'Experts help draft convention', in FBIS-SOV-92-161, 19 Aug. 1992, p. 2.

⁵⁴ 'Armenia requests removal of chemical weapons', in FBIS-SOV-92-089, 7 May 1992, p. 4.

⁵⁵ 'CIS troops deny chemical weapons possession', in FBIS-SOV-92-040, 28 Feb. 1992, p. 64; 'Spokesman says no chemical weapons in Karabakh', in FBIS-SOV-92-089, 7 May 1992, p. 6.

⁵⁶ Mirzayanov, V. and Fyodorov, L., 'A poisoned policy', *Moscow News*, no. 39 (27 Sep.–4 Oct. 1992), p. 9.

⁵⁷ 'Russian chemist faces 15 years', *New Scientist*, vol. 136, no. 1847 (14 Nov. 1992), p. 10.

⁵⁸ 'Mirzayanov, Federov detail Russian CW production', in FBIS-SOV-92-213, 3 Nov. 1992, pp. 2–7.

⁵⁹ See note 58.

⁶⁰ 'Officials on disclosure of chemical arms revelations', in FBIS-SOV-92-219, 12 Nov. 1992, pp. 52–54.

⁶¹ Hiatt, F., 'Russia arrests a dissident scientist', *International Herald Tribune*, 27 Sep. 1992, pp. 1–2.

munity expressed great concern about the possibility that one of the scientists might face charges that carry a penalty of up to 15 years in prison.⁶²

In 1987 the former Soviet Union made an official disclosure of its CW production. At the same time the alleged development of a new nerve gas was officially denied.⁶³ On the other hand, it must be noted that, as the head of the newly established Russian Federation Defence Ministry's International Treaty Directorate pointed out, neither Russia nor any other state has pledged to end CW development, and the 1987 decision is only related to CW *production*.⁶⁴ The same argument was used by Anatoly Kuntsevich, head of the committee dealing with CW destruction problems, who declared that since 1987 there has been no new CW production in the former USSR or Russia. Until now there has been no international treaty banning offensive CW programmes, and the new CWC will also allow 'science in the sphere of psychologically active, highly toxic chemical compounds'.⁶⁵ The debate about using Novichok as a binary weapon continued.⁶⁶

Non-lethal warfare

Non-lethal warfare is designed to avoid casualties and long-term damage and to immobilize people rapidly for a short time (see also section VII of chapter 8). From September 1991 to the spring of 1992, allegations continued that in the fighting between Croatian and Serbian forces 'cobwebs' were dropped throughout the countryside by aircraft. The chemical and morphological tests conducted have shown that the fibres employed were a combination of synthetic material with an additional, finer proteinaceous fibre, possibly of natural origin. The fibres are not toxic, infectious or conductive, and are not traditional CW or BW agents.⁶⁷ However, the cobwebs were reported to have had a major psychological impact on the population. One explanation was that they may have been used to protect aircraft against anti-aircraft defence.

An August 1992 publication discussed the possibility that non-lethal weapons might be used in Serbia if the UN were to decide to fight there.⁶⁸ The possible options include the use of 'carbon-fibre filled warheads' to induce a total breakdown of electricity supply and air defence.

⁶² 'Scientists defend Russian whistleblower', *Science*, vol. 258, no. 5085 (13 Nov. 1992), p. 1086; MacKenzie, D., 'Russian chemist faces 15 years', *New Scientist*, vol. 136, no. 1847 (14 Nov. 1992), p. 10.

⁶³ 'Official denies report on chemical weapons', in FBIS-SOV-92-185, 23 Sep. 1992, p. 2.

⁶⁴ 'Chief of international treaty directorate views arms control', in FBIS-SOV-92-218, 10 Nov. 1992, pp. 2-4.

⁶⁵ 'CBW aide quizzed on program; secrecy rules questioned', in FBIS-SOV-92-224, 19 Nov. 1992, pp. 2-4.

⁶⁶ 'Development of "binary bomb" described', in FBIS-SOV-92-242, 16 Dec. 1992, pp. 23-26.

⁶⁷ Garrett, B. C., 'The curious case of the Croatian cobwebs', *ASA Newsletter*, no. 31 (12 Aug. 1992), p. 6; Fuchs, R., Sostaric, B., Plavsic, F., Prodan, I. and Binenfeld, Z., 'Chemical warfare without chemical agents', *Proceedings of the Fourth International Symposium on Protection Against Chemical Warfare Agents*, FOA report A 40067-4.6, 4.7 (National Defence Research Establishment: Umeå, Sweden, June 1992), p. 285.

⁶⁸ Fulghum, D. A., 'U.S. weighs use of nonlethal weapons in Serbia if U.N. decides to fight', *Aviation Week & Space Technology*, 17 Aug. 1992, pp. 62-63.

The US Department of Defence (DOD) is co-ordinating a new national security strategy endorsing the use of non-lethal technologies as an alternative to conventional and nuclear weapons and the creation of new options to strengthen the US position in the post-cold war world.⁶⁹ One major objective of the use of such new technologies (e.g., blinding lasers, infrasound, non-electromagnetic pulse and neural inhibitors) is to minimize collateral damage and civilian casualties. Also under investigation are techniques which apply chemical compounds to clog machinery and which could be sprayed on to runways to crystallize and destroy aircraft tyres, and microbes that can turn large storage tanks of jet fuel into useless jelly.⁷⁰ The US Army's Armament Research, Development and Engineering Center (ARDEC), which among other tasks conducts research on non-conventional, non-lethal munitions, is working on more than a dozen such technologies.⁷¹

IV. CBW proliferation and measures to halt it

Public concern about CW and to some extent BW proliferation grew in 1992. In January the Director of the CIA testified to the US Senate on proliferation and stated: 'Today, over 20 countries have, are suspected of having, or are developing nuclear, biological, or chemical weapons and the means to deliver them'.⁷² In a White Paper from the British Ministry of Defence, 10 countries were said to have BW programmes and twice that number were alleged to have CW programmes.⁷³ The number of countries alleged to possess chemical weapons or chemical warfare programmes has remained essentially the same over the past few years;⁷⁴ no new evidence became available in 1992.

In the absence of the CWC, counter-proliferation measures such as individual national export control measures, subregional export controls such as those by European Community (EC) countries and co-ordinated export control activities (by the Australia Group) were necessary to contain the spread of chemical and biological weapons. They represented one way of coping with the threat of proliferation of weapons, material and relevant technology.

In the year prior to the conclusion of the CWC there was clear understanding among all of the concerned countries that the export control measures that had already been implemented needed to be tightened. During the December 1991 meeting of the Australia Group two new members, Finland and Sweden, were

⁶⁹ Opall, B., 'Pentagon forges strategy on non-lethal warfare', *Defense News*, vol. 7, no. 7 (17 Feb. 1992), pp. 1, 50; Opall, B., 'Pentagon units jostle over non-lethal initiative', *Defense News*, vol. 7, no. 9 (2 Mar. 1992), p. 6; Munro, N. and Opall, B., 'Military studies unusual arsenal', *Defense News*, vol. 7, no. 42 (19 Oct. 1992), pp. 3, 44.

⁷⁰ See Fulghum (note 68).

⁷¹ Starr, B., 'USA tries to make war less lethal', *Jane's Defence Weekly*, vol. 18, no. 18 (31 Oct. 1992), p. 10.

⁷² '15 January', *Chemical Weapons Convention Bulletin*, no. 15 (Mar. 1992), p. 13; AP, Reuters, 'Iraq will quickly rebuild arms program, CIA chief asserts', *International Herald Tribune*, 16 Jan. 1992, p. 3.

⁷³ Secretary of State for Defence, *Statement on the Defence Estimates 1992* (Her Majesty's Stationery Office: London, July 1992), p. 7.

⁷⁴ See SIPRI, *SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), pp. 160–61.

added. At its next meeting in Paris on 2–5 June the Australia Group decided to add four chemicals (sulphur monochloride, sulphur dichloride, triethanolamine hydrochloride and 2-N,N-diisopropylaminoethyl chloride hydrochloride) to its list of 50 chemicals already subject to export control.⁷⁵ Additionally a list of 65 biological agents subject to control and a list of ‘dual-use’ equipment was introduced. However, according to information released from the meeting, not all of the participants were able to provide assurance that their governments would accept an agreement controlling the export of BW equipment. Other issues on the agenda of the June meeting were applications for membership (by Argentina, Czechoslovakia, Hungary and Poland) and the future of the Australia Group *per se*. At the 7–10 December meeting in Paris, the members of the Australia Group agreed to control the export of organisms and the toxins they produce. They also agreed to control equipment usable for BW production.⁷⁶ The meeting welcomed the conclusion of the CWC, and the group members reiterated their intention to be included among original signatories. Argentina⁷⁷ and Hungary were invited to participate in the next meeting in June 1993 as members. It is perhaps worth mentioning that Hungary held a December seminar in Budapest on CW and BW proliferation for East European countries which are constructing their own export control systems. Turkey also appears likely to join the Australia Group.⁷⁸

During the final stage of the CWC negotiations the Australia Group made a formal statement about the future aim of its activities, noting that its members ‘undertake to review, in the light of the implementation of the convention, the measures that they take to prevent the spread of chemical substances and equipment for purposes contrary to the objectives of the convention, with the aim of removing such measures for the benefit of State Parties to the convention acting in full compliance with their obligations under the convention’.⁷⁹

During the first UN Security Council ‘summit meeting’ at the end of January, 15 heads of states and governments agreed on a communiqué which ‘underlines the need for all member states . . . to prevent the proliferation in all its aspects of all weapons of mass destruction. The proliferation of all weapons of mass destruction constitutes a threat to international peace and security’.⁸⁰ In Washington officials from the five permanent members of the Security Council met in May to discuss, for the third time after the Persian Gulf War, the control of arms trade especially with the Middle East. They adopted guide-

⁷⁵ Odessey, B., ‘Chemical, biological weapons export controls agreed’, *Wireless File*, no. 113 (United States Information Service, US Embassy: Stockholm, 11 June, 1992), p. 5.

⁷⁶ Odessey, B., ‘Agreement reached on biological weapon export controls’, *Wireless File*, no. 243 (United States Information Service, US Embassy: Stockholm, 16 Dec. 1992), pp. 14–15.

⁷⁷ ‘Country joins Australian chemical control group’, in Foreign Broadcast Information Service, *Daily Report—Latin America (FBIS-LAT)*, FBIS-LAT-92-240, 14 Dec. 1992, p. 30.

⁷⁸ ‘19 October’, *Chemical Weapons Convention Bulletin*, no. 18 (Dec. 1992), p. 18.

⁷⁹ Australia, ‘Statement made on behalf of the Australia Group’, Conference on Disarmament document CD/1164, 7 Aug. 1992.

⁸⁰ ‘Note by the President of the Security Council’, United Nations Security Council document S/23500, 31 Jan. 1992.

lines for control of weapons of mass destruction which also specifically focus on chemical and biological weapons and related technology.⁸¹

In June, pressed by its Western allies and the US Congress, the Bush Administration changed its position concerning application of the rules of the Coordinating Committee on Multilateral Export Controls (COCOM) to the former Soviet Union. It was agreed that the newly independent republics would be urged to join in the global effort to control the spread of missile technology and NBC weapons.⁸²

The EC nations, concerned about the implementation in 1993 of the internal market, intensified their efforts to achieve a co-ordinated policy. A special EC commission worked to harmonize the export control regulations of individual countries which are designed to control chemical substances and sensitive technology with the aim of arriving at a single list of dual-use technologies.⁸³

Germany took measures to strengthen its export legislation. In January changes were made in the list of countries (country list H) to which German export control measures are applied. Previously the list covered 54 countries, and industry was greatly concerned about the long time which tended to elapse from filing an application to approval. The list now covers only 34 countries.⁸⁴ The Federal Assembly (Bundestag) also approved legislation to allow investigators to tap telephones and intercept the mail of individuals suspected of violating export laws.⁸⁵ In April the new Federal Export Office (Bundesausfuhramt) was established in Eschborn; it is slated to employ 400 people in 1992. The Federal Export Office is responsible for the control, clarification and approval of all requests for export according to new legislation for foreign trade.⁸⁶ Germany's Customs Criminology Institute (ZKI) operates an early-warning data base system called KOBRA which centralizes all documents filed with customs concerning certain categories of technology where there could be suspicion of weapon proliferation. By the end of 1993 a new export list is to be prepared which will be compatible and co-ordinated with new European, Japanese and US lists.⁸⁷

Owing to the involvement of German companies in the buildup of the Iraqi CBW programme and the results of the UNSCOM findings, trials were conducted in Germany to investigate violations of German foreign trade law. In April trials began in Darmstadt against the Karl Kolb Pilot Plant and the WET

⁸¹ Smith, R. J., '5 nations reach arms export accord', *Washington Post*, 30 May 1992, p. A15. For the text of the document, see appendix 10C in this volume.

⁸² Auerbach, S., 'Cocom eases rules on equipment sales', *Washington Post*, 3 June 1992, p. A5.

⁸³ 'Die EG will Schlupflöcher für den Export sensibler Güter stopfen', *Frankfurter Allgemeine Zeitung*, 2 Sep. 1992, p. 1; Bellamy, C., 'EC nations vote for controls on weapon exports', *The Independent*, 19 Sep. 1992, p. 13.

⁸⁴ 'Umstrittene Exporte erleichtert', *Frankfurter Rundschau*, 23 Jan. 1992, p. 4.

⁸⁵ Vogel, S., 'Bonn to allow wiretaps on arms-related exports', *Washington Post*, 24 Jan. 1992, p. A18; Deupmann, U., 'Ein gutes Gesetz, das Hilfe braucht', *Süddeutsche Zeitung*, 24 Jan. 1992, p. 4.

⁸⁶ 'Neues Bundesausfuhramt kontrolliert Exporte', *Der Tagesspiegel*, 2 Apr. 1992, p. 57; 'Bonn erteilt Exporteuren neue Auflagen', *Frankfurter Allgemeine Zeitung*, 22 Apr. 1992, p. 15.

⁸⁷ 'Europäer erarbeiten eine gemeinsame Ausfuhrliste', *Frankfurter Allgemeine Zeitung*, 13 Oct. 1992, p. 15.

firms.⁸⁸ The court requested the release of UNSCOM documents which might provide additional information about the involvement of German firms, but the German Government denied the request, referring to the political nature of the information involved.⁸⁹ Some judges of the Darmstadt court criticized the Ministry of Justice for its lack of co-operation.

In August an appeal was heard against the verdict of the October 1991 trial against three Imhausen company managers who were convicted of involvement in the buildup of the Rabta CW facility in Libya.⁹⁰ One of the three managers received a stiffer sentence.⁹¹ In another trial the former head of the Imhausen company confessed that government R&D money had been misused to pay employees.⁹²

German companies are estimated to have supplied Iraq with \$198 million of so-called dual-use items during 1986–90. Officials from one German company were alleged to have designed four plants in Iraq for CW production, and three other companies made equipment to fill munitions. Six German companies supplied equipment for making botulin toxin and mycotoxins, including laboratory devices and protective equipment. This information is based on German, UN and US sources.⁹³ As of July only one company had been convicted of exporting to Iraq, and 37 others were under investigation for various violations, not all of which were related to the CBW support of the Iraqi programme.

Japan tightened its export controls on 59 chemicals by requiring prior government approval before export.⁹⁴ Among them are also chemicals harmful to the environment.

The *Russian* Government established a body, including the heads of its foreign policy, industry, economics, finance and security departments, to control arms exports.⁹⁵ In November Russia established rules for control of the export of biological agents that can be used for developing bacteriological (biological) and toxin weapons, thereby making it impossible to export or re-export to states in violation of the 1925 Geneva Protocol or the BWC.⁹⁶ Licensing under this legislation⁹⁷ is mandatory and a licence can be issued only by the Russian

⁸⁸ Müller-Gerbes, H., 'Wie haben deutsche Firmen beim Aufbau des irakischen Giftgas-Arsenals geholfen?', *Frankfurter Allgemeine Zeitung*, 23 Apr. 1992, p. 4; 'Bei Lieferungen nicht an Bomben gedacht', *Frankfurter Allgemeine Zeitung*, 29 Apr. 1992, p. 7.

⁸⁹ Müller-Gerbes, H., 'Richter als "Zinnsoldaten der Macht"?', *Frankfurter Allgemeine Zeitung*, 16 June 1992, p. 4; 'Bundesregierung weist Kritik zurück', *Frankfurter Allgemeine Zeitung*, 30 June 1992, p. 4.

⁹⁰ 'Imhausen-Prozeß: Zum Teil neu verhandeln', *Frankfurter Allgemeine Zeitung*, 21 Aug. 1992, p. 13.

⁹¹ 'Urteil im Imhausen-Prozeß', *Frankfurter Allgemeine Zeitung*, 7 Oct. 1992, p. 4.

⁹² 'Imhausen legt Geständnis ab', *Süddeutsche Zeitung*, 19 Nov. 1992, p. 7; 'Erneut Haft für Hippenstiel-Imhausen', *Süddeutsche Zeitung*, 10 Dec. 1992, p. 7.

⁹³ Smith, R. J. and Fisher, M., 'Lax Bonn oiled Iraq war machine', *International Herald Tribune*, 24 July 1992, p. 1, 2.

⁹⁴ 'Tokyo to tighten controls on chemical exports', in FBIS-EAS-92-117, 17 June 1992, p. 7.

⁹⁵ 'Group to control arms export', in FBIS-SOV-92-023, 4 Feb. 1992, p. 36.

⁹⁶ 'Statute on control of CBW raw materials', in FBIS-SOV-92-237, 9 Dec. 1992, pp. 8–9.

⁹⁷ The law is the Statute on the Procedure for Controlling the Export from the Russian Federation of Pathogens, Their Genetic Variations, and Fragments of Genetic Material Which Could be Used in the Creation of Bacteriological (Biological) and Toxin Weapons. It was approved by the Russian Government as Decree no. 892, dated 20 Nov. 1992; see 'Statute on control of CBW raw materials' (note 96).

Ministry of Foreign Economic Relations.⁹⁸ The new legislation lists specific pathogens, viruses, toxins, genetic variations and fragments of genetic material to which the licensing procedure is to be applied.⁹⁹

In the *USA* in testimony before the Joint Economic Committee, Subcommittee on Technology and National Security, Richard Clarke outlined in March the progress in US non-proliferation measures in 1991 and pointed out that more has to be done with respect to chemical and biological weapons.¹⁰⁰ He pointed especially to several regions, including North Korea, Iran and South-East Asia. For South-East Asia, the USA has proposed that China, India, Pakistan, Russia and the United States hold a conference to address regional proliferation problems, but India has not agreed to participate. One of the main achievements of the 1991 Enhanced Proliferation Controls Initiative (EPCI)¹⁰¹ is its control of CW and BW material. Similar control measures have been adopted or are in the process of being adopted by at least 26 countries.

In July President George Bush outlined a new non-proliferation initiative designed to address the spread of the capability to produce or acquire weapons of mass destruction and the means to deliver them, which were seen to constitute a growing threat to US national security.¹⁰² It suggested four guiding principles for multilateral and regional action, including a demand for harmonization of export controls.¹⁰³ In October the US Senate strengthened the 1993 Defence Authorization Bill by adding \$56 million for research on non-proliferation and \$20 million for international non-proliferation activities.¹⁰⁴ Ultimately, Congress authorized \$168 million for fiscal year (FY) 1993 to combat the proliferation of NBC weapons.¹⁰⁵

⁹⁸ 'Government adopts rules for biological weapons export', in FBIS-SOV-92-228, 25 Nov. 1992, p. 2.

⁹⁹ The list contains many of the biological agents on the Australia Group's June 1992 list of biological agents; see 'Yeltsin's document on pathogen export control', in FBIS-SOV-92-238, 10 Dec. 1992, pp. 8–10.

¹⁰⁰ Statement of Richard A. Clarke, Assistant Secretary for Politico-Military Affairs, Department of State, before the Joint Economic Committee, Subcommittee on Technology and National Security, 13 Mar. 1992; Mandine, R., 'Iraq's nuclear program said to be put on halt', *Wireless File*, no. 50 (United States Information Service, US Embassy: Stockholm, 13 Mar. 1992), pp. 14–15.

¹⁰¹ See *SIPRI Yearbook 1992* (note 74), p. 163.

¹⁰² US Department of State, 'Non-proliferation efforts bolstered', *US Department of State Dispatch*, vol. 3, no. 29 (20 July 1992), pp. 569–71.

¹⁰³ The guiding principles are: (a) the USA will build on existing global norms against proliferation and where possible strengthen and broaden them; (b) the USA will focus special efforts on those areas where the dangers of proliferation remain acute, notably the Middle East, the Persian Gulf, South Asia, and the Korean Peninsula; (c) US non-proliferation policy will seek the broadest possible multilateral support while continuing to show leadership on critical issues; and (d) the USA will address the proliferation issue through the entire range of political, diplomatic, economic, intelligence, regional security, export controls and other tools available. See US Department of State (note 102).

¹⁰⁴ Towell, P., 'Two major obstacles dissolve as time for talk winds down', *Congressional Quarterly*, vol. 50, no. 38 (26 Sep. 1992), p. 2960.

¹⁰⁵ Towell, P., 'Spending bill trims some now, sets bigger cuts in motion', *Congressional Quarterly*, vol. 50, no. 40 (10 Oct. 1992), pp. 3184–89.

V. Destruction of chemical weapons

US–Russian bilateral agreements

During a June summit meeting President George Bush and President Boris Yeltsin stressed their commitment to the global elimination of chemical weapons, as expressed in the Joint Statement on Chemical Weapons.¹⁰⁶ They agreed to instruct their negotiators in Geneva to act so that the CWC could be concluded by the end of August 1992 and pledged to support the 1989 Wyoming Joint Memorandum¹⁰⁷ on confidence-building measures (CBMs) in the area of CW destruction. New provisions for data exchange and inspection under the Joint Memorandum will be implemented as soon as agreed upon. Bush and Yeltsin agreed to update the 1990 bilateral agreement on the destruction of chemical weapons,¹⁰⁸ and to bring it into force.

In the Agreement on the Safe and Secure Transportation, Storage and Destruction of Weapons and the Prevention of Weapons Proliferation,¹⁰⁹ both parties pledged their co-operation to assist Russia to achieve: (a) the destruction of nuclear, chemical and other weapons, (b) the safe and secure transportation and storage of such weapons, and (c) the establishment of additional verifiable measures against the proliferation of such weapons. Among other things the agreement provides the legal framework for US financial support of Russian CW destruction. It entered into force upon signature in June 1992 and will remain in force for seven years.

In July Russia and the USA began bilateral talks in Geneva about implementing the June 1990 agreement.¹¹⁰ Under the 1989 Wyoming Joint Memorandum the second phase, data exchange, will start not later than four months prior to the initialling of the text of the CWC.¹¹¹

The US CW destruction programme

In late November 1991 the US Congress extended the deadline for the destruction of CW stockpiles to July 1999,¹¹² after earlier having extended the completion date for destruction to 30 April 1997. These deadline changes were further complicated by a six-month shutdown of the Johnston Atoll Chemical Agent Disposal System (JACADS). In April 1992 the destruction deadline

¹⁰⁶ 'Letter dated 3 Aug. 1992 from the Representative of the United States of America addressed to the President of the Conference on Disarmament transmitting documents relating to arms control and disarmament issues agreed on during the summit meeting held by Presidents Bush and Yeltsin in Washington, DC in June 1992', Conference on Disarmament document CD/1162, 12 Aug. 1992.

¹⁰⁷ SIPRI, *SIPRI Yearbook 1990: World Armaments and Disarmament* (Oxford University Press: Oxford, 1990), pp. 531–32.

¹⁰⁸ See note 51.

¹⁰⁹ See note 106.

¹¹⁰ See note 51.

¹¹¹ '20 July', Institute for Defense and Disarmament Studies, *Arms Control Reporter* (IDDS: Brookline, Mass.), sheet 704.B.533, Sep. 1992.

¹¹² US General Accounting Office, *Chemical Weapons: Stockpile Destruction Cost Growth and Schedule Slippages are Likely to Continue*, Report of the Chairman, Committee on Governmental Affairs, US Senate, GAO/NSIAD-92-18 (General Accounting Office: Washington, DC, Nov. 1991).

was extended to the year 2000, with the cost estimated at nearly \$8 billion.¹¹³ Under the leadership and sponsorship of the National Academy of Sciences a study is being conducted to investigate chemical demilitarization (chemdemil) technology alternatives to incineration. These technologies include among others: hydrolysis, aminolysis, thermohydrolysis, bioremediation, supercritical water oxidation, pyrolysis, fluidized-bed combustion, plasma arc and electrochemical techniques.¹¹⁴ A final report was due by the end of 1992, but in June the Office of Technology Assessment (OTA) was able to present a report on alternatives to on-site incineration for the destruction of CW. The report was prepared partially in response to protests by local community groups and other organizations opposed to the Army's current incineration programme which have suggested that other technologies might be safer.¹¹⁵ The following destruction techniques were mentioned: chemical neutralization; supercritical water oxidation; steam gasification technology; and plasma arc technology.

In October after intense debate on the FY 1993 defence authorization bill, the US Congress ordered re-examination of alternative destruction technologies and extended the completion date for destruction of all chemical weapons to 31 December 2004.¹¹⁶ The Army was also requested to establish a Chemical Demilitarization Citizens' Advisory Commission in each state where 5 per cent or less of the US CW stockpile is located. The Secretary of the Army is required to submit to Congress by 31 December 1993 a report assessing possible alternative destruction technologies and to respond to the report by the National Academy of Sciences mentioned above. Additionally, the Secretary of the Army is to submit to Congress not later than 1 May 1993 a report on the condition and integrity of the US CW stockpiles. Table 7.1 shows the current schedule for the US destruction programme.

The US Army established a new agency, the Chemical Material Destruction Agency (USACMDA),¹¹⁷ based on the former Office of the Program Manager for Chemical Demilitarization, with an expanded mission including the disposal of non-stockpile items such as wastes from earlier disposal efforts, un-serviceable munitions, chemical production facilities, sites known to contain significant concentrations of buried chemical weapons and wastes, binary weapons and components.

JACADS continued its operational verification testing (OVT). Phase I of the OVT was completed in February 1991; phase II focused on the disposal of VX

¹¹³ Statement by Susan Livingstone, Assistant Secretary of the Army (Installations, Logistics and Environment), before the Subcommittee on Defense, Committee on Appropriations, US Senate, 102nd Congress, 2nd Session, Chemical Disposal Program, 12 May 1992.

¹¹⁴ Ember, L., 'Incineration of chemical arms to be studied', *Chemical & Engineering News*, vol. 70, no. 15 (13 Apr. 1992), pp. 29–30.

¹¹⁵ US Congress, Office of Technology Assessment, *Disposal of Chemical Weapons: Alternative Technologies—Background Paper*, OTA-BP-O-95 (US Government Printing Office: Washington, DC, June 1992).

¹¹⁶ See Ember (note 114); *National Defense Authorization Act for Fiscal Year 1993: Conference Report to Accompany HR 5006*, 1 Oct. 1992, US House of Representatives, 102nd Congress, 2nd Session, report 102-966 (US Government Printing Office: Washington, DC, 1992), pp. 566–67.

¹¹⁷ 'PM to convert to agency', *Chemical Demilitarization Update*, vol. 1, no. 6 (May 1992), p. 2; 'US destruction developments', *Pacific Research*, vol. 5, no. 3 (Aug. 1992), pp. 24–25.

TABLE 7.1 TO GO ON THIS PAGE.

stored in M55 rockets and was concluded in March 1992 with the destruction of 13 876 rockets. On 21 January an explosion occurred in one of the facility's four rotary kiln furnaces and operations were halted.¹¹⁸ Phase III of the OVT, the disposal of ton-containers filled with mustard gas, was completed in October. During phase III, 67 containers were decontaminated and more than 51 000 kg were destroyed in a two-stage liquid incinerator.¹¹⁹ The last phase of the OVT, the disposal of mustard gas-filled projectiles, is planned to be concluded in early 1993, more than six months behind schedule.

Construction of the Tooele Chemical Disposal Facility (TOCDF) at Tooele Army Depot in Utah was approximately 61 per cent complete in October.¹²⁰ The TOCDF is scheduled to be completed in the summer of 1993 and test runs may start in August 1993. At the TOCDF, disposal of 42.3 per cent of the US stockpile will start in early 1995.

The third destruction facility at Anniston Army Depot, Alabama (where 7.1 per cent of the US CW stockpiles are located) will start destruction according to the previous plan in October 1997. The construction contract is expected to be awarded in the autumn of 1993.¹²¹ However, a new law blocks at least temporarily the Army's use of incineration for its destruction programme, and thus \$105 million were removed from the FY 1993 military construction appropriations bill, preventing construction at Anniston. This October 1992 decision is closely related to a review of alternative technologies which the Army is required to conduct and report on by December 1993.¹²² At three other sites in Indiana (Newport Army Ammunition Plant), Kentucky (Lexington-Blue Grass Army Depot) and Maryland (Aberdeen Proving Ground), all with less than 5 per cent of the total stockpile, construction was scheduled to start in 1994 and 1995. However, owing to strong opposition to construction of an incineration plant this schedule is unlikely to be kept.

Since 1990 the Army has trained more than 2000 individuals at its Chemical Demilitarization Training Facility at the Aberdeen Proving Ground, another important step in facilitating the US destruction programme.¹²³

Some factors have changed since the 1988 decision to use high-temperature incineration at each storage facility, and subsequent to a 1990 congressional decision, the Army is now also conducting a programme to develop and adopt the cryofracture technique. A two-phase cryofracture testing programme began in January 1990. Phase I, non-agent tests, was carried out at the General Atomics facility in San Diego. Phase II, agent-related tests, is being conducted

¹¹⁸ 'Johnston Atoll blast', *Pacific Research*, vol. 5, no. 1 (Feb. 1992), p. 26; 'Explosion halts chemical arms destruction', *Chemical & Engineering News*, vol. 70, no. 6 (10 Feb. 1992), p. 22.

¹¹⁹ 'OVT nears completion at JL facility', *Chemical Demilitarization Update*, vol. 1, no. 8 (Oct. 1992), p. 2.

¹²⁰ 'Tooele update', *Chemical Demilitarization Update*, vol. 1, no. 8 (Oct. 1992), p. 5.

¹²¹ 'Anniston update', *Chemical Demilitarization Update*, vol. 1, no. 8 (Oct. 1992), p. 5.

¹²² Ember, L., 'Chemical arms destruction: Congress puts incineration on hold', *Chemical & Engineering News*, vol. 70, no. 43 (26 Oct. 1992), p. 4.

¹²³ 'Training is underway at CDTF', *Chemical Demilitarization Update*, vol. 1, no. 8 (Oct. 1992), p. 4.

at the Chemical Agent Munition Disposal System (CAMDS) at Tooele Army Depot in Utah.¹²⁴

The Russian CW destruction programme

In early 1992 it became apparent that Russia was unable to begin CW destruction.¹²⁵ In January it was announced that a state committee for elimination of chemical weapons would be created, and President Yeltsin reported on preparations for a state programme.¹²⁶ The then two-year-old draft for the former Soviet state programme will be re-examined by the Supreme Soviet of the Russian Federation.¹²⁷

In February Russian Foreign Minister Andrey Kozyrev addressed the CD in Geneva and stated that the 40 000 tonnes of toxic agents for which Russia has assumed responsibility are difficult to destroy and that, while Russia has the technology for destruction, assistance from other countries would be helpful and welcomed.¹²⁸

By the end of February President Yeltsin had established a Committee on Convention Problems Relating to Chemical and Biological Weapons, with the Russian specialist Professor Anatoly Kuntsevich as its chairman.¹²⁹ Among other duties, the committee will deal with implementation of the CWC and organize elimination of the CW stockpiles. Kuntsevich highlighted three major destruction problems: personnel problems, inadequate funding of R&D related to CW elimination, and difficulties in implementing destruction programmes as a result of reactions from local authorities and the public.¹³⁰ Under the May 1992 agreement on chemical weapons of other CIS states will co-operate in the CW destruction which will be carried out by Russia.¹³¹ Financial commitments will be regulated by a separate agreement.

In June President Yeltsin issued a directive on Priority Measures for Implementing Russia's Obligations in Destroying Chemical Weapons Stockpiles. Under this order the Committee on Convention Problems Relating to Chemical and Biological Weapons assumed responsibility for organizing the CW destruction programme.¹³² In July the Russian Supreme Soviet adopted a resolution which calls for 'draft comprehensive programs for the phased destruction of chemical weapons' to be submitted to the Supreme Soviet by 15 September.¹³³ A slightly delayed draft plan, the Complex Program of the Stage-

¹²⁴ 'Cryo evaluation underway', *Chemical Demilitarization Update*, vol. 1, no. 7 (July 1992), pp. 4-5.

¹²⁵ 'Russia not able to destroy chemical arms', *Chemical & Engineering News*, vol. 70, no. 3 (20 Jan. 1992), p. 17; Thränert, O., *Probleme der Abrüstung Chemischer und Biologischer Waffen in der GUS*, no. 53 (Friedrich-Ebert Stiftung: Bonn, Oct. 1992).

¹²⁶ 'Chemical weapons elimination group formed', in FBIS-SOV-92-019, 29 Jan. 1992, p. 6.

¹²⁷ 'Problems cited in chemical weapons elimination', in FBIS-SOV-92-023, 4 Feb. 1992, p. 7.

¹²⁸ 'Further on proposals', in FBIS-SOV-92-030, 13 Feb. 1992, p. 2.

¹²⁹ 'Chemical, biological weapons committee set up', in FBIS-SOV-92-040, 28 Feb. 1992, p. 2.

¹³⁰ 'Problems of eliminating chemical arms explained', in FBIS-SOV-92-055, 20 Mar. 1992, p. 4.

¹³¹ See note 50.

¹³² 'Yeltsin decree on destruction of chemical weapons', in FBIS-SOV-92-117, 17 June 1992, p. 24.

¹³³ The resolution is entitled Resolution of the Russian Federation Supreme Soviet on Ensuring the Fulfillment of the Russian Federation's International Commitments in the Sphere of Chemical, Bacterio-

By-Stage Elimination of Chemical Weapons in the Russian Federation, was presented to the Russian Parliament in October.¹³⁴ According to the plan destruction will be conducted at Novocheboksark in the Chuvashiya region, Kambarka in the Udmurtia region and Gornyy in the Saratov region. At Volks-17 in the Saratov region a pilot industrial facility will be located for recycling the by-products of detoxification. The sarin, soman and VX ammunition (a total of 9800 tonnes), stored at depots in the cities of Shchuchye in the Kurgan region and Kizner in the Udmurtia region, will be transported to the Khimprom facility at Novocheboksark.¹³⁵

The first phase of the programme, which is slated to start in April 1993, will include the following activities: ecological evaluation, feasibility studies of projects, manufacturing and testing of pilot facilities, testing of technology and training of experts. Destruction *per se* will not start until 30 June 1997.¹³⁶ According to press reports the first phase of the programme will cost 45 billion roubles (in 1993 prices), of which 4.4 billion roubles will be spent in 1993, and at least \$4.5 million will be needed to purchase equipment (e.g., furnaces for thermal treatment) from other countries.¹³⁷ The 1993 budget for the various destruction facilities is the following: Kambarka, 320 million roubles; Gornyy, 207 million roubles; Novocheboksark, 100 million roubles; Volks-17, 29 million, 100 million roubles for railroad modernization; and 80 million roubles for a diagnostic and prevention centre. According to the plan, by 2004 some 43 per cent of the CW stocks will be destroyed.¹³⁸ In July the overall cost of the programme was estimated at 100 billion roubles;¹³⁹ by the end of 1992 the figure had increased to 400–500 billion roubles (approximately \$1–\$1.25 billion) for destruction of the entire stockpile.¹⁴⁰

It is currently impossible to evaluate seriously these expenditure figures owing to: (a) the enormous inflation in Russia, (b) the totally unreliable foreign exchange rates, and (c) the disagreement about what kind of expenditures might be included in the calculations (e.g., whether housing costs, approximately 15 per cent of the amount to be spent on infrastructure development, have been included). In phase I of the plan three facilities must be made operational. They are intended to destroy at least 45 per cent of the agents including lewisite, mustard gas and lewisite-mustard gas mixture stored at Kambarka and Gornyy.¹⁴¹ At Kambarka there are 7000 tonnes of lewisite in

logical (Biological), and Toxin Weapons, no. 3244-1; see 'Resolution on chemical weapons commitments', in FBIS-SOV-92-144, 27 July 1992, pp. 36–37.

¹³⁴ 'Deputies view draft bill on eliminating chemical arms', in FBIS-SOV-92-208, 27 Oct. 1992, p. 46; 'Committee examine program for destroying chemical weapons', in FBIS-SOV-92-212, 2 Nov. 1992, p. 56.

¹³⁵ 'Panels discuss plan for destruction of chemical weapons', in FBIS-SOV-92-215, 5 Nov. 1992, pp. 49–50.

¹³⁶ 'Plans ready for destruction of chemical weapons', in FBIS-SOV-92-188, 28 Sep. 1992, pp. 2–3.

¹³⁷ 'Committee examine program for destroying chemical weapons' (note 134).

¹³⁸ See note 135.

¹³⁹ 'Scrapping of arms to cost 100 billion roubles', in FBIS-SOV-92-132, 9 July 1992, p. 3; 'Delays in chemical weapon disarmament viewed', in FBIS-SOV-92-084, 30 Apr. 1992, pp. 5–6.

¹⁴⁰ Ember, L., 'Russia seeks U.S. expertise, money to destroy its chemical arms', *Chemical & Engineering News*, vol. 70, no. 47 (23 Nov. 1992), pp. 14–15.

¹⁴¹ 'Official examines destruction of CBW weapons', in FBIS-SOV-92-186, 24 Sep. 1992, pp. 2–4.

containers which have been stored there for more than 40 years.¹⁴² At Gornyy nearly 1200 tonnes of mustard gas and lewisite are stored in barrels (700 tonnes of mustard gas, 230 tonnes of lewisite, 152 tonnes of mustard-lewisite mixture, and 72 tonnes of mustard-lewisite mixture in dichloroethane).¹⁴³

At the Novocheboksark site, production facility no. 3, shop no. 83, for VX was operational from December 1972 to 1987 and is now mothballed.¹⁴⁴ However, there remain artillery shells and rockets filled with sarin, soman and VX of approximately 9800 tonnes under sealed conditions.¹⁴⁵ According to the destruction plan, the facility will be converted into a disposal facility.¹⁴⁶ Destruction operations might also be carried out at the following former production facilities: Berezniki, Chapayevsk and Dzerzhinsk (Gorkiy region) and at Volgograd.¹⁴⁷

Additional information about the Russian destruction programme and former Soviet CW production activities was presented in October by the two Russian scientists mentioned above.¹⁴⁸ According to their information, 30 000 tonnes of the officially declared 40 000 tonnes of agent are phosphorous organic agents—sarin, soman and VX—and the remaining 10 000 tonnes are composed of 7000 tonnes of lewisite, 1500 tonnes of a mixture of mustard gas and lewisite, and 1500 tonnes of mustard gas. In addition to the previously mentioned former production sites, herbicides were produced in Ufa, psychotropic substances in Volsk and riot control agents in Slavgorod. Mustard gas was produced in the 1940s in Chapayevsk and Dzerzhinsk, as was lewisite. After World War II a confiscated German plant was brought to Dzerzhinsk for mustard gas and lewisite production, which was carried out until 1952. During the 1940s there was also a small production plant for lewisite and mustard gas in Moscow. Production of soman and sarin took place in Volgograd and, in addition, VX was produced at Novocheboksark. In Chapayevsk during the 1940s overall production was of the range of 10 000–15 000 tonnes of mustard gas.

The destruction technologies which might be used by Russia can be readily summarized. Until recently neutralization was the disposal technique of choice. Now other techniques such as chemical destruction, incineration and plasma technologies are under consideration. Lewisite might be reprocessed to extract arsenic, probably in the form of gallium arsenide.¹⁴⁹ In Kambarka the lewisite will likely first be pumped from huge containers into smaller, one cubic metre containers. However, the detoxification of lewisite with molten

¹⁴² 'Udmurtia discusses chemical weapons disposal', in FBIS-SOV-92-064, 2 Apr. 1992, p. 3.

¹⁴³ Ember, L., 'Russia seeks U.S. expertise, money to destroy its chemical arms' (note 140); 'No proven technology for chemical disposal', in FBIS-SOV-92-086, 4 May 1992, p. 5.

¹⁴⁴ 'Chemical weapons destruction sites discussed', in FBIS-SOV-92-190, 30 Sep. 1992, pp. 2–3.

¹⁴⁵ See Ember (note 140).

¹⁴⁶ 'Chemical weapons destruction sites discussed' (note 144); 'Novocheboksark's plant may switch to destroying chemical arms', in FBIS-SOV-92-228, 25 Nov. 1992, pp. 2–3.

¹⁴⁷ "'Mixed feelings" over proposed CW Convention', in FBIS-SOV-92-172, 3 Sep. 1992, pp. 2–3.

¹⁴⁸ 'Fedorov, Mirzayanov article on chemical war against environment', in FBIS-SOV-92-212, 2 Nov. 1992, pp. 2–4; 'Mirzayanov, Fedorov detail Russian CW production' (note 58).

¹⁴⁹ 'Udmurtia discusses chemical weapons disposal' (note 142); 'Udmurtia plans to destroy chemical weapons', in FBIS-SOV-92-113, 11 June 1992, p. 6; 'Project to convert war gas into metal noted', in FBIS-SOV-063, 1 Apr. 1992, pp. 4–5.

sulphur into a water-insoluble polymer is still being considered,¹⁵⁰ as is a two-step process involving chlorination followed by electrolysis.¹⁵¹ For mustard gas and the nerve agents, detoxification into reaction products for future commercial use is being studied. As mentioned in the *SIPRI Yearbook 1992*,¹⁵² it has also been proposed that nuclear explosions be used to destroy the Russian CW stockpile.¹⁵³ The Moscow-based Chetek Corporation continues its attempt to market technology and assistance, in Russia and elsewhere, for the destruction of toxic wastes using underground explosions. Chetek has proposed using three underground explosions to destroy the entire Russian CW stockpile. However, as international concern and national uncertainty about the method grew, it became increasingly unlikely that such a technique would be utilized.¹⁵⁴ In November it was made known that Russia has abandoned plans to destroy chemical weapons by nuclear explosion.¹⁵⁵

In December 1991 the US Congress allocated \$400 million to support the nuclear and CW disarmament obligations of the former Soviet Union.¹⁵⁶ Of the total amount, \$25 million will be allocated to Russia to begin CW destruction as agreed during a visit of Russian officials to Washington on 30 July.¹⁵⁷ The agreement was concluded between the US DOD and the President's Committee on Conventional Problems of Chemical and Biological Weapons of the Russian Federation, headed by Anatoly Kuntsevich. Under it the DOD will provide: (a) development of mobile CW destruction systems; (b) participation in the establishment of national laboratory complexes, including providing technical equipment; (c) control and monitoring systems at destruction site; (d) medical facilities at destruction sites; (e) joint testing or experimentation related to destruction; and (f) other co-operation related to destruction as may be agreed.

The US funds will be used to begin construction of three destruction facilities in Russia. US companies have been invited to participate in the project, but contributions from Germany, Japan and other donors are also sought. In accordance with the above-mentioned July agreement, a Russian delegation

¹⁵⁰ Leonov, G. S. and Sheluchenko, V. V., 'Principal technological and environmental aspects of the destruction of chemical weapons', *Disarmament*, vol. 15, no. 2 (1992), pp. 94–100.

¹⁵¹ See Ember (note 140).

¹⁵² SIPRI, *SIPRI Yearbook 1992* (note 74), p. 169.

¹⁵³ 'Plans to destroy chemical weapons revealed', in FBIS-SOV-92-044, 5 Mar. 1992, pp. 5–6; 'Russia's nuclear business: is the threat real?', *Moscow News*, no. 19 (10–17 May 1992), p. 8.

¹⁵⁴ Hiatt, F., 'Russian nuclear scientists seek business, food', *Washington Post*, 18 Jan. 1992, pp. A1–A20.

¹⁵⁵ DPA, 'Keine atomare Entsorgung von Rußlands Giftmüll', *Süddeutsche Zeitung*, 21 Nov. 1992, p. 2.

¹⁵⁶ *SIPRI Yearbook 1992* (note 74), p. 170.

¹⁵⁷ 'Agreement between the Department of Defense of the United States of America and the President's Committee on Conventional Problems of Chemical and Biological Weapons of the Russian Federation concerning the safe, secure and ecologically sound destruction of chemical weapons', Conference on Disarmament document CD/1161, 5 Aug. 1992; Leopold, G., 'Russia wants early chemical demolition start', *Defense News*, vol. 7, no. 32 (10 Aug. 1992), p. 6; 'USA helfen Rußland bei C-Waffen-Zerstörung', *Süddeutsche Zeitung*, 1–2 Aug. 1992, p. 2.

including local Russian leaders from Cheboksary and Kambarka paid a visit to the Tooele Army Depot in the autumn of 1992.¹⁵⁸

In September a Russian delegation headed by Kuntsevich visited Germany to talk to officials at German companies about possible involvement in the Russian CW destruction programme. A contract was signed between the German company EST GmbH (set up by Deutsche Aerospace AG and Lurgi-Umwelt-Beteiligungsgesellschaft mbH) and the Russian company Metalchim to construct a destruction facility in Kambarka.¹⁵⁹ During a November visit to Washington, Kuntsevich stated that the Russian legislative committee had approved a destruction plan on 30 October according to which the former CW production facility at Novocheboksark will be converted to a destruction facility and two other destruction facilities will be built.¹⁶⁰ At that time the US Congress was discussing the defence authorization bill for FY1993 and ultimately \$800 million was allocated to help former Soviet republics dismantle their arsenals of nuclear and chemical weapons.¹⁶¹

In November it was reported that in addition to the \$25 million originally earmarked for CW destruction, the USA will provide \$30 million more for the Russian destruction programme.¹⁶² Other countries have also considered providing financial assistance to Russia. For 1993 Germany budgeted 10 million DM to support Russian destruction of weapons of mass destruction, particularly nuclear warheads.¹⁶³

Canadian CW destruction

During Operation 'Swiftsure', Canada spent \$14.28 million on the destruction of residual mustard gas stock by incineration. Some 15 tonnes of mustard gas and one-third tonne of assorted nerve agents from World War II, which had been stored at Suffield, were destroyed during the operation. The mustard gas was frozen inside boxes and then fed into the incinerator—technology comparable to the cryofracture technique. The nerve agents were neutralized using an alcohol solution.¹⁶⁴

¹⁵⁸ 'Russia joins the U.S. in demilitarization effort', *Chemical Demilitarization Update*, vol. 1, no. 8 (Oct. 1992), pp. 1–3.

¹⁵⁹ 'Lurgi will in Rußland Chemiewaffen entsorgen', *Der Tagesspiegel*, 7 Sep. 1992, p. 14; 'Lurgi baut Fabrik zur Waffenvernichtung', *Frankfurter Allgemeine Zeitung*, 8 Sep. 1992, p. 19; 'Contract to destroy chemical arms', *Financial Times*, 9 Sep. 1992, p. 5.

¹⁶⁰ Leopold, G., 'Russia seeks Western, U.S. aid to destroy chemical weapons', *Defense News*, vol. 9, no. 46 (16 Nov. 1992), p. 38.

¹⁶¹ Towell, P., 'Spending bill trims some now, sets bigger cuts in motion', *Congressional Quarterly*, vol. 50, no. 40 (10 Oct. 1992), pp. 3184–89.

¹⁶² See Leopold (note 160).

¹⁶³ 'Zehn Millionen Mark als "Abrüstungshilfe" bewilligt', *Süddeutsche Zeitung*, 3 Nov. 1992, p. 2.

¹⁶⁴ Pugliese, D., 'Canada puts new spin on incineration', *Defense News*, vol. 7, no. 30 (27 July 1992), pp. 9–10.

Iraqi CW destruction

In the autumn of 1992 Iraq began large-scale destruction of its CW stocks under the supervision of UNSCOM.¹⁶⁵ An incineration destruction facility for mustard gas was built by Iraq at Muthanna to UNSCOM specifications. It will also be used for the destruction of chemical precursors. Approximately 400 tonnes of mustard gas will be destroyed by incineration. The incineration facility will be used additionally to destroy chemicals intended for use in missiles and other chemical material found at Muthanna. The nerve agents GB and GB/GF mixtures are being destroyed by controlled hydrolysis in another plant constructed by Iraq at Muthanna. Destruction is closely supervised by UNSCOM. As of December 1992, the following items had been destroyed: 12 000 empty munitions shells, 5000 122-mm rockets filled with sarin, 5500 kg of mustard gas, 40 500 litres mixture of GB/GF, 5000 litres of D4, 1100 litres of dichloroethane and 16.5 tonnes of thiodiglycol (TDG).¹⁶⁶

VI. Old CW ammunition and toxic armament wastes

During 1992 there was much public concern about old chemical ammunition dumped in the Baltic Sea. In March a German newspaper reported that as late as 1965 the German Democratic Republic had dumped a large quantity of World War II chemical ammunition (approximately 30 000 tonnes) in the vicinity of the Danish island Bornholm.¹⁶⁷ According to the report the artillery shells contained mustard gas and tabun. It was also reported that a large gas bubble containing warfare agent gas had formed on the bottom of the Baltic Sea near Bornholm. This was soon dismissed by experts as scientifically unfeasible. However, 'rotten' gases can form as a result of the decay of organic material in a marine environment and can be deposited in sediment layers.¹⁶⁸

During a February visit by a German politician to Königsberg it was discussed that the German Navy and the former Baltic Fleet might together search for dumped chemical ammunition, particularly German munitions, in the Baltic Sea.¹⁶⁹ The pros and cons of raising the dumped CW ammunition were analysed from both a political and scientific point of view. Some estimates place the amount of dumped ammunition in the Baltic Sea at 400 000

¹⁶⁵ 'Beginn der Vernichtung von irakischem Giftgas', *Neue Zürcher Zeitung*, 11 Nov. 1992, p. 3; United Nations press release DH/1227, Geneva, 6 Sep. 1992, p. 3.

¹⁶⁶ Marcaillou, A., 'U.N. Special Commission update: Iraq CBW destruction', *ASA Newsletter*, no. 33 (16 Dec. 1992), pp. 1, 8; United Nations Security Council document S/24984, 17 Dec. 1992, p. 23.

¹⁶⁷ Oberholz, A., 'Eines Tages könnten Giftgasklumpen bis an Bornholms Strände treiben', *Frankfurter Allgemeines Sonntagsblatt*, 1 Mar. 1992, p. 3.

¹⁶⁸ 'Giftgasblase Seifenblase?', *Frankfurter Rundschau*, 3 Mar. 1992; 'Giftgas-Bergung gefährlich', *Frankfurter Rundschau*, 5 Mar. 1992, p. 4; 'Entwarnung für Bornholm', *Frankfurter Rundschau*, 16 Mar. 1992, p. 4; 'Keine Giftgas-Blase südlich von Bornholm', *Süddeutsche Zeitung*, 16 Mar. 1992, p. 5.

¹⁶⁹ 'Hennig: Giftgasgranaten aus der Ostsee bergen', *Der Tagesspiegel*, 2 Mar. 1992, p. 2; 'Dumped chemical weapons, contamination viewed', in FBIS-SOV-92-043, 4 Mar. 1992, pp. 15-16.

tonnes,¹⁷⁰ but a more realistic figure seems to be approximately 300 000 tonnes.¹⁷¹

It was reported that the Soviet Union may have dumped chemical bombs in 1946–48 at two sites, 50 nautical miles off Bornholm and 30 nautical miles from the Latvian port Liepaja, which had previously been used in the late 1940s by the Allies for dumping German CW ammunition.¹⁷² Allegations of later dumping by Soviet forces could not be confirmed, and debate continued about the possible effect on the environment of leaking munitions.¹⁷³ Not only has former Soviet sea dumping come under public criticism. It was also reported that there is a CW dump left by the former Soviet Army in Nagorno-Karabakh, Azerbaijan, close to the Turkish border.¹⁷⁴

In March the German Ministry of Traffic established a commission to investigate the status of dumped munitions and to consider future measures,¹⁷⁵ and a conference of Baltic foreign ministers took place in Copenhagen at which the participants agreed to co-operate more fully on environmental questions.¹⁷⁶ In April the Baltic ministers for the environment signed the Convention for the Protection of the Baltic Sea (a revised version of the Baltic Sea Convention) in Helsinki and agreed on a programme for redevelopment of the sea which will cost 36 billion DM.¹⁷⁷ Sweden, which is very much concerned about the ammunition dumped in the Baltic, had in 1991 ordered its National Maritime Administration to conduct investigations on the Swedish continental shelf which resulted in an autumn 1992 report on the current situation of chemical ammunition dumped in the Baltic Sea and the Skagerrak.¹⁷⁸ The report stated that in 1947 the Soviet Union dumped some 5000 tonnes of chemical ammunition in an area off Gotland and approximately 30 000 tonnes east of the island of Christiansö off Bornholm. However, it appears unclear if this dumped ammunition was of Soviet origin or ammunition discovered in Germany after World War II and dumped by the Allies. The former Baltic Fleet participated in the dumping operations carried out by the Allies in the late 1940s.¹⁷⁹

In February China submitted a document to the CD related to its long-standing dispute with Japan about chemical weapons abandoned by Japan on

¹⁷⁰ 'Dumped chemical weapons, contamination viewed' (note 169); 'St Petersburg official on chemical arms probe', in FBIS-SOV-92-055, 20 Mar. 1992, pp. 35–36.

¹⁷¹ Laurin, F., 'Massdumpad giftgas i Östersjön', *Svenska Dagbladet* (Stockholm, Sweden), 23 Mar. 1992, p. 11 (in Swedish).

¹⁷² 'St Petersburg official on chemical arms probe', in FBIS-SOV-92-055, 20 Mar. 1992, pp. 35–36.

¹⁷³ 'Cleanup of Baltic chemical weapons waste viewed', in FBIS-SOV-92-143, 24 July 1992, pp. 4–7.

¹⁷⁴ 'Chemical weapons dump could pose danger', in FBIS-SOV-92-041, 2 Mar. 1992, p. 65.

¹⁷⁵ Haas, K., 'Seit über vier Jahrzehnten auf Tauchstation', *Süddeutsche Zeitung*, 23 Apr. 1992, p. 9; 'Krause läßt Giftgas in der Ostsee untersuchen', *Süddeutsche Zeitung*, 11 Mar. 1992, p. 6.

¹⁷⁶ 'Außenminister-Konferenz der Ostsee-Anrainer-Staaten', *Frankfurter Allgemeine Zeitung*, 5 Mar. 1992, pp. 1–5; 'Anlieger: Sauberes Meer gemeinsame Aufgabe', *Süddeutsche Zeitung*, 7–8 Mar. 1992, p. 2.

¹⁷⁷ 'EG tritt Ostsee-Konvention bei', *Süddeutsche Zeitung*, 10 Apr. 1992, p. 7.

¹⁷⁸ *Rapport om kartläggning av förekomsten av dumpade kemiska stridsmedel på den svenska delen av kontinentalsockeln* (Sjöfartsverket: Norrköping, Sweden, 1992), (in Swedish); *Summary of a Report on Investigation of the Existence of Dumped Chemical Weapons on the Swedish Part of the Continental Shelf* (National Maritime Administration: Norrköping, Sweden, 1992).

¹⁷⁹ 'Threat of dumped war gases in Baltic denied', in FBIS-SOV-92-059, 26 Mar. 1992, p. 18.

Chinese territory.¹⁸⁰ The document listed 18 dumping sites at six suspected locations. More than 300 000 chemical ammunition pieces and 120 tonnes of bulk CW agents have thus far been recovered including mustard gas, mustard gas-lewisite, diphenylcyanoarsine, hydrogen cyanide, phosgene and chloroacetophenone. In response the Japanese Ambassador to the CD referred to the serious efforts which Japan has made to solve the problem bilaterally.¹⁸¹

Austria submitted a paper to the CD describing a 1949–50 campaign where CW munitions, originally German CW munitions from World War II, were collected, sorted and provisionally buried.¹⁸² During 1974–76 more than 28 000 grenades and rocket projectiles were moved to ‘long-term’ storage (i.e., the individual projectiles were placed in aluminium capsules and then stored in containers). This case influenced the final CWC negotiations because these abandoned CW munitions had to be stored by Austria, which at the time the munitions were dug up was unable to destroy them. Such storage of old CW munitions is not permitted under the CWC.

In Germany reports of recently located old chemical ammunition continued.¹⁸³ Chemical warfare agents were discovered on the property of a former German ammunition production facility near Löcknitz in Mecklenburg-Vorpommern that had been used since the 1960s by the National People’s Army of the GDR.¹⁸⁴ At Falkenhagen in Brandenburg the former German Wehrmacht had a production facility for chemical warfare agents. After World War II Soviet troops were stationed there. In 1992 experts were still able to find chemical agents in bunkers and dangerous contamination of the soil after the withdrawal of troops.¹⁸⁵

The problem of conventional ammunition dumping was also in the news in 1992 as allegations were made that the UK has been dumping ammunition off the coast of Cornwall since 1987.¹⁸⁶

Another important ecological problem which is receiving increasing public attention, particularly in Germany, is related to former troop stationing areas. The withdrawal of CIS troops from the eastern part of Germany has made clear that during the past 40 years no consideration was taken of the possible negative effects of the presence of troops.¹⁸⁷ The German Government has commissioned a private company to work with local authorities to perform an on-site analysis and risk assessment of the troop stationing areas after troop withdrawal. The minimum amount of money which will be needed to

¹⁸⁰ Conference on Disarmament document CD/1127, 18 Feb. 1992.

¹⁸¹ Conference on Disarmament document CD/PV. 614, 27 Feb. 1992, pp. 18–19.

¹⁸² ‘Old chemical weapons: description of a long-term storage facility under safe conditions’, Conference on Disarmament document CD/CW/WP. 397, 5 May 1992.

¹⁸³ Thomé-Kozmiensky, K. J. *et al.*, *Management zur Sanierung von Rüstungsaltslasten* (EF Verlag für Energie- und Umwelttechnik: Berlin, 1992).

¹⁸⁴ ‘Kampfstoffreste der Wehrmacht gefunden’, *Süddeutsche Zeitung*, 13 Mar. 1992, p. 5; Krispin, S., ‘Nichts sehen, nichts riechen, nichts sagen’, *Süddeutsche Zeitung*, 11 June 1992, p. 40.

¹⁸⁵ ‘Chemische Kampfstoffe in geflutetem Wehrmachtbunker’, *Der Tagesspiegel*, 7 Nov. 1992, p. 7.

¹⁸⁶ ‘Greenpeace: Britische Munition im Meer versenkt’, *Süddeutsche Zeitung*, 10 Sep. 1992, p. 8.

¹⁸⁷ ‘Russisches Roulett’, *Der Spiegel*, vol. 46, no. 2 (5 Jan. 1992), pp. 55–58; see also Thomé-Kozmiensky, K. J. *et al.* (note 183); *Fachtagung Rüstungsaltslasten Erkundung und Untersuchung von ehemals und aktuell militärisch genutzten Flächen* (Umweltinstitut Offenbach: Offenbach a.M., Germany, 1992).

redevelop the nearly 44 000 contaminated sites—including 3000 sites contaminated by former Soviet troops and troops from the National People's Army of the GDR—will be of the order of 210 billion DM for a clean-up process which is expected to take 10 years.¹⁸⁸

The problem of withdrawing troops and cleaning up after them is of general concern for many nations including the USA, which has troops stationed both abroad and within the borders of the USA. In the next 20 years the USA will spend approximately \$25 billion for redevelopment and environmental security at its bases within the USA.¹⁸⁹

VII. New developments in NBC protection

One of the significant events of 1992 was the Fourth International Symposium on Protection Against Chemical Warfare Agents, held on 8–12 June in Stockholm, Sweden.¹⁹⁰ More than 650 participants from science institutes, government, the defence industry and defence research establishments discussed new trends and developments in chemical defence, influenced partially by early analysis of the Persian Gulf War. There is clear understanding that defence research will continue even when the CWC enters into force and that there will be a link between such research and chemical disarmament.¹⁹¹ On the first day of the symposium the UNSCOM experts presented their findings and an evaluation of the inspections in Iraq.¹⁹²

It is obvious that defence establishments are drawing their first conclusions about future NBC defence in light of the Persian Gulf War. Until recently military planners focused mainly on fighting under NBC conditions in the cool climate of the North. In the aftermath of the Persian Gulf War, Israel, with its vast experience in desert warfare, is now being asked to share its knowledge about product development. Many Persian Gulf countries are interested in acquiring NBC protective equipment for desert conditions,¹⁹³ and the US Army has ordered a new chemical protective undergarment (69 000 suits have already been produced and 100 000 more are to be produced). The new suits reduce heat, stress, weight and bulk, and have been improved by the addition of carbon which acts to trap chemical agents.¹⁹⁴

As a result of the Persian Gulf War, Israel began distributing more than 800 000 new gas masks to its population.¹⁹⁵ Distribution of the improved

¹⁸⁸ 'IWH: Altlasten kein Investitionshemmnis', *Frankfurter Allgemeine Zeitung*, 17 Nov. 1992, p. 18; 'Umwelt-Altlasten kosten bis zu 400 Milliarden Mark', *Süddeutsche Zeitung*, 19 Nov. 1992, p. 2.

¹⁸⁹ 'Verstöße im Ausland gegen Umweltvorschriften', *Süddeutsche Zeitung*, 23 Nov. 1992, p. 9.

¹⁹⁰ See *Proceedings of the Fourth International Symposium on Protection Against Chemical Warfare Agents* (note 67).

¹⁹¹ Dunn, P., 'Chemical defence and chemical disarmament: the need for both activities', *Proceedings of the Fourth International Symposium on Protection Against Chemical Warfare Agents* (note 67), pp. 9–23.

¹⁹² 'Chemical warfare agents IV', *ASA Newsletter*, no. 31 (12 Aug. 1992), pp. 1, 10.

¹⁹³ Mitchell, B., 'War piques interest in anti-chemical gear', *Jerusalem Post*, 27 June 1992.

¹⁹⁴ 'Army gets new CW clothing', *Jane's Defence Weekly*, vol. 18, no. 22 (28 Nov. 1992), p. 9.

¹⁹⁵ 'Neue Gasmasken für Israel', *Frankfurter Rundschau*, 11 Jan. 1992, p. 2.

masks began in October. Over a period of 10 months, 5 million people will be equipped with the new masks.¹⁹⁶

In the spring of 1992 the US General Accounting Office (GAO) published a report about the DOD's chemical protection preparedness in the Persian Gulf War. One of the conclusions of that report was that the department was not adequately prepared for chemical warfare. The GAO recommended that the DOD 'develop and implement a long-range action plan with target dates to ensure that required chemical defence equipment is available for all military personnel when needed'.¹⁹⁷ In September the US Army set up a new agency, the Chemical and Biological Defence Agency, to be responsible for R&D and acquisition for chemical and biological defence.¹⁹⁸

VIII. New BW developments

The 1991 Third Review Conference of the BWC agreed to establish a new *Ad Hoc* Group of Governmental Experts to discuss future verification measures for the BWC, and its first meeting was held in Geneva on 30 March–10 April 1992.¹⁹⁹ At the second meeting on 23 November–4 December, also in Geneva, the expert group examined 21 potential measures that might be used in the future to enhance compliance under the BWC.²⁰⁰ The potential measures were grouped in seven categories: (a) information monitoring, (b) data exchange, (c) remote sensing, (d) off-site inspections, (e) exchange visits, (f) on-site inspections, and (g) continuous monitoring.

The sixth annual information exchange, and the first since the Third Review Conference where it was decided to improve the information exchange,²⁰¹ resulted in declarations from 15 countries by the end of April 1992 (Australia, Austria, Canada, Cyprus, Czechoslovakia, Germany, Japan, Mongolia, New Zealand, Norway, Sweden, Switzerland, the UK, the USA and Yugoslavia).²⁰² In subsequent months the following countries presented declarations: Argentina (27 August), Belarus (14 May), Belgium (8 July), Bulgaria (26 May),

¹⁹⁶ Reuters, 'Israel starts distributing new gas masks', *International Herald Tribune*, 21 Oct. 1992, p. 5.

¹⁹⁷ 'Chemical warfare protective equipment needs upgrading', *Chemical & Engineering News*, vol. 70, no. 21 (25 May 1992), p. 13; US General Accounting Office, *Operation Desert Storm: DOD Met Need for Chemical Suits and Masks, but Longer Term Actions Needed*, Report to the Chairman, Subcommittee on Readiness, Committee on Armed Services, House of Representatives, GAO/NSIAD-92-116 (General Accounting Office, Washington, DC, Apr. 1992).

¹⁹⁸ Muradian, V., 'U.S. Army creates unit for chemical defense', *Defense News*, vol. 7, no. 41 (12 Oct. 1992), p. 60.

¹⁹⁹ *Arms Control Reporter*, sheet 701.B.91, May 1992.

²⁰⁰ Newmann, R., 'Nations examine BWC verification compliance measures', *Wireless File*, no. 234 (United States Information Service, US Embassy: Stockholm, 3 Dec. 1992), pp. 9–10.

²⁰¹ The improvements were the following: (a) to add a declaration on 'nothing to declare' or 'nothing new to declare'; (b) to amend and extend the exchange of data on research centres and laboratories and to exchange information on national biological defence research and development programmes; (c) to amend the exchange of information on outbreaks of infectious diseases and similar occurrences caused by toxins; (d) to encourage publication of results and promotion of use of knowledge; (e) to amend the measure for active promotion of contacts; and (f) to add three new confidence-building measures: 'declaration of legislation, regulations and other measures', 'declaration of past activities in offensive and/or defensive research development programmes' and 'declaration of vaccine production facilities'.

²⁰² United Nations Office for Disarmament Affairs document ref. DDA/4-92/BWIII, 30 Apr. 1992.

China (1 August), Cuba (22 October), Denmark (30 June), Finland (1 June), France (15 June), Hungary (30 April), Japan, additional information (28 April), Jordan (14 August), Malta (30 April), Mexico (2 September), the Netherlands (22 May), Peru (21 September), Russia (3 July), South Korea (1 May), Spain (30 August), Thailand (20 August), Tunisia (7 May) and Ukraine (15 June).²⁰³ By November 36 nations had participated in the information exchange—far fewer than in 1991, the year of the Review Conference.

In 1992 important new information about the former Soviet BW programme became available. During his January visit to Washington President Yeltsin pledged to halt Russian research on biological weapons.²⁰⁴ He also pledged that no funds would be budgeted for BW research. In April Yeltsin signed a decree committing Russia, as the successor to the USSR, to the BWC.²⁰⁵

Official proof of the true nature of the 1979 Sverdlovsk anthrax accident was given in March when draft legislation to provide pensions to families of 64 people who died of anthrax was presented in the Supreme Soviet.²⁰⁶ In an April interview with the Chief of the Directorate for Protection against Biological Weapons more information was presented about the accident.²⁰⁷ In 1979 R&D had been conducted at Military Camp 19 in Sverdlovsk, where the outbreak occurred, in an attempt to find a more effective anthrax vaccine. During the June summit meeting in Washington Yeltsin acknowledged that the Sverdlovsk anthrax outbreak was the result of military research to make biological weapons.²⁰⁸

Information was also presented about a field test laboratory located on Vozrozhdeniye Island in the Aral Sea,²⁰⁹ where development and testing of bacteriological weapons had been conducted since World War II.²¹⁰ Other sites where bacteriological research had been conducted included: the bacteriological centre in Obolensk near Moscow, the virology centre in Koltsovo near Novosibirsk, the Biological Instrument Building Institute and the Biochemical Machine Project in Moscow, the Institute for Ultrapure Drugs in what was then Leningrad and several Moscow institutions of higher education.²¹¹

In May, after President Yeltsin had issued a decree forbidding any military biological programme in violation of the BWC, the recently appointed head of the committee on conventional problems of chemical and biological warfare, Anatoly Kuntsevich, confirmed that after the USSR ratified the BWC ‘there

²⁰³ United Nations Office for Disarmament Affairs document ref. DDA/4-92/BWIII/Add.1, 12 June 1992; Add. 2, 12 Aug.; Add. 3, 22 Sep. 1992; Add. 4, 3 Nov. 1992.

²⁰⁴ Devroy, A. and Smith, R. J., ‘U.S., Russia pledge new partnership’, *Washington Post*, 2 Feb. 1992, pp. A1–A26.

²⁰⁵ ‘Yeltsin signs decree on biological weapons’, in FBIS-SOV-92-074, 16 Apr. 1992, p. 3; AP, ‘Yeltsin commits to germ warfare ban’, *Washington Post*, 17 Apr. 1992, p. A28.

²⁰⁶ ‘Draft laws, congress preparations approved’, in FBIS-SOV-92-065, 3 Apr. 1992, pp. 41–42.

²⁰⁷ ‘General quizzed on chemical weapons production’, in FBIS-SOV-92-082, 28 Apr. 1992, pp. 4–5; V. Chelikov, ‘A weapon against their own people’, *Moscow News*, no. 23 (25 May–1 June 1992), p. 8.

²⁰⁸ Smith, R. J., ‘Yeltsin blames ’79 anthrax on germ warfare efforts’, *Washington Post*, 16 June 1992, pp. A1–A15.

²⁰⁹ ‘Closure of bacteriological test range demanded’, in FBIS-SOV-92-010, 15 Jan. 1992, p. 70.

²¹⁰ ‘Biological weapons program, violations viewed’, in FBIS-SOV-92-087, 5 May 1992, pp. 4–6; ‘Documents for shutdown of weapons site ready’, in FBIS-SOV-92-040, 28 Feb. 1992, pp. 54–55.

²¹¹ ‘Biological weapons program, violations viewed’ (note 210).

were, legally speaking, violations of it in this country'.²¹² In the mid-1980s steps were taken to curtail the offensive programme. He also confirmed that there are now no stockpiles of biological agents in Russia. Additionally, foreign experts have been invited to visit the military research facilities.

Nevertheless in August the UK and the USA expressed concern that Russia might not have fulfilled its earlier promise to discontinue and dismantle its BW programme.²¹³ After a first official denial²¹⁴ and perhaps in consideration of the promised financial aid from the USA, Russia responded to requests from the US State Department to prove that the programme had ceased by admitting that activities banned under the BWC had been conducted from 1946 until March 1992.²¹⁵ After talks and consultations in Moscow in September, Russia proved to British and US officials that it has terminated prohibited BW research and closed down the test facilities. President Yeltsin also ordered an examination of the Institute of Specially Pure Biological Preparations in St Petersburg.²¹⁶ In a significant step a Joint Statement on Biological Weapons was adopted by Russia, the UK and the USA.

In the spirit of the new climate of openness, Kuntsevich later admitted that the USSR had continued research, testing and production after ratifying the BWC. Methods of preparing biological agents for military purposes and of delivering them via aircraft and missiles were developed in the St Petersburg institute and at the military facilities in Kirov, Yekaterinburg (formerly Sverdlovsk) and Sergiyev Posad, and testing had been carried out on Vozrozhdeniye Island in the Aral Sea.²¹⁷ When disclosures about the former Soviet and subsequently Russian BW programme were made, experts also asked about current research in the USA and raised questions about the borderline between defensive and offensive research in light of the growing threat of proliferation.²¹⁸

In October British, Russian and US experts conducted an investigation of the above St Petersburg institute. They found that the institute was 'only indirectly connected in the most general way' with work on bacteriological weapons.²¹⁹ Additionally, information was given in September that the Russian Government will reduce by 50 per cent the personnel involved in military biological programmes and will also reduce the financing of such research by 30 per cent.²²⁰

²¹² 'Yeltsin's biological weapons decree assessed', in FBIS-SOV-92-097, 19 May 1992, p. 23.

²¹³ Smith, R. J., 'U.S. fears Moscow still makes germ weapons', *International Herald Tribune*, 1 Sep. 1992, p. 1.

²¹⁴ 'Ministry denies bacteriological weapons charges', in FBIS-SOV-92-172, 3 Sep. 1992, p. 2.

²¹⁵ 'Russia broke germ weapons ban', *The Independent*, 15 Sep. 1992, p. 9.

²¹⁶ Gordon, M. R., 'Russia and West reach accord on monitoring germ-weapon ban', *New York Times*, 15 Sep. 1992, p. 6; 'Official on biological weapons talks with U.S.', in FBIS-SOV-92-180, 16 Sep. 1992, pp. 15–16.

²¹⁷ 'Official examines destruction of CBW weapons', in FBIS-SOV-92-186, 24 Sep. 1992, pp. 2–4.

²¹⁸ 'Source cited on U.S. biological weapons', in FBIS-SOV-92-199, 14 Oct. 1992, pp. 3–4; 'Mutual biological warfare concerns pondered', in FBIS-SOV-92-194, 6 Oct. 1992, pp. 2–4.

²¹⁹ 'St. Petersburg institute cleared of biological weapons charges', in FBIS-SOV-92-228, 25 Nov. 1992, p. 2.

²²⁰ 'Russian, U.S. statement on biological weapons', in FBIS-SOV-92-178, 14 Sep. 1992, p. 2.

IX. Environmental implications of the Persian Gulf War

In January the US GAO published two reports dealing with the impact of the Kuwaiti oil fires, which occurred when 611 oil wells were ignited by the Iraqis in late February 1991, on the health of US troops stationed in the Persian Gulf who were exposed to smoke.²²¹ To investigate the potential long-term health risks, a variety of measures were taken including: (a) air and soil sampling to determine whether there were harmful pollutants in areas where US troops were present, (b) a biological study of a large number of soldiers, and (c) a health risk analysis, which was scheduled to be completed by December 1992. The measures focused on facilitating health risk analysis to project the incidence of illness probably attributable to oil-fire smoke exposure. In a follow-up report,²²² the US Environmental Protection Agency (EPA) reviewed an April 1991 interim report. Its major finding was that no significant quantities of pollutants that would cause severe acute or chronic health effects could be found, except for high levels of certain substances. More important was the assessment that the extent of possible long-term health risks to US troops exposed to pollution remains an unanswered question. At least two years of monitoring a large group which had been exposed is needed.

On the other hand, the sea environment and water quality both seem to have been affected negatively by the oil released during the war. Experts claim that 6–8 billion barrels of oil were released, and the cost of clean-up may amount to as much as 5 billion DM.²²³ Experts estimate that 700 km of the Saudi Arabia coast were contaminated by oil.²²⁴ According to investigations conducted by the United Nations Educational, Scientific & Cultural Organization (UNESCO), the coral reefs have survived but with varying degrees of damage.²²⁵ After almost two years the impact of the oil spills is still evident but the ecosystem is starting to recover, owing in part to an enormous redevelopment programme.

X. Conclusions

The conclusion of the CWC in 1992 was the most significant event of the year. It will provide the basis for CW disarmament via destruction of stock-piled chemical weapons and chemical warfare agents. The destruction must be

²²¹ US General Accounting Office, *Defense Health Care: Efforts to Address Health Effects of the Kuwait Oil Well Fires*, Report to the Chairman, Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives, GAO/HRD-92-50 (GAO: Washington, DC, Jan. 1992); US General Accounting Office, *International Environment: Kuwaiti Oil Fires: Chronic Health Risks Unknown but Assessments Are Under Way*, Briefing Report to the Chairman, Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives, GAO/RCED-92-80BR (GAO: Washington, DC, Jan. 1992).

²²² See US General Accounting Office, *International Environment: Kuwaiti Oil Fires: Chronic Health Risks Unknown but Assessments Are Under Way* (note 221).

²²³ 'Ölpest im Golf kostet weitere fünf Milliarden Mark', *Süddeutsche Zeitung*, 27 Apr. 1992, p. 8.

²²⁴ 'Korallenriffe offenbar kaum geschädigt', *Frankfurter Allgemeine Zeitung*, 5 Mar. 1992, p. 12.

²²⁵ 'Korallenriffe überlebten Ölpest im Golfkrieg', *Süddeutsche Zeitung*, 19 May 1992, p. 48.

carried out within a limited period of time and will be monitored by stringent, intrusive on-site inspection to verify claims of non-compliance.

Destruction presents a challenge to several countries. The US CW destruction programme has been forced to extend its completion date, and costs continue to increase. In the past incineration was considered the most effective destruction method, but a committee of the US National Academy of Science is now studying other technologies for chemical demilitarization with a report expected in summer 1993. The FY 1993 budget appropriations bill contains provisions for revision of the programme, and a new deadline of 31 December 2004 has been set for elimination of US CW stockpiles. The new schedule results in part from the fact that under the CWC more time is allowed for destruction than in the 1990 US–Soviet bilateral destruction agreement. The technologies under study include: chemical neutralization, supercritical water oxidation, steam gasification and plasma arc pyrolysis. Growing awareness in the USA about the possible risks of incineration to health and the environment is another factor which may have contributed to the new situation.

During the June Bush–Yeltsin summit meeting in Washington both leaders reconsidered the validity of the 1990 bilateral destruction agreement and confirmed Russia's role as successor to the former Soviet CW stockpiles. Since all of the chemical weapons of the former Soviet Union are located on Russian territory, Russia now faces a very heavy economic and technical burden and has begun the arduous process of designing and setting up its own destruction programme. In 1992 such a programme was designed by an official State Committee and later approved by the Russian Parliament. In phase I two facilities will be constructed, and a former CW production facility will be converted to a destruction facility.

The cost of the Russian CW destruction programme increased dramatically in 1992. Neutralization technology may be used in the destruction programme, but owing to the need to dispose of a variety of agents and munitions other chemical decomposition techniques are also being considered including incineration, chemical electrolysis, cryofracture and plasma techniques. Foreign financial and technical assistance for the dismantling of Russia's chemical weapons, including the \$25 million approved by the US Congress in 1991, is extremely important. Both financial aid and technical expertise are needed, and a number of countries have been asked to help Russia.

New information was revealed in 1992 that the former Soviet Union conducted CW R&D as late as the early 1990s—clear demonstration of the need for the CWC which will outlaw similar activities in the future. The currently existing international legal framework does not provide adequate prohibition. It should be noted that the 1987 Soviet announcement that it had stopped CW production did not encompass its R&D programme.

Official information about the former Soviet biological defence research programme proved that the 1979 anthrax outbreak in Sverdlovsk was related to military research activities. Additionally, there now seems evidence that the programme continued until the beginning of 1992. Only after President Yeltsin intervened were steps taken to dismantle the programme. This information

about the continuation of BW R&D highlights the need for improvement of the BWC as regards verification and confidence building.

As in the past various allegations of the use of chemical weapons or chemical warfare agents continued to be made. In 1992 new allegations were made about regions where there is military conflict such as the new republics in the former Soviet Union and in Bosnia and Herzegovina. It remains very difficult to verify such allegations.

CW and to a lesser extent BW proliferation is one of the most threatening developments of the 1990s. The number of countries alleged to possess or to be attempting to acquire chemical weapons has not decreased, and stopping further proliferation appears to be the task which lies ahead. Concerned countries, especially those in Western Europe and North America, have strengthened their national legislation. Export control measures and policies as applied by the Australia Group have been made more specific and elaborated upon. Under the CWC there will be a need for extensive review and revision of both national and international export control policies and legislation.

New findings from the UNSCOM inspections and new information about the involvement of foreign companies in the buildup of the Iraqi CW and BW capability have evoked strong reactions in the concerned countries and led to investigations and trials.

Public interest has increased about the threat posed by old chemical munitions that have been dumped at sea or buried and not yet discovered. There is a need for extensive scientific study and technical evaluation of the many unanswered questions about the state of these munitions, their impact on the environment and the possibility to salvage them.

The problem of soil contamination as a result of chemicals, petrol, oil and other toxic wastes resulting from long-term stationing of troops and military training activities has added a new dimension to study of the ecological impact of military activities. Enormous resources must be allocated to clean up and redevelop the affected areas, as has been shown by the aftermath of the withdrawal of former Soviet troops from eastern Germany.

The enormous oil spills in the Persian Gulf and the environmental impact of the oil fires in Kuwait have been the subject of much investigation. These scientific studies must continue in order to draw conclusions about the possible impact of these occurrences on the environment and on humans.

Defence research will continue under the CWC, and there will be a link between defence research and chemical disarmament. Based on a first analysis of the Persian Gulf War, R&D appears to be needed in the area of protective clothing and gas masks for use under very specific climatic conditions.

The 1991 Third Review Conference of the BWC highlighted the need to strengthen the BWC. Experts are now meeting on a regular basis to prepare verification measures for discussion at the 1996 Review Conference. The 1992 information exchange, which was agreed to at the Third Review Conference, produced much new information, but the number of countries taking part in the mandatory exercise did not increase.

The most important achievement of 1992 was the conclusion of negotiations on the CWC. The main question for the near future will be whether or not the signing and implementation of the CWC will have a significant impact on: (a) future proliferation of chemical and biological weapons, (b) CW stockpile destruction with respect to ecological, health and safety concerns, (c) future research in the area of new toxic agents and (d) NBC defence R&D. The 'new environment' will need to be monitored closely to identify any changes which may result from the Chemical Weapons Convention.