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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

COMMITTEE ON CHEMISTRY EDUCATION*

# EDUCATION, OUTREACH, AND CODES OF CONDUCT TO FURTHER THE NORMS AND OBLIGATIONS OF THE CHEMICAL WEAPONS CONVENTION

## (IUPAC Technical Report)

*Prepared for publication by*
GRAHAM S. PEARSON[1,‡] AND PETER MAHAFFY[2]

[1]*Department of Peace Studies, University of Bradford, Bradford, West Yorkshire BD7 1 DP, UK;*
[2]*Department of Chemistry, The King's University College, 9125 50th Street, Edmonton, Alberta T6B 2H3, Canada*

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The 2005 Oxford Workshop leading to this technical report was organized by OPCW's R. Trapp and members of IUPAC Project 2004-048-1-020 (a joint OPCW/IUPAC Project on Education and Outreach regarding Chemical Weapons) P. W. Atkins (UK); E. D. Becker (USA); L. K. Sydnes (Norway); and N. P. Tarasova (Russia).

‡Corresponding author: E-mail: Graham_Pearson@Compuserve.com

# Education, outreach, and codes of conduct to further the norms and obligations of the Chemical Weapons Convention

## (IUPAC Technical Report)

*Abstract*: The 2002 IUPAC evaluation of scientific and technological advances relevant to the operation of the Chemical Weapons Convention (CWC) included a recommendation that greater efforts are required in education and outreach to the worldwide scientific and technical community to increase awareness of the CWC and its benefits. In 2004, the President of IUPAC and the Director-General of the Organisation for the Prohibition of Chemical Weapons (OPCW) agreed on a proposal for a joint project on chemistry education, outreach, and the professional conduct of chemists. This led to a joint IUPAC/OPCW international workshop held in Oxford, UK on 9–12 July 2005 with 27 participants from 18 different countries. This report sets out the background to the workshop, the scope of the presentations and discussions, the outcomes of the workshop, and the recommended steps to further chemical education, outreach, and codes of conduct in regard to the obligations of the CWC.

*Keywords*: chemical weapons; codes of conduct; OPCW; Chemical Weapons Convention; outreach; ethics; responsible use; public understanding of chemistry; IUPAC Committee on Chemistry Education.

### INTRODUCTION AND BACKGROUND

In 2002, the International Union of Pure and Applied Chemistry (IUPAC) undertook an evaluation of scientific and technological advances in the chemical sciences that might have an impact on the implementation of the Chemical Weapons Convention (CWC). This evaluation [1] was published in *Pure and Applied Chemistry* (*PAC*) in December 2002 prior to the First Review Conference of the CWC held on 28 April 2003. The Director-General of the Organisation for the Prohibition of Chemical Weapons (OPCW) summarized the importance of this IUPAC evaluation in his opening statement to the Sixth Session of the Conference of States Parties on 14 May 2001:

> *An important aspect of the preparations for the review conference is an assessment of the scientific foundations of the Convention. Does the present verification regime under Article VI, and the Schedules contained in the Annex on Chemicals, adequately reflect the scientific and technological progress that has been made over the past decade, and the current trends in science and technology? Much has changed, as is evidenced by the completion of the human genome project and the emergence of genomics, as well as by advances in chemical production technologies, a better understanding of the functioning of certain biomolecules and receptors, etc. The International Union of Pure and Applied Chemistry has proposed to the Secretariat that it undertake a review of key areas of science, with a view to identifying developments and trends that are relevant to the CWC. We welcome this offer, and look forward to the results of this international scientific re-*

*view. Its results will, of course, be passed on to Member States for advice and action well before the review conference.*

As the only independent, nongovernmental, international organization devoted to the chemical sciences and their applications, IUPAC was regarded as very well placed to conduct this review. Formed in 1919, IUPAC is an association of bodies—National Adhering Organizations (NAOs)—that represent the chemists of different member countries. IUPAC has 49 NAOs, and 21 Associate NAOs (ANAOs).

The CWC totally prohibits the development, production, stockpiling, and use of chemical weapons. In 2002, the CWC had 145 States Parties, 29 Signatory States, who have signed the Convention but have yet to ratify the Convention, and 20 non-signatory States. Some of the Signatory and non-signatory States might not have ratified or acceded to the Convention because of a lack of awareness of the benefits that the Convention would bring. It is noted that education and outreach are vitally important to promote both the universality and the implementation of the Convention.

The report of the 2002 evaluation included a section entitled "Education and Outreach". Summary findings included statements that:

*1. Greater efforts on education and outreach to the worldwide scientific and technical community are needed in order to increase awareness of the CWC and its benefits. An informed scientific community within each country can be helpful in providing advice to States Parties and in disseminating unbiased information to the public.*

*2. Education of and outreach to Signatory States and non-signatory States could be helpful in increasing awareness of the importance of universal adherence to the Convention thereby enhancing safety and security for all States.*

The rationale for these findings included the observations that an informed scientific and technical community within each country could be very helpful in providing advice and disseminating information to the public. Consequently, IUPAC, together with its NAOs, could play an important role in this education and outreach program by working in cooperation with the National Authorities responsible for the implementation of the CWC within States Parties to enhance awareness by chemists of the obligations and undertakings of the Convention. A parallel approach could usefully be taken worldwide by chemical industry associations in cooperation with National Authorities of CWC States Parties and signatories. In due course, this might lead to incorporating chemical weapon prohibition and non-proliferation considerations into university and school curricula as part of chemistry education in a similar way to that in which environmental issues, ethics of genetics, and similar issues have been incorporated into chemistry and biology education.

The IUPAC evaluation was considered by the Scientific Advisory Board (SAB) of the OPCW in its report forwarded by the Director-General [2] to the States Parties for consideration at the First Review Conference of the CWC in April 2003. In his covering note, the Director-General observed that:

*2.20 In relation to international cooperation and related matters, the SAB has concluded that the OPCW needs to clearly establish what it requires in the field of education, outreach, and international cooperation. At the same time, the SAB has observed that current OPCW international cooperation programmes appear to be making useful contributions to the development of States Parties' national capacities in the peaceful uses of chemistry. OPCW international cooperation programmes and its educational and outreach activities would benefit from increased cooperation with other international, regional, and national organisations.*

The SAB report addressed these aspects in more detail:

*9.1 Greater publicity is needed by OPCW about its aims and objectives, and about the key issues it faces. This must include information on the requirements in relation to the*

*declaration, destruction, and verification of CW and related facilities; the methodologies the OPCW uses (particularly for analysis); the nature of and the reasons for industrial declarations; the nature of and reasons for industrial inspections and the value gained from such inspections; the role of National Authorities; and the requirements to provide assistance and to foster international cooperation.*

*9.2 Greater efforts in terms of education and outreach to the worldwide scientific and technical community are needed in order to increase awareness of the Convention and its benefits. An informed scientific community within each country can be helpful in providing advice to States Parties and in disseminating unbiased information to the public. Education of, and outreach to, signatory States and non-signatory States could be helpful in increasing the awareness of the importance of universal adherence to the Convention, thereby enhancing the safety and security of all states.*

*9.3 The SAB noted that the Secretariat had developed certain projects that supported these goals, in particular the Associate Programme and the Ethics Project.*

*9.4 The SAB was convinced that efforts in the area of education and outreach are important to further the objectives of the Convention; these efforts include raising awareness, assuring that the principles of the Convention become firmly anchored in professional ethics and teaching, and promoting international cooperation in the field of chemistry. International cooperation and outreach were also important with respect to attracting additional countries to adhere to the Convention. The SAB expressed a strong desire to further discuss and clarify its own role in relation to education, outreach, and international cooperation. At the same time, the SAB noted and welcomed the contributions that certain non-governmental organisations, as well as national chemical societies and science academies, have been making in relation to creating awareness about the Convention. Public awareness and education about the Convention can contribute significantly to encouraging compliance with its norms and provisions.*

*9.5 There are a number of opportunities in the area of outreach, education, and international cooperation. In particular, the SAB reviewed the OPCW's programmes in the area of international cooperation in the light of the developments in science and technology, and concluded as follows:*

> *(a) there is good reason for close cooperation between the OPCW and other relevant international organisations, such as UNITAR, WHO, or UNEP, in further developing the international cooperation programmes of the OPCW;*
>
> *(b) the programmes and projects currently being implemented by the OPCW in the area of international cooperation appear to be contributing to the development of the national capacities of the States Parties in the area of the peaceful uses of chemistry. Two members of the SAB are involved in one of these programmes (i.e. the programme for support of research projects implemented by the ICA (International Cooperation and Assistance) Division); and*
>
> *(c) in further enhancing these programmes, particular attention should be given to projects aimed at improving the capabilities of the States Parties to monitor chemical compounds.*

*9.6 The SAB considered it useful for the OPCW to continue and intensify its dialogue with other organisations, such as the IUPAC and its chemistry education division; with other international science unions in relevant fields such as biochemistry and molecular biology (IUBMB) or biological sciences (IUBS); with professional and chemical industry as-*

> *sociations; with international institutes and programmes; with organisations of engineers and scientists committed to CW disarmament; and with national as well as regional science academies.*
>
> *9.7 The SAB concluded that it will need to continue discussing practical and useful measures in relation to education, outreach, and international cooperation as part of its future work programme.*

The report of the First Review Conference [3], whilst not explicitly addressing education and outreach, included the following conclusion:

> *7.79 The First Review Conference* ***noted*** *that a valuable aspect of national implementation measures involves ensuring that the chemical industry, the scientific and technological communities, the armed forces of the States Parties, and the public at large are aware of and knowledgeable about the prohibitions and requirements of the Convention.*

In addition, the First Review Conference in paragraph 7.83

> *(d)* ***encouraged*** *States Parties to take measures to raise awareness about the prohibitions and requirements of the Convention, inter alia in their armed forces, in industry, and in their scientific and technological communities;*

Subsequent to the First Review Conference, a proposal for a joint project on chemistry education, outreach, and the professional conduct of chemists was agreed between the Director-General of the OPCW, Ambassador Rogelio Pfirter, and the President of IUPAC, Prof. Leiv Sydnes, in early 2004. It also built upon the Ethics Project of OPCW's Technical Secretariat, which recognized that the CWC affects the work of all those using chemicals in academia, industry, or government and that the ethical conduct of those using chemicals is important for the effective implementation of the CWC.

The proposed objectives for the joint project were to:

- increase awareness of the CWC and its requirements in the chemical and chemical engineers communities (and more generally in the international scientific community);
- enhance knowledge of the CWC's key provisions and requirements;
- integrate issues related to the CWC and its implementation into chemistry teaching; and
- promote professional conduct of chemists and chemical engineers that is fully in line with the CWC.

The project was discussed by representatives of the OPCW, its SAB, and IUPAC at a meeting in The Hague on 17 January 2005. This meeting agreed the project outline and decided to take it forward through a meeting to be held in Oxford in July 2005.

The SAB met for its 7$^{th}$ session from 9–11 March 2005 when it received a report on the joint project, including information on the planned Oxford meeting, from Alberto Fratadocchi, chair-designate of the temporary working group on education and outreach. The SAB encouraged the continuation of this work [4], on the understanding that over the long term it would lead, inter alia, to awareness-raising, efforts to provide educational materials, guidance to school and university science teachers, and the incorporation of the Convention's requirements into codes of conduct and ethics for scientists and engineers. Subsequently, on 25 May 2005, the Director-General of the OPCW issued a note [5] to the Executive Council on the 7$^{th}$ SAB report, stating:

> *12. As regards education and outreach, the Director-General notes the state of preparations for an international workshop being organised jointly by the OPCW and the International Union of Pure and Applied Chemistry, which will focus on how the requirements of the Convention can be better reflected in codes of professional conduct and ethics as well as in chemistry education. The workshop is scheduled for 10 to 12 July*

*2005 in Oxford, the United Kingdom of Great Britain and Northern Ireland, and the Secretariat will render the support required to ensure that it is success.*

The international workshop took place as planned in Oxford from 9 to 12 July 2005 with the aim of developing concrete proposals for follow-up measures, both at the level of governments of CWC States Parties and through the existing mechanisms of science unions such as IUPAC and its constituent NAOs and network of national chemical societies and science academies.

## JOINT OPCW/IUPAC WORKSHOP: THE CHEMICAL WEAPONS CONVENTION, CHEMISTRY EDUCATION, AND THE PROFESSIONAL CONDUCT OF CHEMISTS

The OPCW and IUPAC organized a workshop entitled *The Chemical Weapons Convention, Chemistry Education and the Professional Conduct of Chemists* at St. Anne's College, Oxford, UK on 9 to 12 July 2005. Financial support was provided by the OPCW and IUPAC.

Twenty-seven participants from 18 countries [6] participated in the workshop, which included plenary sessions and presentations by leading international scientists and engineers engaged in chemistry education and in codes of conduct. The workshop successfully brought together the collective knowledge of academia, industry, government, and the OPCW in order to address how education, outreach, and codes of conduct could facilitate the implementation of the CWC within States Parties and how awareness of the CWC could be placed in a broader educational context of ethical concerns in chemistry. Plenary presentations provided background for six discussion sessions in which the participants in two working groups addressed how under- and postgraduate education might address the ethical and practical aspects of preventing the misuse of chemistry and how academia, industry, and government might be encouraged to reflect CWC issues in their codes of conduct or practice.

*Key findings by the workshop participants are summarized below* in three sections, as follows:

A. Presentations and Discussions
B. Workshop Outcomes
C. Summary Findings and Observations

### A. PRESENTATIONS AND DISCUSSIONS

Presentations at the workshop were divided into six sessions, as follows:

- **Background and Context for the Workshop**

  Workshop organizers Peter Atkins, Chair of the IUPAC Committee on Chemistry Education, and Ralf Trapp of the OPCW Secretariat, set out the workshop objective to develop concrete proposals for follow-up measures, both at the level of governments of CWC States Parties and through the existing mechanisms of science unions, such as IUPAC and its constituent NAOs and network of national chemical societies and science academies.

  Jiri Matousek, Chair of the OPCW SAB, then set out a conceptual framework for the discussion of how issues relating to the CWC might be incorporated into chemistry education.

- **Codes of Conduct I**

  Three speakers addressed different aspects relating to codes of conduct. Bob Mathews of the Australian Defence Science and Technology Organization examined the role of codes of conduct in the context of the CWC and why it is important to raise awareness of the CWC among chemists. A layered approach to codes was outlined with a universal code containing guiding principles, a code of ethics developed by scientific or professional societies, and a code of practice developed

by the institution or workplace. These various codes would be seen as complementary and may be most effective if developed as a package. Attention needs to be given to bioregulators and toxins, which fall between classical chemical weapons and traditional biological agents; the prohibitions of both the Biological and Toxin Weapons Convention (BTWC), and the CWC applied to such mid-spectrum agents.

Graham Pearson of the Department of Peace Studies, University of Bradford, UK then spoke on behalf of the UNESCO Division of Ethics and Science to outline current UNESCO activities on a code of conduct for scientists. The World Conference for Science in Budapest in 1999 organized by UNESCO and ICSU (International Council for Science) had paid special attention to ethical principles and responsibilities in the practice of science and had agreed that UNESCO's COMEST (World Commission on the Ethics of Scientific Knowledge and Technology) had a special responsibility to follow up on this issue. A draft recommendation for feasibility studies on a universal declaration of science ethics to be carried out in 2005 to 2007 had been prepared for consideration at the 33rd General Conference of UNESCO in Paris in October 2005.

Alastair Hay of the Unit of Molecular Epidemiology of the University of Leeds, UK then outlined the Royal Society's recent activities in regard to the roles of codes of conduct in preventing the misuse of scientific research. Although wide consultation was needed when developing codes, the Royal Society found clear value in having such codes. It was pointed out that many valuable guidelines for professional conduct already exist such as the existing health and safety regulations in the UK, which require risk assessments to be carried out in regard to both those carrying out an activity and also those who might be affected by the activity. The presentation concluded by considering the seven questions raised by John Freeman, UK Ambassador to the Conference on Disarmament, as chair of the 2005 BTWC Geneva meetings to address the content, promulgation, and adoption of codes of conduct for scientists.

- **Codes of Conduct II**

Graham Pearson of the Department of Peace Studies, University of Bradford, UK examined what could be gained from the experience of the States Parties to the BTWC who were, in 2005, addressing the content, promulgation, and adoption of codes of conduct for scientists. The BTWC is the international treaty providing the closest parallel to the CWC, with both Conventions containing general-purpose criteria [7] which prohibit entire classes of weapons. The BTWC Meeting of Experts held in Geneva on 13 to 24 June 2005 had seen the participation of over 500 individuals with over 280 from capitals coming from 82 States Parties and 3 Signatory States, 8 intergovernmental organizations (including the OPCW), 23 guests of the Meeting and 16 nongovernmental organizations (NGOs). The seven questions posed by the Chair, John Freeman, were reviewed, and it was noted that these were equally applicable to codes for the CWC.

Brian Rappert of the University of Exeter, UK set out a strategy for engaging life scientists regarding dual-use research [8]. In 2003, Rappert and Dando led a series of 26 seminars to over 600 participants in university life science departments in England, Scotland, Wales, Northern Ireland, and Germany during the 2004–5 academic year. These interactive seminars on dual-use research were introduced with nine slides, followed by discussion of questions selected by the seminar organizers. This approach was suggested as a useful model for the chemical sciences. The key was to go to the people engaged in the science of interest and to create a situation in which they discussed issues with each other. Such an approach went beyond awareness-raising to enabling debate about the key issues.

- **Education I**

Alastair Hay of the Unit of Molecular Epidemiology of the University of Leeds, UK described how codes of conduct for scientists had been successfully discussed with A-level students at a local school. Hay also spoke recently to 200 teachers of chemistry and pointed out the opportunities that are already in the current UK A-level and GCSE level curricula to explore "spiritual, moral and cultural dimensions in addition to gaining scientific knowledge and understanding of chemical topics" and to consider moral and ethical issues "through discussion of the uses of scientific knowledge including the recognition that such uses can have both beneficial and harmful effects."

Jiri Matousek of the Faculty of Science of Masaryk University, Brno, Czech Republic described a course he has developed at the Masaryk University entitled "Military Chemistry, Toxicology and Protection against Highly Toxic Chemicals", which addresses issues related to the CWC. This 28-hour course comprises four main parts: an introduction that sets the scene regarding chemical weapons; the chemistry and toxicology of the basic types of chemical warfare agents; the fundamentals for protection of military and civilian personnel against chemical weapons and highly toxic chemicals; and issues related to chemical disarmament, including the historical development of treaties prohibiting chemical weapons, the CWC, and technologies for chemical weapon destruction.

Alberto Fratadocchi of the Academy of Science of the Institute of Bologna, Italy then described a 2005 meeting that considered how the Bologna Academy of Science could support the CWC and the OPCW. This initiative focused on chemistry education in high schools and universities, with particular attention given to ethics and professional responsibility of chemists, chemical engineers, and industrial chemists. One recommendation was that the authors and editors of chemical education books should include a chapter on ethics and responsibility. The need had also been recognized for a degree course that would help chemists to be trained as possible OPCW inspectors and to provide information relating to the implementation of the CWC. The Bologna Academy of Science decided to establish a committee to study the curricula of high school students and university students.

- **Education II**

Ferruccio Trifiró of the University of Bologna, Italy addressed chemical weapons in scientific literature and in education. He examined the treatment of chemical weapons in scientific journals by comparing the number of references to terms such as "lewisite" and "sarin" in the past year to the previous 50 years. He then considered what should be done in Italy to increase awareness of chemists about the CWC, referring to three papers recently published in the Italian journal of the chemical society *La Chimica e L'Industria*. Finally, consideration was given to what was useful to publish or teach to make chemists more aware of the CWC.

- **International Law and the Role of the Chemical Industry**

Kobi-Renee Leins of the Mines-Arms Unit in the Legal Division in the International Committee of the Red Cross (ICRC) in Geneva, Switzerland spoke on international law and norms governing work in the life sciences. She referred to historical laws relevant to poisoning and the deliberate spread of disease, recalling ancient taboos and the customary rules of international law that prohibit the use of poison or poisoned weapons or chemical weapons. The international treaties—the Geneva Protocol of 1925, the Biological and Toxin Weapons Convention of 1972, and the Chemical Weapons Convention of 1993—and the requirements for national laws under Article IV of the BTWC and Article VII of the CWC apply to all persons within the States Parties to these Conventions. Consequently, all scientists, physicians, and those who employ them have a respon-

sibility under specific treaties and under customary international law to prevent the hostile use of chemistry and the life sciences.

Richard Robson of the European Chemical Industry Council (CEFIC), Belgium described the global chemical industry's Responsible Care program, and then examined the role for chemical industry in the implementation of the CWC. The Responsible Care program was a public commitment by the chemical industry to improve the safety, health, and environmental performance of chemical products and processes. The program was launched in Canada in 1985 and is now an International Council of Chemical Associations (ICCA) initiative operating in 85 countries worldwide, covering over 90 % of the world's chemical production. The Responsible Care Global Charter calls for those involved to abide by global principles to continuously improve and report performance, advance sustainable development, enhance product stewardship, promote Responsible Care through the value chain, support national and global Responsible Care governance processes, and address stakeholder concerns and expectations.

Robson's second presentation examined the role of the chemical industry in the implementation of the CWC. He first outlined current voluntary contributions by industry to implement the CWC. Robson then considered codes of conduct, noting that these exist in several States Parties to the CWC. The aim of these codes of conduct is to strengthen the cooperation between industry and the national authorities, to provide a basis for more effective control, and to reduce the administrative burden wherever possible. This was illustrated by the UK code of conduct on chemicals subject to trade controls and voluntary requirements, drawn up jointly by the CIA (Chemical Industries Association), BCTDA (British Chemical Distributors and Traders Association), and CPA (Crop Protection Association). The UK code addresses chemical weapon and drug precursors, chemicals subject to export licensing, chemicals subject to the prior informed consent (PIC) convention, and persistent organic pollutants (POPs). The objective of the UK code is to increase awareness throughout the industry, establish and improve standards of control, protect against diversion of chemicals in the illicit production of drugs and weapons of mass destruction, cooperate fully with government and law enforcement authorities, promote environmentally sound management of chemicals in international trade, and safeguard the chemical industry's good reputation.

## B. WORKSHOP OUTCOMES

In the *opening session* of the workshop, participants discussed ways to increase awareness of the CWC and its requirements and obligations and examined how these can be advanced in the communities of chemists and chemical engineers and, more generally, in the international scientific community. They also examined how to promote professional conduct consistent with these requirements and obligations and how to more fully reflect in chemistry education the knowledge of the CWC and its requirements.

The OPCW noted that it had been engaged in an ethics project with the States Parties to the CWC to promote awareness of the CWC among chemistry/engineering professionals, to promote a culture of compliance with the requirements of the Convention, and to integrate ethical and scientific aspects of chemical weapons disarmament into chemistry and chemical engineering education. The OPCW recalled that the 2003 First Review Conference had noted that a valuable aspect of national implementation measures involves ensuring that the chemical industry, the scientific and technological communities, the armed forces of the States Parties, and the public at large are aware of the prohibitions and requirements of the CWC. *Appendix 1* provides extracts from relevant sections of the Convention.

Each participant was assigned to one of two discussion groups, on education/outreach issues and codes of conduct and practice. Reports from the discussion groups were presented in the final session of the workshop, which identified key issues to be addressed in this IUPAC technical report.

The wide-ranging deliberations of the two discussion groups are summarized below.

## I. Chemistry Education and Outreach

The education and outreach working group (Natalia Tarasova of Russia, convenor; Peter Mahaffy of Canada, reporter) began by considering several science communication principles identified in the draft report on IUPAC's niche in enhancing the public understanding of chemistry from IUPAC Project ##2004-047-1-050, chaired by Peter Mahaffy. This framework led to the following formulation of how the requirements and obligations of the CWC could be communicated in an educational context:

- Who are the target audiences?
- What should be communicated?
- How should this be communicated?
- Strategies for implementation
  - Short term
  - Longer term
- How to assess the effectiveness of these communications

### *Target audiences*

The following were identified as being the primary target audiences:

a. Educators, especially secondary and postsecondary school teachers, through whom citizens and the public at large can be reached.
b. Scientists, chemical engineers, and technologists, as they are primarily engaged in science and technology using chemicals—and these chemicals fall under the CWC.
c. The preferred approach is to work through undergraduate and postgraduate programs to reach these target audiences.
d. Neither IUPAC nor the OPCW has the resources needed to work directly with teachers and students. However, both IUPAC and the OPCW can influence and work with other organizations.
e. IUPAC chemists were recognized as a primary target for educational initiatives to reach chemists. Furthermore, many IUPAC chemists work in educational contexts.
f. Authorities responsible for accreditation of educational programs such as ACS and EuCheMS should also be targeted, to foster a culture of incorporating ethical issues into curriculum.
g. In some countries and contexts, an appropriate target will be ministries of education.

### *What should be communicated?*

Currently, many people know that there is some kind of treaty relating to chemical weapons but most are unable to summarize key features or know what is specifically prohibited. One measure of success for any educational initiative would be improving awareness in the target audiences that the CWC is relevant to them. In considering what needs to be communicated, it was recognized that this depends on understanding what the target audience needs to know and is willing to know.

It was suggested that education start with the positive uses of chemicals, leading into the potential for multiple uses of some chemicals and thus the concept of dual-use chemicals and the prohibitions and obligations under the CWC. This needs to be put into the context of professional responsibility of each individual for the beneficial use of chemicals and chemical technologies.

In developing codes of conduct for the next generation of chemists and users of chemicals, the workshop emphasized the importance of using pedagogical strategies to help each cohort of students engage the topic and take ownership. This led to the suggestion that students formulate their own codes of behavior with respect to the use of dual-use chemicals.

In considering how such communication should be achieved, it was recognized that the National Authorities within each State Party to the CWC are the primary conduits at present. However, National Authorities have very limited resources and are generally not well connected within the State Party with other government bodies that have responsibility in the area of education, or with educational institu-

tions. Communication should therefore involve working with national ministries of education and of the environment where appropriate.

Above all, the need was to motivate involvement by scientists and teachers at all levels. The workshop highlighted the importance of working with organizations that represent the target audiences (such as scientists and educators), enabling them to communicate with students and other members of the public.

### *Strategies for implementation*

Short-term action items

1. Support international science education conferences for teachers where chemicals and the prohibitions and obligations arising from the CWC can be raised in the broader context of the responsible use of chemistry.
   *Implementation, timeline, and responsibility:*
   - Chemistry Education for Sustainable Development Conference and workshop on dual-use materials and the CWC (Moscow, 2005), Tarasova
   - ICCE (Seoul, 2006; Mauritius, 2008), IUPAC CCE
2. Use of IUPAC Web site for disseminating information regarding CWC-related courses and initiatives already in place.
   *Implementation, timeline, and responsibility:*
   - Courses reported in this workshop by speakers and participants—e-mail information to Ferruccio Trifiró (Trifiro@fci.unibo.it), 15 August 2005
   - IUPAC (NR) representatives survey, Peter Atkins for CCE, 15 Sept. 2005
   - CCE will look after placement on IUPAC Web site
3. Letter from IUPAC president to select graduating chemistry students. Convey a simplified code of ethics, information about CCW—in the context of building enthusiasm for the profession of chemistry.
   *Implementation, timeline, and responsibility:*
   - Leiv Sydnes, with feedback from others, December 2005
   - Pilot this letter through several national societies, including some with existing mechanisms for communicating with graduates.
4. IUPAC/OPCW joint project
   A central part of the strategy is to develop educational materials to be used with secondary and postsecondary teachers, with the following components:
   a. White paper explaining the CWC, starting with general-purpose criterion.
   b. Case studies on chemicals that fall under CWC that also have beneficial uses.
   c. Materials and guidelines to help students develop their own code of ethics/behavior—perhaps making use of historical codes.
   d. Include suggestions on target audiences, and ways to disseminate materials more broadly.
   e. Include code of ethics and supporting materials.
   f. Include materials that could form the basis for one or more undergraduate lectures.
   g. Propose mechanism for translation into native languages, starting with the six UN languages used by OPCW.
   h. Address from the outset how success will be measured.

   *Scope and limitations:*

   Project will prepare a basic set of materials to pilot in several contexts (Moscow, 2005; UK, 2006). Project will propose, but not implement wide-scale dissemination, including the identification of future partners.

   *Implementation, timeline, and responsibility:*

   Alastair Hay (project leader, UK), Ted Becker (USA), Alberto Fratadocchi (Italy), Peter

Mahaffy (Canada), Robert Mathews (Australia), Brian Rappert (UK), Richard Robson (Belgium), O.P. Sharma (India), Rolando Spanevello (Argentina), Natalia Tarasova (Russia), Ralf Trapp (Netherlands).

- 15 Aug. 2005—IUPAC Project Proposal Submitted (Hay, assistance Mahaffy)
- 15 Sept. 2005—Draft white paper (Trapp), draft toxicology materials (Hay)
- 15 Oct. 2005—Draft of materials for pilot (various)
- 1 Nov. 2005—Pilot materials at conference in Moscow, followed by (1) day workshop to further develop integrated set of materials (Tarasova, various)
- 1 March 2006—Pilot of materials in UK (Hay)
- 1 Aug. 2006—Possible further pilot and dissemination of materials at ICCE in Seoul (Mahaffy, Tarasova, various)
- 1 Nov. 2006—Final project report (Hay)

5. Dissemination of workshop outcomes
   *Implementation, timeline, and responsibility:*
   - Prepare report of outcomes for *PAC* (Pearson, assistance Mahaffy, 15 November 2005)
   - Summarize key findings for *Chemistry International* (*CI*) (Pearson, assistance Mahaffy, 15 November 2005)
   - Possible further dissemination of detailed papers from workshop through Chemistry Education International (CEI)—CCE

Longer-term action items

6. Identification of appropriate accreditation agencies for undergraduate programs for chemists and teachers
   *Implementation, timeline, and responsibility:*
   - CCE—Beijing, August 2005 (Atkins)
7. IUPAC/OPCW-sponsored debates where the topic would relate to CWC—perhaps at the IUPAC General Assembly (undergraduate level), and the Chemistry Olympiad (secondary schools)
   *Implementation, timeline, and responsibility:*
   - Topic to be considered at CCE meeting, Beijing, August 2005 (Atkins)

   *How to assess the effectiveness of these communications*

   This would be addressed as part of the IUPAC/OPCW joint project.

## II. Codes of Conduct

The codes of conduct working group (Graham Pearson of the UK, convenor; Jo Husbands of the USA, reporter) considered the following aspects of developing codes for those engaged in science and technology using chemicals:

- Scope of code of conduct
- Who needs the code?
- Why is a code necessary?
- What codes are needed?
- What should codes include?
- Drafting elements for a society-level code of conduct
- Subsequent activities
- Next steps
- Review of the seven Freeman questions

### *Scope of a code of conduct*

It was recognized that any code needed to address the potential misuse of chemicals to cause harm to humans, animals, and the environment. Particularly from an IUPAC viewpoint, the potential misuse

needed to be widely crafted so as to include pesticides, illicit drugs, chemical and biological weapons, hazardous wastes, etc.

*Who needs the code?*

A code is required for all those engaged in science and technology using chemicals. The code needs to be widely crafted so as to be applicable to chemists, physicists, mathematicians, life scientists, etc. A code should not be restricted to scientists and engineers but should also be applicable to those making policy decisions, administrators, funding organizations and bodies, sales personnel, etc., and should apply throughout academia, industry, and government.

*Why is a code necessary?*

To fully implement the CWC, a code is necessary:

- To complement national implementation legislation and regulations.
- To achieve in-depth compliance throughout academia, industry, and government of all those engaged in science and technology using chemicals.
- To implement the general-purpose criterion of the CWC under which chemical weapons are defined as *Toxic chemicals and their precursors,* ***except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes.*** The text in bold is known as the general-purpose criterion which embraces **all** toxic chemicals and their precursors unless in types and quantities for purposes not prohibited under the Convention.
- To protect public health and the environment.

It was recognized that the reasons why a code is important would be different in different States Parties.

*What codes are needed?*

There has been much attention paid to codes of conduct during the past decade, notably following the UNESCO/ICSU World Conference on Science in Budapest, Hungary in 1999 and subsequently by UNESCO/COMEST as well as by ICSU. The States Parties to the BTWC recently addressed *the content, promulgation and adoption of a code of conduct for scientists.* From these different perspectives, benefit was seen from a tiered or layered approach:

- Universal principles/declarations—an aspirational code
- Society codes—guidance on conduct
- Institutional or workplace codes—setting out workplace practices

These three types of code were seen as complementary. The responsibility for developing such codes could be different according to the layer or tier concerned. Thus, the universal principles/declaration were being actively studied by UNESCO/COMEST who plan feasibility studies leading to an ethical declaration of principles in science and technology. Another initiative by Sir David King, the Chief Scientific Adviser to the British government, who, following a Carnegie meeting in 2004 of the Ministers of Science of the G-8 Nations, developed seven key principles *Rigour, Respect and Responsibility*. These are being piloted with scientists in the British government and have also been sent to the G-8 Nations and to the EU.

At the professional society code level, IUPAC and national societies could play a key role. In the context of the CWC, National Authorities in the States Parties should also play a role. The next layer, the institutional or workplace codes, would need to reflect the particular characteristics and requirements of the institution or workplace.

*What should codes include?*

Focus should be on the extension of existing codes, where such codes existed, rather than on the creation of new codes. For example, at the level of institutional/workplace codes, existing requirements for

risk assessments for health and safety purposes might be extended to considering whether proposed activities were lawful and consistent with national implementing legislation for the CWC.

For any code to be effective, it needs to involve those concerned in a continuing process. This applies to the development and updating of codes, and also to their implementation, particularly at the institutional/workplace level. All elements of the community to be subject to a code need to be involved, to create a sense of shared ownership. This engagement needs to continue during implementation.

At the Meeting of Experts held by the States Parties to the BTWC in June 2005, many elements of the community had been successfully engaged through the open sessions with participation of both intergovernmental organizations (IGOs) and "guests of the Meeting of Experts" which included 23 NGOs. Clear benefits would result from considering codes of conduct in the context of the CWC in a similar open session involving both the States Parties to the CWC and relevant IGOs and NGOs. Education and outreach are critical components of any approach to effective codes of conduct. A research study by Brian Rappert (University of Exeter) and Malcolm Dando (University of Bradford) carried out 26 seminars for over 600 participants in university life science departments in London (6), the rest of England (13), Scotland (3), Wales (2), Northern Ireland (1), and Germany (1) showed that there was little knowledge of the BTWC or of dual-use issues in the life sciences. The situation was likely to be similar in regard to knowledge of the CWC in university natural science departments.

Case studies/examples help to demonstrate why codes matter to every element of the community engaged in science and technology using chemicals. However, specific examples need to be identified that are seen as relevant to each part of the community. The workshop recommended using positive examples first and then illustrating how misuse may occur, such as the following:

Positive examples

- New tools and techniques—microreactors
- Synthesis of new chemicals and development of new processes
- Research in the interface between traditional chemical and biological agents
- Intangible technology—the answers to the question "How did you do that?"

Negative examples

- Illicit drugs
- Aum Shinrikyo sarin attacks in the Tokyo subway
- Bhopal methyl isocyanate accident
- Chemical warfare images of Halabjah

### *Drafting elements for a society-level code of conduct*

Consideration was given to identifying the sort of language that might be included in a code of conduct at the intermediate society level such as in a model code that might be promulgated by IUPAC to its NAOs. Such a code could start by recalling why codes are important—namely, to complement national implementing legislation for the CWC, to achieve in-depth compliance throughout academia, industry, and government, to implement the general-purpose criterion, which makes the CWC relevant to all toxic chemicals and their precursors, and to protect public health and the environment. The sequence in which these reasons might be listed in a code could well differ depending on which points were particularly relevant in a specific country.

In considering possible language for codes, the discussion group had copies of the *Rigour, Respect and Responsibility* code taken forward by Sir David King (UK), the American Chemical Society Code, the Royal Australian Institute Code, and the Royal Society of Chemistry code. None of these include specific mention of the CWC. Bearing these codes in mind, the discussion group considered the sort of language that might usefully appear in a society-level code.

Three considerations might be helpful in providing transition from general to specific codes relevant to implementation of the CWC:

- Extraordinary benefits to the quality of life, public health, and agriculture throughout the world are made available by the knowledge, methods, and techniques in science and technology using chemicals.
- The possible misuse of this knowledge, methods, and techniques in science and technology using chemicals places moral and ethical responsibilities on those engaged in science and technology using chemicals to ensure that their activity is aimed only at bringing benefit to humankind and the environment.
- The stewardship responsibilities of those engaged in science and technology using chemicals for sustainable development and the needs of future generations underlines the importance of complying with and supporting relevant international treaties and conventions.

Consequently, the responsibilities of all those engaged in science and technology using chemicals are to ensure that their work is, and is perceived to be, in compliance with the international treaties and national laws and regulations prohibiting chemical or biological weapons or illicit drugs and relating to banned and severely restricted chemicals, the PIC convention, POPs, the Basel Convention, etc.

These were subsequently developed into a model code of principles which might be proposed for adoption by the IUPAC Council as an IUPAC Recommendation.

Additional drafting elements were identified which might be incorporated into professional society-level codes or institutional/workplace codes:

- Acknowledge that minimizing risks from misuse of science and technology using chemicals is a responsibility of members of professional societies and the workplace.
- Recognize that personal benign intent is an insufficient justification for setting aside such responsibilities.
- Be aware of the possible misuses of science and technology using chemicals.
- Consider the direct and indirect benefits and harms of science and technology using chemicals to colleagues, their professional communities, and society at large.
- Ensure that all are knowledgeable about and comply with relevant international and national laws and regulations.
- Where inadequacies are identified in regard to existing laws and regulations, such concerns should be raised with relevant policy officials and professional organizations.
- Take actions within spheres of influence to reduce the risk of misuse of knowledge, methods, and techniques in science and technology using chemicals.

Responsibility for minimizing the risk that science and technology using chemicals may be misused is both a matter for individuals and for the professional and technical communities. Collectively, it was important to:

- Recognize that their expertise brings additional responsibility to reduce the risk that science and technology using chemicals may be misused.
- Set up procedures so that those concerned about possible misuse or perceived misuse can address such concerns and resolve them.
- Educate the members of professional and technical communities and the public about the potential for the misuse of science and technology using chemicals and how the risk of such misuse may be minimized, including through increased awareness of codes.

### *Subsequent activities*

The considerations above for providing the transition from the general to the specific were subsequently developed into a model code of principles which might be proposed for adoption by the IUPAC Council as an IUPAC Recommendation.

In addition, the drafting elements, which might be incorporated into the society-level code or into the institutional/workplace codes, were subsequently developed into a set that might be considered for

approval and inclusion in their own codes by regional and national chemical societies and other IUPAC NAOs. These will be developed into an IUPAC Recommendation for approval by the IUPAC Council.

### *Next steps*

Action is needed to take forward codes of conduct for those engaged in science and technology using chemicals. This will require concerted effort at the three levels—OPCW, IUPAC, and the National Authorities of the States Parties to the CWC.

OPCW

OPCW needs to give evidence of support for the IUPAC education and codes of conduct initiative that IUPAC NAOs can refer to in taking national action and approaching their National Authorities as well as other national government agencies.

The objective of the IUPAC education and codes of conduct initiative is to achieve in-depth compliance with the CWC, which complements national implementation measures. OPCW and its States Parties might adopt complementary measures to achieve in-depth compliance through education and codes, in parallel to and after completion of the follow-up to the current OPCW Action Plan on the Implementation of Article VII Obligations (National Implementation), which the Conference of the States Parties will discuss and decide on at its 10$^{th}$ Session in November 2005, to achieve in-depth compliance through education/outreach/codes. Such complimentary measures might be proposed by a group of like-minded States Parties and could be linked with offers of assistance in education/awareness-raising/codes to any States Parties that wished to receive such assistance.

IUPAC

The first step should be the preparation of an IUPAC technical report based on the model of the technical report following the IUPAC Bergen, Norway meeting in 2002. The technical report should be published in *PAC* with short reports in other appropriate IUPAC publications such as *CI*.

Further action by IUPAC should be through the NAOs and ANAOs as well as the Committee on Chemical Education (CCE). IUPAC should consider adopting a code of principles and/or providing "model" codes for adoption by NAOs and ANAOs.

National authorities

As the primary responsibility for the national implementation of the CWC within a State Party rests with the National Authority of the State Party, actions by NAOs and ANAOs are more likely to be effective if they work with National Authorities in engaging education and science ministries, professional associations, and trade associations to promote education and codes of conduct. There would be clear benefits from harmonization nationally across academia, industry, and government of such efforts in regard to all areas of science and technology using chemicals.

### *Review of the seven Freeman questions*

The discussion group noted that in 2004, John Freeman (UK Ambassador and Chair of the 2005 BTWC meetings) circulated to the BTWC States Parties seven questions about *the content, promulgation, and adoption of codes of conduct for scientists* to be examined at the 2005 Geneva meetings. If "BTWC" is replaced by "CWC", these questions are equally applicable to a code of conduct in relation to the CWC. The discussion group considered whether they had been sufficiently addressed during the OPCW/IUPAC workshop in Oxford.

1. *How can we raise awareness of the CWC provisions in the global scientific community and reinforce the responsibilities of scientists?*
   This had been addressed as the central theme of the OPCW/IUPAC Oxford workshop.
2. *Should under-graduate and post-graduate education programmes address the ethical and practical aspects of preventing the misuse of science? How can we encourage due consideration of the possible consequences of the misuse of research?*
   This had also been addressed as a central theme of the OPCW/IUPAC Oxford workshop.

3. *How can we encourage universities, industry, research bodies and government to reflect CWC issues in their own in-house codes of practice and operational frameworks? Might we consider the introduction of guidance or instructions into existing structures that deal with the safety and ethics of individual experiments and research?*
   This had also been addressed as a central theme of the OPCW/IUPAC Oxford workshop.
4. *How can we promote the proper use of science-based activities and knowledge and encourage appropriate oversight of such work?*
   There had been less attention given to the question of oversight. The discussion group noted the potential concern about chemicals in the mid-spectrum region between traditional chemical agents and biological agents such as calmatives and bioregulators. It was important to ensure that any work in this region was carefully considered to ensure that it was neither in breach nor perceived to be in breach of the CWC or the BTWC.

   The question of national chemical defense programs was also considered. It was noted that in 2004 the OPCW adopted a format for the annual submission by States Parties of information on national protective programs. Transparency of such programs between States Parties and more widely to the public is important to demonstrate that States Parties are both compliant and perceived to be compliant with the obligations of the CWC and the BTWC.

   Finally, it was noted that special attention might be given in codes for those engaged in science and technology using chemicals within government to ensure that perceptions of their activities are in compliance with international treaties and national laws and regulations.
5. *Is it necessary to provide guidance on how to deal with research that throws up unexpected or unpredictable results of relevance to the* CWC *prohibitions?*
   This was another area to which less attention had been given. The discussion group considered that this was especially relevant in the mid-spectrum region between traditional chemical and biological agents and in regard to synthetic chemicals that mimic biological functions. Unexpected/unpredicted results should be addressed in codes especially at the institutional/workplace level.
6. *How might we promote consideration among research and project funders of CWC issues when considering proposals, e.g., whether the research could be misused in the future and what steps might help prevent this?*
   This had also been addressed as a central theme of the OPCW/IUPAC Oxford workshop.
7. *To whom or to what body might an individual turn if he/she suspects that someone else's conduct is in breach of CWC prohibitions? What safeguards might there be for such individuals? And how might any malign accusations be filtered out?*
   This had also been addressed in the OPCW/IUPAC Oxford workshop.

It was thus evident that the OPCW/IUPAC workshop had addressed most if not all of the questions raised by Ambassador Freeman in the context of the BTWC meetings to address codes of conduct for scientists.

## C. SUMMARY FINDINGS AND OBSERVATIONS

### I. Chemistry Education and Outreach

1. Outreach to those engaged in science and technology using chemicals and efforts to ensure that the education of all chemists includes an awareness of the requirements and obligations of the CWC will contribute to achieving in-depth compliance within States Parties to the Convention. An informed scientific and technological community within each country can help provide advice to the States Parties and disseminate unbiased and accurate information to the public.

2. Steps need to be taken in chemistry education both at secondary and postsecondary levels to enhance the awareness of both the benefits that science and technology using chemicals can bring and of the potential for misuse in regard to illicit drugs, chemical and biological weapons, PIC chemicals, POPs, etc.
3. Those engaged in science and technology using chemicals need to recognize their role in ensuring sustainable development and that compliance and implementation of international treaties such as the CWC and the BTWC contribute to sustainable development.
4. From the point of view of the implementation of the CWC and achieving in-depth compliance, a concerted effort is needed involving both the OPCW and the National Authorities of the States Parties and IUPAC, its NAOs and ANAOs.
5. OPCW needs to clearly endorse the education and codes initiative, which can be referred to by NAOs and ANAOs in approaching their respective National Authorities and other national ministries.
6. An IUPAC/OPCW joint project is proposed to take forward the proposed chemistry education and outreach initiative. This project will prepare a basic set of materials, such as a white paper on the CWC emphasizing the general-purpose criterion, case studies to demonstrate why education/outreach/codes are important, and a model code of ethics and supporting materials, to pilot in several countries and contexts.
7. The President of IUPAC will consider writing to students graduating in chemistry, to build enthusiasm for the profession of chemistry whilst alerting them to their responsibilities to protect health and the environment and be aware of the potential misuse of chemicals. The letter should emphasize the importance of ensuring that their activities are, and are perceived to be, in compliance with international treaties, national laws, and regulations such as those relating to illicit drugs, chemical and biological weapons, banned and severely restricted chemicals, PIC chemicals, POPs, etc. The letter, which might include a model code, could be piloted through appropriate NAOs and ANAOs or national societies that already communicate with chemistry graduates.

## II. Codes of Conduct

8. Codes of conduct are needed for all those engaged in science and technology using chemicals to protect public health and the environment and to ensure that activities in science and technology using chemicals are, and are perceived to be, in compliance, with international treaties, national laws and regulations such as those relating to illicit drugs, chemical and biological weapons, banned and severely restricted chemicals, PIC chemicals, persistent organic pollutants (POPs), etc.
9. Such codes of conduct are complementary to national implementing legislation for the CWC and will help to achieve in-depth compliance throughout academia, industry, and government of those engaged in science and technology using chemicals. They will extend awareness of the general-purpose criteria of both the CWC and the BTWC and thus help ensure its effective implementation.
10. Codes of conduct might be developed in the following layers:
    - Universal principles/declarations such as those being developed by UNESCO/COMEST
    - Society codes such as those of or being developed by professional and industrial associations
    - Institutional/workplace codes such as those in or being developed by individual institutions/workplaces

    The three layers are complementary and mutually reinforcing. The approach to be adopted throughout should be to extend existing codes rather than seeking to create new codes.

11. Successful codes require the involvement of all elements of the community engaged in science and technology using chemicals to create a sense of shared ownership and increase their effectiveness. At the institutional/workplace level, creating processes in which the ethical aspects of each new piece of work is considered, would be similar to the process for health and safety risk assessments already required in many countries.
12. IUPAC should develop a model code of principles as well as draft elements for codes which might be promulgated to IUPAC NAOs and ANAOs urging them to review any existing codes to ensure these elements are included.
13. As with the chemistry education/outreach initiative, OPCW needs to clearly endorse the benefits that can arise from in-depth compliance as a result of codes of conduct for all those engaged in science and technology using chemicals. Consideration should be given to taking complementary measures to achieve in-depth compliance through education/awareness raising/codes, in parallel to and after completion of the follow-up to the current OPCW Action Plan on the Implementation of Article VII Obligations (National Implementation), which the Conference of the States Parties will consider at its 10th Session in November 2005.

## REFERENCES AND NOTES

1. G. W. Parshall, G. S. Pearson, T. D. Inch, E. D. Becker. *Pure Appl. Chem.* **74**, 2323 (2002).
2. OPCW. "Note by the Director-General: Report of the Scientific Advisory Board on Developments in Science and Technology", Conference of States Parties, First Review Conference, 28 April–9 May 2003, RC-1/DG.2, 23 April 2003.
3. OPCW. "Report of the First Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (First Review Conference)", Conference of States Parties, First Review Conference, 28 April–9 May 2003, RC-1/5, 9 May 2003.
4. OPCW. "Report of the Seventh Session of the Scientific Advisory Board", Scientific Advisory Board, Seventh Session, 9–11 March 2005, SAB-7/1, 11 March 2005.
5. OPCW. "Note by the Director-General: Report of the Seventh Session of the Scientific Advisory Board", Executive Council, Forty-First Session, 28 June–1 July 2005, EC-41/DG.8, 25 May 2005.
6. Participants came from the following countries: Argentina, Australia, Belgium, Canada, Croatia, Cuba, Czech Republic, Germany, India, Iran, Italy, Norway, Russia, Sweden, Switzerland, Ukraine, UK, and USA.
7. In the BTWC, the general-purpose criterion is embodied in Article I that states: *Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:*

   *(1) Microbial or other biological agents, or toxins whatever their origin or method of production**, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes**;*

   The text in bold is the general-purpose criterion. At successive BTWC Review Conferences, the States Parties have agreed extended understanding to this prohibition. At the Fourth Review Conference in 1996, it was agreed that *the Convention unequivocally covers all microbial or other biological agents or toxins, **naturally or artificially created or altered, as well as their components,** whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes.* The extended understanding makes it clear that the prohibitions of the BTWC apply to chemicals in the mid-spectrum region between classical chemical agents and traditional biological agents.
8. Dual-use research is research which could be used for permitted or prohibited uses. This term is applicable to much work in science and technology.

9. United Nations. *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction,* available at <http://www.opcw.org/cwc/cwc-eng.htm>.
10. Organization for the Prohibition of Chemical Weapons. *States Parties to the Chemical Weapons Convention*. Available at <http://www.opcw.org/html/db/members_ratifyer.html>.

## LIST OF ACRONYMS

| | |
|---|---|
| BCTDA | British Chemical Distributors and Traders Association |
| BTWC | Biological and Toxin Weapons Convention |
| CCE | Committee on Chemistry Education (IUPAC) |
| CEFIC | Conseil Européen de l'Industrie Chimique/European Chemical Industry Council. |
| CIA | Chemical Industries Association |
| COMEST | World Council on the Ethics of Scientific Knowledge and Technology |
| CPA | Crop Protection Association |
| CW | chemical weapons |
| CWC | Chemical Weapons Convention |
| ICCA | International Council of Chemical Associations |
| ICCE | International Committee for Chemical Education |
| ICRC | International Committee of the Red Cross |
| ICSU | International Council of Science |
| IUBMB | International Union of Biochemistry and Molecular Biology |
| IUBS | International Union of Biological Sciences |
| IUPAC | International Union of Pure and Applied Chemistry |
| NAO | National Adhering Organization (IUPAC) |
| OPCW | Organisation for the Prohibition of Chemical Weapons |
| PIC | prior informed consent |
| POP | persistent organic pollutant |
| SAB | Scientific Advisory Board of the OPCW |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNITAR | United Nations Institute for Training and Research |
| WHO | World Health Organization |

## APPENDIX 1. THE CHEMICAL WEAPONS CONVENTION

### Introduction

The Chemical Weapons Convention (CWC) [9] totally prohibits the development, production, acquisition, stockpiling, or retention of chemical weapons. It defines chemical weapons as meaning the following, together or separately:

> *(a) Toxic chemicals and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes; [Emphasis added]*
>
> *(b) Munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices;*
>
> *(c) Any equipment specifically designed for use directly in connection with the employment of munitions and devices specified in subparagraph (b).*

The text in bold is referred to as the **general-purpose criterion**, which ensures that all toxic chemicals and their precursors are embraced by the Convention *except where intended for purposes not prohibited under the Convention.* Toxic chemicals are defined in the Convention as meaning:

> *Any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere.*

All chemicals that can cause death, temporary incapacitation, or permanent harm to humans or animals are thus prohibited unless they are in types and quantities consistent with their intended uses for purposes not prohibited under the Convention, which are defined in the Convention as:

> *(a) Industrial, agricultural, research, medical, pharmaceutical or other peaceful purposes;*
>
> *(b) Protective purposes, namely those purposes directly related to protection against toxic chemicals and to protection against chemical weapons;*
>
> *(c) Military purposes not connected with the use of chemical weapons and not dependent on the use of the toxic properties of chemicals as a method of warfare;*
>
> *(d) Law enforcement including domestic riot control purposes.*

The CWC was opened for signature in January 1993 and entered into force on 29 April 1997, which was 180 days after the 65$^{th}$ State Party had deposited its instrument of ratification. In July 2005, the Convention has 145 States Parties [10].

Article VII of the Convention, which sets out the measures to be taken by the States Parties to implement the CWC nationally, states that:

> *General undertakings*
>
> *1. Each State Party shall, in accordance with its constitutional processes, adopt the necessary measures to implement its obligations under this Convention. In particular, it shall:*
>
> *(a) Prohibit natural and legal persons anywhere on its territory or in any other place under its jurisdiction as recognized by international law from undertak-*

*ing any activity prohibited to a State Party under this Convention, including enacting penal legislation with respect to such activity;*

*(b) Not permit in any place under its control any activity prohibited to a State Party under this Convention; and*

*(c) Extend its penal legislation enacted under subparagraph (a) to any activity prohibited to a State Party under this Convention undertaken anywhere by natural persons, possessing its nationality, in conformity with international law.*

*2. Each State Party shall cooperate with other States Parties and afford the appropriate form of legal assistance to facilitate the implementation of the obligations under paragraph 1.*

*3. Each State Party, during the implementation of its obligations under this Convention, shall assign the highest priority to ensuring the safety of people and to protecting the environment, and shall cooperate as appropriate with other States Parties in this regard.*

*Relations between the State Party and the Organization*

*4. In order to fulfil its obligations under this Convention, each State Party shall designate or establish a National Authority to serve as the national focal point for effective liaison with the Organization and other States Parties. Each State Party shall notify the Organization of its National Authority at the time that this Convention enters into force for it.*

*5. Each State Party shall inform the Organization of the legislative and administrative measures taken to implement this Convention.*

*6. Each State Party shall treat as confidential and afford special handling to information and data that it receives in confidence from the Organization in connection with the implementation of this Convention. It shall treat such information and data exclusively in connection with its rights and obligations under this Convention and in accordance with the provisions set forth in the Confidentiality Annex.*

*7. Each State Party undertakes to cooperate with the Organization in the exercise of all its functions and in particular to provide assistance to the Technical Secretariat.*

The regime that States Parties have to implement in regard to chemicals is specified in Article VI of the Convention which addresses "Activities Not Prohibited under this Convention". The key requirement is stated in paragraph 2 that:

*2. Each State Party shall adopt the necessary measures to ensure that toxic chemicals and their precursors are only developed, produced, otherwise acquired, retained, transferred, or used within its territory or in any other place under its jurisdiction or control for purposes not prohibited under this Convention. To this end, and in order to verify that activities are in accordance with obligations under this Convention, each State Party shall subject toxic chemicals and their precursors listed in Schedules 1, 2 and 3 of the Annex on Chemicals, facilities related to such chemicals, and other facilities as specified in the Verification Annex, that are located on its territory or in any other place under its jurisdiction or control, to verification measures as provided in the Verification Annex.*

The Convention in its Annex on Chemicals assigns chemicals judged to present a risk to the Convention into three Schedules according to the following criteria:

***Guidelines for Schedule 1***

1. *The following criteria shall be taken into account in considering whether a toxic chemical or precursor should be included in Schedule 1:*

   (a) *It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;*

   (b) *It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:*

      (i) *It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;*

      (ii) *It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;*

      (iii) *It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;*

   (c) *It has little or no use for purposes not prohibited under this Convention.*

***Guidelines for Schedule 2***

2. *The following criteria shall be taken into account in considering whether a toxic chemical not listed in Schedule 1 or a precursor to a Schedule 1 chemical or to a chemical listed in Schedule 2, part A, should be included in Schedule 2:*

   (a) *It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;*

   (b) *It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;*

   (c) *It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;*

   (d) *It is not produced in large commercial quantities for purposes not prohibited under this Convention.*

***Guidelines for Schedule 3***

3. *The following criteria shall be taken into account in considering whether a toxic chemical or precursor, not listed in other Schedules, should be included in Schedule 3:*

   (a) *It has been produced, stockpiled or used as a chemical weapon;*

   (b) *It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that might enable it to be used as a chemical weapon;*

*(c) It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;*

*(d) It may be produced in large commercial quantities for purposes not prohibited under this Convention.*