OPCW

Scientific Advisory Board

Tenth Session
21 – 23 May 2007

SAB-10/1
23 May 2007
Original: ENGLISH

REPORT OF THE TENTH SESSION OF THE SCIENTIFIC ADVISORY BOARD

1. AGENDA ITEM ONE – Opening of the Session

The Scientific Advisory Board (SAB) held its Tenth Session from 21 to 23 May 2007 at OPCW headquarters in The Hague, the Netherlands. The Session was opened by the Chairperson of the SAB, Jiří Matoušek of the Czech Republic. Mahdi Balali-Mood of the Islamic Republic of Iran served as Vice-Chairperson. A list of participants appears as Annex 1 to this report.

2. AGENDA ITEM TWO – Adoption of the agenda

The SAB **adopted** the following agenda for its Tenth Session:

1. Opening of the Session
2. Adoption of the agenda
3. Welcoming address by the Deputy Director-General
4. Overview of developments at the OPCW since the Ninth Session of the Scientific Advisory Board
5. Establishment of a drafting committee
6. Report on an OPCW-IUPAC workshop, held in April 2007, on the impact of advances in science and technology on the Chemical Weapons Convention:
   - (a) Presentation on the IUPAC report on the workshop
   - (b) Presentation on plenary session 2, on synthesis
   - (c) Presentation on plenary session 3, on production technologies
   - (d) Presentation on plenary session 4, on nanotechnology and the delivery of drugs
   - (e) Presentation on plenary session 5, on analysis

(f) Presentation on plenary session 6, on medical countermeasures and decontamination

(g) Identification of points relevant to the work of the Scientific Advisory Board as set out in subitems 6(b) to (f)

7. Update on biomedical samples

8. Sampling and analysis: update and the way ahead

9. Assistance and protection against chemical weapons

10. Opportunities for the OPCW to further develop its international-cooperation portfolio to promote the peaceful uses of chemistry

11. Update on education and outreach in the context of the Chemical Weapons Convention

12. Future work of the Scientific Advisory Board

13. Any other business

14. Closure

3. AGENDA ITEM THREE – Welcoming address by the Deputy Director-General

3.1 The Deputy Director-General delivered a welcoming address on behalf of the Director-General. He began by thanking the Chairperson, Jiří Matoušek of the Czech Republic, and Dr Koichi Mizuno of Japan for their outstanding contributions to the SAB's work. He expressed the hope that both the SAB and the OPCW would be able to continue to benefit from their expertise, even though their formal association with SAB would be ending on 16 August 2007.

3.2 The Deputy Director-General also made the following points:

(a) He emphasised the importance of the contributions that the SAB would be making during the preparations for the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter "the Second Review Conference").

(b) He noted that these contributions would be based, *inter alia*, on the initial report of the international workshop jointly organised by the OPCW and the International Union of Pure and Applied Chemistry (IUPAC) and held in Zagreb from 22 to 25 April 2007.

(c) He emphasised the importance, for the analysis of biomedical samples, of holding confidence-building exercises—a strategy that would, he said, allow for broad participation by interested laboratories.

(d) He pointed to the need to review the OPCW's requirements for the analysis of toxins, and to determine, as a first step, the current capabilities of designated laboratories in this regard.

(e) He welcomed the ongoing discussions on education and outreach developed by the OPCW-IUPAC project education and outreach in the context of the Convention.

(f) Finally, he indicated that, to ensure adequate funding for all SAB endeavours, the Secretariat would continue to appeal to States Parties to contribute generously to the SAB Trust Fund.

4. AGENDA ITEM FOUR – Overview of developments at the OPCW since the Ninth Session of the Scientific Advisory Board

The SAB was briefed on developments at the OPCW since its Ninth Session, which took place from 12 to 14 February 2007, particularly as regards preparations for the Second Review Conference. The briefing also addressed the way ahead, and the SAB discussed the preparations for the finalisation of the SAB report to the Second Review Conference.

5. AGENDA ITEM FIVE – Establishment of a drafting committee

The SAB established a committee, made up of four of its members, to draft the preliminary report of the SAB to the Second Review Conference on developments in science and technology.

6. AGENDA ITEM SIX – Report on an OPCW-IUPAC workshop, held in April 2007, on the impact of advances in science and technology on the Chemical Weapons Convention

Subitem 6(a): Presentation on the IUPAC report on the workshop

6.1 The SAB heard a presentation on the draft report prepared by IUPAC on the international workshop, which was held in Zagreb from 22 to 25 April, and which drew 68 participants from 30 countries. It heard that two high-level conclusions had been drawn: that, with respect to advances in science, there was an increasing convergence between chemistry and biology; and that, with respect to technological advances, there was an increasing shift of chemical production towards what are known as non-traditional chemical-producing countries.

6.2 The workshop had also drawn a number of lower-level conclusions related to the Chemical Weapons Convention (hereinafter "the Convention"), in such areas as the following:

(a) national implementation and the general-purpose criterion;[1]

(b) declarations of toxic chemicals used in law enforcement;

---

[1] Among the definitions of "chemical weapons" given in Article II, paragraph 1, of the Convention, is the following, in subparagraph 1(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".

Some States Parties and commentators refer to this condition as the "general-purpose criterion".

(c) enhancements to the inspection regime for other chemical production facilities (OCPFs);

(d) the analytical capabilities of the OPCW, including as regards the analysis of toxins;

(e) the training of chemists, particularly in developing countries;

(f) strengthening links with other regulatory and non-proliferation regimes;

(g) international cooperation in the dissemination of peaceful technologies; and

(h) outreach to the scientific community.

6.3 More-detailed presentations then addressed each of the plenary sessions that were relevant to the work of the SAB. The presentations on these sessions are summarised below.

Subitem 6(b): Presentation on plenary session 2, on synthesis

6.4 The plenary session on synthesis focussed on three areas: the discovery and development of drugs, an assessment of toxins (extended abstract only), and the use of bio-informatics in the post-genomic era. Most of the discussion focussed on the accumulation of data on toxic chemicals within the pharmaceutical and pesticide industries, and on how the Convention might be used to safeguard against the improper use of these data.

Subitem 6(c): Presentation on plenary session 3, on production technologies

6.5 The session on production technologies began by addressing the current profile of the chemical industry. It identified current trends in chemical production, and underlined the increasing importance, in this regard, of a number of countries in Eastern Europe, Asia, and South America such as the Russian Federation, India and China, and Brazil. Participants also discussed microreactors, and noted that although the particular technology surrounding them was new, the starting materials and products in many cases would be the same (in terms of quantities and types). There could, however, be implications for the industry-inspection regime, including as regards inspections of OCPFs, should the technology become integrated into industrial production.

Subitem 6(d): Presentation on plenary session 4, on nanotechnology and the delivery of drugs

6.6 In the fourth plenary session, on nanotechnology and the delivery of drugs, three presentations addressed a number of issues, including recent advances in the use of aerosols to deliver drugs directly to the lungs, and the increasingly opaque boundaries between chemical, biological, and nanotechnological entities. The SAB considered that it should examine these issues further, and that they needed careful monitoring.

Subitem 6(e): Presentation on plenary session 5, on analysis

6.7 The fifth plenary session focussed on the on- and off-site analysis of environmental samples, on biomedical samples, and on the detection in the field of chemical-warfare agents. Participants noted that major issues had not changed significantly since 2002. Although the equipment and analytical methods used for on-site inspections were considered fit-for-purpose, there remained a desire to reduce both the logistical burden imposed by equipment and the amount of time that analysis takes. Any new equipment considered for use in this regard would need to be small, rugged, and cost-effective. Should new techniques be adopted, clear identification criteria would need to be agreed.

Subitem 6(f): Presentation on plenary session 6, on medical countermeasures and decontamination

6.8 The final session discussed decontamination and medical countermeasures against chemical weapons, and consisted of three speakers and one discussant. Alternative oximes for the treatment of exposure to nerve agents are still being evaluated. Further mechanistic studies are required in order to find a mechanism other than enzyme reactivation that can yield beneficial effects against agents such as soman. Improved therapies for poisoning by nerve agents and other chemical-warfare agents are being investigated.

Subitem 6(g): Identification of points relevant to the work of the Scientific Advisory Board as set out in subitems 6(b) to (f)

6.9 The points raised in the workshop that are of interest to the work of the SAB are as follows:

(a) the accelerated discovery of chemicals, and the potential implications for the development of new chemical weapons;

(b) potential applications of nanotechnology in both offensive and defensive chemical weapons programmes; and

(c) changing production technologies and the increasing globalisation of the chemical industry, and the impact of these factors on the implementation of the Convention.

7. AGENDA ITEM SEVEN – Update on biomedical samples

7.1 The SAB heard two reports on the preparations the OPCW Laboratory is making to develop a capacity to analyse biomedical samples in the context of investigations of alleged use of chemical weapons. It was told that initial steps included compiling papers from the professional literature on relevant analytical methods, and that these methods would be assessed and the results distributed to interested laboratories. It was also told that preparations had started for a first confidence-building exercise, which had been made possible by funding provided by the Dutch Ministry of Foreign Affairs to the Netherlands Organisation for Applied Scientific Research – TNO, and which would allow participants to test their methods and compare them with those used in other laboratories.

7.2 The SAB was of the view that the OPCW Laboratory is still lacking the staff and equipment required to fully support this activity. However, it also took the view that voluntary assistance from outside experts should enable the first confidence-building exercise to proceed, and it noted that States Parties would be asked to nominate designated and other laboratories to participate in this exercise.

7.3 The SAB was given a detailed account of the survey sent to States Parties to determine current capabilities in regard to the analysis of biomedical samples and to invite them to provide an indication of their interest in participating in confidence-building exercises. It noted that approximately 40 responses had been received.

7.4 As recommended by the temporary working group on biomedical samples, the first confidence-building exercise will involve the distribution of two urine samples to the participating laboratories—one spiked with biomarkers for sulfur mustard; the other, with a biomarker for sarin. Spiking levels will be 50 parts per billion for the initial exercise. Details of analytical methods currently in use will be distributed to the participants, although laboratories will also be free to select their own. It is hoped that operating procedures will be developed as a result of these exercises.

7.5 The SAB discussed the possibility of short-term secondments to the OPCW as a way in which to secure expertise. However, it took the view that, although this was a possible way forward, whether it could be realised depended on the level of financial resources available to the Secretariat.

AGENDA ITEM EIGHT – Sampling and analysis: update and the way ahead

8.1 The SAB was told that, in connection with plans to change the format of OPCW proficiency tests in order to more accurately reflect how actual samples would be handled in a real situation, draft standard operating procedures had been prepared, and that a draft work instruction on the reporting of results was in preparation.

8.2 The SAB was then briefed on progress in the development of an OPCW capacity for air sampling, primarily for the safety of the inspectors. It heard that the limiting factor was the level of resources available to the OPCW to embark on such a programme, but noted that work on the capacity for air sampling had been carried out, that preliminary results would be due in September 2007, and that work on producing quantitative results was being planned.

8.3 The limitations of the current methods for the on-site analysis of water samples and extracts were described. The need to evaporate water to dryness prior to derivatisation was a serious burden in terms of the time and equipment required. Although the OPCW was exploring some alternative procedures, no timetable for completion of this work could be given because of the limited resources available.

8.4 The SAB heard that the next version of the OPCW Central Analytical Database (OCAD) would be released in November 2007, and that it would contain over 3,500 chemicals. The recommendation of the SAB that degradation products of scheduled chemicals be added to the OCAD was pending approval by the Executive Council (hereinafter "the Council"). However, the Validation Group continues to scientifically evaluate data that have been submitted, and the Secretariat is actively

seeking new sources of data on this class of compounds. The SAB's view remained that it was important in the context of verification, especially for any investigation of alleged use, that degradation products be added to the database, as well as data on riot-control agents.

8.5 The SAB heard that issues surrounding the analysis of toxins remained unresolved. The OPCW Laboratory, it was told, would undertake a survey of designated laboratories to determine their current capabilities in this regard. It heard that one important issue was whether analytical methods distinguish between active and inactive conformations of proteinaceous toxins, and that the requirement to eliminate false positives would also need careful consideration.

8.6 The SAB emphasised that OPCW designated laboratories, and other interested laboratories in States Parties, were an important resource for the OPCW, with many of them offering assistance at no cost to it. However, it also recognised that the OPCW Laboratory needs to maintain a certain level of expertise in-house.

9. AGENDA ITEM NINE – Assistance and protection against chemical weapons

9.1 The SAB heard a presentation on the measures the OPCW had taken to promote assistance and protection against chemical weapons under Article X of the Convention. It noted that Article X had recently been accorded more importance by States Parties, particularly in the context of the fight against terrorism.

9.2 The SAB was briefed on current issues in this regard, including the following:

(a) Article X as it relates, *inter alia,* to United Nations General Assembly resolutions;

(b) concepts of assistance;

(c) new templates adopted by the Conference of the States Parties for the submission of information on international protection programmes and offers of assistance;

(d) the data bank on protection; and

(e) the nomination of qualified experts in the context of investigations of the alleged use of chemical weapons.

9.3 With regard to the issue in subparagraph 9.2(e), the SAB heard that States Parties would be invited to nominate qualified experts from different disciplines, and that the Secretariat had identified three major areas where external expertise was deemed to be required:

(a) medically related areas such as the treatment of mass casualties, epidemiology, veterinary medicine, and biomedical and environmental sampling;

(b) disaster management; and

(c) the disposal of unexploded ordnance and improvised explosive devices.

9.4 The SAB was informed that the initial training of qualified experts would take place after they had been selected by the Director-General.

9.5 In the last part of the briefing, the SAB was told about a plan to grant broader access to the data bank on protection, which delegates can now peruse only at OPCW headquarters. The SAB was informed that it would be made available to authorised users over the Internet.

10. AGENDA ITEM TEN – Opportunities for the OPCW to further develop international cooperation to promote the peaceful uses of chemistry

10.1 The SAB heard a presentation on activities the OPCW is undertaking to support international cooperation, particularly in the field of chemical activities not prohibited by the Convention. It was told that there are eight programmes currently in operation:

(a) the Associate Programme;

(b) the Conference Support Programme;

(c) the Internship Support Programme;

(d) the Programme for the Support of Research Projects;

(e) the Laboratory Assistance Programme;

(f) the Equipment Exchange Programme;

(g) courses on the development of analytical skills; and

(h) the Information Service.

10.2 The SAB was told that the Secretariat hopes to improve and expand on these programmes in a number of ways including by pursuing the following goals:

(a) increased scope of delivery;

(b) the wider involvement of the chemical industry;

(c) increased cooperation with other international organisations such as the International Programme on Chemical Safety, the Intergovernmental Forum on Chemical Safety, the United Nations Institute for Training and Research, and United Nations Environment Programme;

(d) the creation of an evaluation-and-review system; and

(e) the provision of laboratory support and of general budgetary support for research, subject to the availability of resources.

10.3 The SAB expressed its support for cooperation with other international organisations. It inquired whether there had been any contact between the Third World Academy of Sciences and the OPCW, and was told that there had.

11. AGENDA ITEM ELEVEN – Update on education and outreach in the context of the Chemical Weapons Convention

11.1 The SAB heard an update on the progress that had been made on a joint OPCW-IUPAC project on education and outreach, intended for those working in the chemical sciences. It was told that the project was still in its preliminary stages and that much remained to be done.

11.2 The SAB was told that the project had yielded results in three areas so far:

(a) A workshop on education and outreach conducted in Oxford, the United Kingdom of Great Britain and Northern Ireland in 2005 concluded that the OPCW should continue to support IUPAC in raising awareness and carrying out educational initiatives, as well as establishing codes of conduct. It also stressed IUPAC's contacts with various national associations, and highlighted the importance of National Authorities' becoming involved in education, outreach, the establishment of codes of conduct, and the generation and maintenance of support among governments for these activities.

(b) An international conference entitled "Chemical Education: Responsible Stewardship" and held in Moscow, the Russian Federation, from 30 October to 2 November 2005, addressed, *inter alia,* green chemistry, education related to the Convention, and ethics in chemistry. It recognised both the lack of attention given to these issues by national associations, and the need for further efforts at the national level, especially in the area of public awareness.

(c) An international seminar on the operating aspects of the joint OPCW-IUPAC project on education and outreach, which was held in Bologna from 20 to 22 September 2006, brought together members of the SAB and IUPAC. The general ethical principles of chemistry were discussed, as were various existing codes of conduct and new models of university curricula for chemists and chemical engineers more in keeping with the goals of the Convention. The seminar had also heard a presentation on new microsensor detection techniques, which are currently used to analyse chemicals responsible for the degradation of paper, and which have proved to be highly sensitive when it comes to the detection of certain organophosphate compounds. It was concluded that States Parties should be encouraged to become actively involved in the promotion of these issues. A further proposal from this seminar called for the naming of a point of contact between the OPCW and the European Chemicals Agency in regard to the European Union's system for the registration, evaluation, and authorisation of chemicals, known as REACH.

11.3 At its Sixth Session the SAB took a decision on[2] on the formation of a temporary working group on education and outreach that would discuss further the contribution the SAB might make to enhancing awareness of the Convention. However, the group had never met. It was now proposed that it should be made up of those SAB members who had participated in the aforementioned Oxford workshop. The SAB decided that

---

[2] Subparagraph 10.1(c) of SAB-6/1, dated 18 February 2004

a decision on this matter would need to be considered further, and that terms of reference would be developed, in due course.

11.4 Various opinions were expressed on what steps should be taken next. However, most members of the SAB agreed that the results achieved so far—for example, those yielded by the Oxford workshop—should be used to structure the draft terms of reference for the group, and that these should address practical procedures regarding education, awareness-raising, and outreach. It was suggested, on the one hand, that the SAB make a decision without undue delay to convene such a group—but also, on the other, that it should not feel rushed into making such a decision merely because progress in this area had been made by other organisations.

11.5 The SAB highlighted the synergies between the programme on education and outreach and the aforementioned measures the Secretariat takes in the field of international cooperation, and took the view that these synergies could be exploited in order to increase awareness while promoting international cooperation.

12. AGENDA ITEM TWELVE – Future work of the Scientific Advisory Board

12.1 The SAB decided to hold its next regular Session in February 2008 with a view to finalising its report to the Second Review Conference. The SAB also decided that, subject to the availability of funding, the temporary working group on sampling and analysis would meet in early December 2007 and February 2008. It also decided to call for additional nominations to incorporate expertise on high-performance liquid chromatography-mass spectrometry.

12.2 At its Eighth Session, the SAB established a temporary working group on advances in technology and their potential impact on the operation of the Convention (such as microreactors, nanotechnology, and new methods of dispersion).[3] It decided that this group should meet before the Second Review Conference, subject to the availability of funding, and nominated Dr Herbert de Bisschop of Belgium to chair it.

12.3 The SAB decided to continue to address the whole complex of scientific, technological, and medical aspects of assistance and protection against chemical weapons, and the opportunities for the OPCW to further develop its international-cooperation portfolio, which includes the promotion of the peaceful uses of chemistry, as well as education and outreach in the context of the Convention.

13. AGENDA ITEM THIRTEEN – Any other business

The SAB proposed to name a Vice-Chairperson for each temporary working group.

14. AGENDA ITEM FOURTEEN – Adoption of the report

The SAB considered and adopted the report of its Tenth Session.

---

[3] See subparagraph 9(d) of the report of the Eighth Session of the SAB (SAB-8/1, dated 10 February 2006), and paragraph 13 of the Note by the Director-General responding to that report (EC-44/DG.7, dated 8 March 2006).

15. AGENDA ITEM FIFTEEN – Closure

The Chairperson closed the Session at 17:52 on 23 May 2007.

Annexes:

Annex 1: List of Participants in the Tenth Session of the Scientific Advisory Board

Annex 2: Preliminary Report of the Scientific Advisory Board to the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention on Developments in Science and Technology

Annex 1

LIST OF PARTICIPANTS IN THE TENTH SESSION OF THE SCIENTIFIC ADVISORY BOARD

	Participant	State Party
1.	Rolando A Spanevello	Argentina
2.	Herbert de Bisschop	Belgium
3.	Danko Škare	Croatia
4.	Jirí Matoušek	Czech Republic
5.	Jean-Claude Tabet	France
6.	Detlef Maennig[4]	Germany
7.	László Halász	Hungary
8.	R Vijayaraghavan	India
9.	Mahdi Balali-Mood	Iran (Islamic Republic of)
10.	Alberto Breccia Fratadochi	Italy
11.	Koichi Mizuno	Japan
12.	Abdool Jackaria	Mauritius
13.	José González Chávez	Mexico
14.	Godwin Ogbadu	Nigeria
15.	Bjørn-Arne Johnsen	Norway
16.	Titos Quibuyen	Philippines
17.	Victor Kholstov[5]	Russian Federation
18.	Philip Coleman	South Africa
19.	Miguel A Sierra	Spain
20.	Valery Kukhar	Ukraine
21.	Robin Black	United Kingdom of Great Britain and Northern Ireland
22.	James Robert Gibson	United States of America

[4] Dr Maennig attended the Session on 23 May only.
[5] Professor Kholstov attended the Session on 21 and 22 May only.

Annex 2

PRELIMINARY REPORT OF THE SCIENTIFIC ADVISORY BOARD TO THE SECOND SPECIAL SESSION OF THE CONFERENCE OF THE STATES PARTIES TO REVIEW THE OPERATION OF THE CHEMICAL WEAPONS CONVENTION ON DEVELOPMENTS IN SCIENCE AND TECHNOLOGY

1. INTRODUCTION

1.1 Pursuant to Article VIII, paragraph 22, of the Convention, the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter "the Second Review Conference") will take place from 7 to 18 April 2008.

1.2 The SAB was established by the Director-General in accordance with Article VIII, subparagraph 21(h) and paragraph 45, of the Convention, so that he could offer to the Conference, the Council, and States Parties specialised advice in those areas of science and technology that are relevant to the Convention. In keeping with this mandate, and as its contribution to the preparations for the review of the operation of the Convention by the Second Review Conference, the SAB has prepared this report, which analyses relevant developments in science and technology over the past five years, and presents recommendations and observations that the SAB considers to be important both to the review of the operation of the Convention and to its future implementation.

1.3 This report provides updates on issues identified in the SAB's report to the First Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter "the First Review Conference"), and sets forth several additional issues for consideration. It discusses the following topics:

(a) advances in science and technology:

(i) the convergence of chemistry and biology;

(ii) the accelerated discovery of chemicals;

(iii) nanotechnology;

(iv) technologies for delivery systems; and

(v) production technologies;

(b) schedules of chemicals:

(i) captive use of Schedule 1 chemicals;

(ii) salts of scheduled chemicals;

(iii) Chemical Abstracts Service registry numbers;

(iv) saxitoxin;

(v) ricin; and

(vi) new toxic compounds

(c) verification:

(i) on- and off-site sampling and analysis; and

(ii) analysis of biomedical samples;

(d) destruction of chemical weapons;

(e) assistance and protection against the effects of chemical weapons, and international cooperation; and

(f) education and outreach in the context of the Convention.

2. ADVANCES IN SCIENCE AND TECHNOLOGY

2.1 Science and technology are advancing at an increasing rate in areas directly relevant to the Convention. It is important that the OPCW take note of these developments in order to ensure that the Convention, and in particular its verification regime, continue to be implemented effectively.

Convergence of chemistry and biology

2.2 An important trend in the life sciences is the increasing convergence of chemical and biological systems, which results from an increasing understanding of complex life processes in the post-genomic era, and the emerging ability to replicate life processes. These advances will undoubtedly lead to major benefits to humankind in the medical and other sciences, but there is also a clear potential for abuse. These developments reinforce the overlap between the Convention and the Biological and Toxin Weapons Convention, as does the increasing number of toxins and potentially toxic bioregulators being characterised.

Accelerated discovery of chemicals

2.3 New biologically active molecules are being discovered at an unprecedented rate. For example, parallel synthesis and high-throughput screening are producing data on millions of compounds. The tools for such techniques are becoming widely available in various parts of the world, and could be targeted at the discovery of selectively toxic molecules. Pharmaceutical and pesticide companies now hold huge databases of biological data that could be a source of prototypes for new chemical-warfare agents. It should, however, be noted that most of these data are generated through the use of *in vitro* assays, and that investigations of relatively

few compounds progress to the study of their toxicity. Although these databases have been in existence since the 1950s, they have had relatively little impact on the development of new chemical-warfare agents. Moreover, a major offensive programme would be required in order to convert a new biologically active toxic compound into a chemical weapon.

2.4 One area in which the discovery of drugs is causing some concern involves compounds that could be developed legitimately within the constraints of the Convention as non-lethal agents for law-enforcement purposes. Such compounds clearly have dual-use potential. The accelerated discovery of drugs has resulted in the identification of many new compounds that act very selectively on the central nervous system, both regionally and with regard to receptor subtypes. It remains to be seen what challenge, if any, one or another of these compounds could pose to the Convention. It should be noted here too that, although many extremely potent compounds that act on the central nervous system were discovered from the 1950s to the 1970s, only two types, anticholinergics and opioids, appear to have been developed into chemical-warfare agents or non-lethal agents for use in law enforcement purposes.

Nanotechnology

2.5 Developments in the rapidly expanding field of nanotechnology and particle engineering offer new opportunities to develop defensive countermeasures against chemical weapons—for example, in the delivery of drugs, in the development of new sensors, in diagnostics, and in the development both of improved filtration systems for respirators and protective clothing, and of new decontaminants.

2.6 Advances in nanotechnology and aerosol technology are being explored with a view to achieving more-effective and more-targeted delivery of biologically active compounds. Many of the considerations that promote the design of particles for the delivery of drugs via the respiratory system might also have a bearing on the dissemination of aerosolised chemical-warfare agents. Nanotechnology is being exploited to engineer or design biologically active systems and so-called smart materials that respond to specific stimuli and deliver active ingredients to targets in the body. Nanotechnology is also being explored with an eye on the development of capsules for the enclosure of ingredients, and the targeted delivery of biologically active compounds. It may enhance the effectiveness of active groups in binding to specific targets in organs or cells. Nanoparticulates may also provide a new means of facilitating entry into the body or cells, particularly in the brain, in order to achieve selective reactions with target proteins or genes, or to overcome any immune reaction of the target organism. Some nanoparticulate materials show greater toxicity than micronised material. It should, however, be recognised that the sophisticated engineering of a high-value drug for targeted delivery may not be appropriate for a chemical weapons delivery system, where as much as 99.9% of the toxic chemical disseminated will not reach its target organ within the human body.

Technology for delivery systems

2.7 Pharmaceutical companies are showing an increasing interest in administering drugs by inhalation as an alternative non-invasive method of delivery. In the case of drugs with a low molecular mass, many of which are readily absorbed by the lungs, this route circumvents the extensive metabolism that occurs in the intestinal tract following administration by ingestion. Larger molecules such as proteins are also absorbed through the lung membrane, albeit at a slower rate. A major goal of pharmaceutical companies has been the development of devices that would deliver insulin as an inhalable aerosol and that would thus obviate the need for millions of diabetics to inject insulin. Drug companies are also focussing on the lungs as a point of entry for the rapid administration of drugs to the central nervous system. The physical properties that promote rapid absorption through the lungs are similar to those that promote the penetration of the blood-brain barrier, and a number of devices have been developed for administering as aerosols such drugs as opioids, anti-migraine drugs, and anti-convulsants.

2.8 Many of the considerations that promote the design of particles for the effective and targeted delivery of drugs via the respiratory system would be applicable to the dissemination of a chemical-warfare agent as an aerosol. The efficiency of absorption has been improved, for instance, through the use of large porous aerosol particles that allow the delivery of drugs into the deep alveolar regions of the lungs and that promote their absorption there. The spray-drying equipment needed to create such particles is relatively inexpensive and widely available, although the optimisation of a well-engineered particle requires expertise and considerable effort. This type of technology can be combined with nanotechnology to deliver nanoparticulate aggregates that will, once absorbed, disperse in the body, where their design (*e.g.*, multifunctional polymeric design) could facilitate the improved and more-selective delivery and targeting of drugs.

Production technologies

2.9 As noted in the report of the SAB to the First Review Conference (RC-1/DG.2, dated 23 April 2003), major developments relevant to the implementation of the verification regime under Article VI of the Convention are taking place in the production of industrial chemicals.

2.10 Technological innovations continue to make chemical manufacturing more versatile and more efficient. The flexibility of the chemical industry is increasing with the widespread use of multipurpose production equipment, and the emerging use of microreactors, which was noted in the SAB's report to the First Review Conference, may add an additional dimension. Microreactors exhibit many potential advantages for the manufacture of a number of fine chemicals, and they eliminate problems associated with the scaling-up of production processes from laboratory to industrial-scale volumes. Microreactor systems would not exhibit the traditional signatures if adapted to the manufacture of highly toxic compounds, and could significantly reduce the time required to make the transition, in the development of highly toxic new compounds, from the research to the production stage. However, although these systems have become more prevalent in

research-and-development laboratories, including industrial research-and-development laboratories, they are not yet being widely used in industry, and they have been integrated into industrial-scale production more slowly than some had predicted. This development clearly requires a watching brief to assess what impact it might have on the verification regime under the Convention.

2.11 Significant advances are also being made in the application of chemical and bio-catalysis to industrial production. Approximately 85% of chemical processes are catalytic. Nanotechnology offers new approaches to the design of catalysts that will increase reactivity, selectivity, and efficiency.

2.12 The increasing globalisation of the chemical industry means that chemical production is spreading to new, non-traditional countries, and the trend towards the optimisation of what is known as scale of production is leading to the creation of so-called world plants—a phenomenon whereby a single plant supplies a significant part of the total world production of a given chemical. This is leading in turn to an increase in the international trade in chemicals. A number of countries in Eastern Europe, Asia, and South America, including the Russian Federation, India and China, and Brazil, are becoming major players in the production of chemicals, including fine chemicals.

2.13 As production technologies change and the number of potential chemical-warfare agents increases, the general-purpose criterion for the definition of chemical weapons and for verification at OCPFs becomes more important.[6] The OCPF verification regime was included in the Convention as a dynamic system that would take into account advances in chemical-production technologies. This regime needs to evolve further in terms of the number of inspections conducted, the selection of OCPF plant sites, and how inspection aims are determined with regard to unscheduled chemicals in order to ensure compliance.

2.14 It is essential in this respect that inspectors and National Authorities be kept informed of changes in production technologies.

3. SCHEDULES OF CHEMICALS

3.1 Both the definition of chemical weapons and the schedules of chemicals themselves have been the object of extensive discussions by the SAB. Many of the chemicals that are listed in Schedules 1, 2, and 3 have been used, stored, or weaponised as chemical-warfare agents.

3.2 The Convention contains a mechanism to amend the schedules. Chemicals can be added to, or deleted from, the schedules subject to agreement by States Parties.

---

[6] Among the definitions of "chemical weapons" given in Article II, paragraph 1, of the Convention, is the following, in subparagraph 1(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".

Some States Parties and commentators refer to this condition as the "general-purpose criterion".

They can also be moved from one schedule to another should the States Parties consider this beneficial for verification purposes.

Captive use of Schedule 1 chemicals

3.3 The SAB was asked by the Director-General to consider the issue of the "captive use or production" of Schedule 1 chemicals, in which the chemical is not isolated but is an intermediate in an industrial process. Under the only possible scenario known to the SAB in which such a process could take place, nitrogen mustard (HN-3), a Schedule 1 chemical, would be formed as an impurity in the synthesis of pethidine-like compounds, because of the presence (at approximately 1%) of triethanolamine in the diethanolamine used as a precursor. However, the nitrogen mustard would be present at such a low concentration that it would be impractical to isolate it from the reaction mixture. The SAB considers this to be a purely academic issue that does not require adjustments to Schedule 1.

Salts of scheduled chemicals

3.4 The SAB was asked by the Director-General to review its observations on salts of scheduled chemicals. These salts are chemically distinct from their parent compounds, and have different physical and chemical properties, as well as their own CAS registry numbers. Their inherent toxicity usually differs little from that of the parent compound, although the physical hazard will be different. The salt can easily be retransformed into the base (with the exception of quaternary salts). In industry, a base is often converted to a salt if it is more convenient to handle or, in the case of drugs, to administer. Normally, from the standpoint of the end user, there is no essential difference between the free base and the corresponding salt.[7] The SAB notes that, on regulatory grounds, States Parties have disagreed with its recommendation that all salts of scheduled chemicals be treated in the same way as their corresponding free bases. Consequently, salts of scheduled chemicals are to be treated differently from their corresponding free bases in relation to, for example, the Convention's provisions on the trade in scheduled chemicals. It should be noted that there are cases where scheduled chemicals are an intermediate in the production of such salts. Even though these bases are not isolated or captured from the equipment, they could be removed from the production equipment if that were so decided. Declarations might thus still be due, depending on the amounts produced.[8]

Chemical Abstracts Service registry numbers

3.5 One issue that the SAB noted in the context of its previous recommendations on salts is the role of the CAS registry numbers indicated in the schedules of chemicals. The SAB has come to the view that, while the CAS registry numbers are a useful identification aid, they were intended as specific identifiers of

---

7 See paragraph 2.10 of SAB-II/1, dated 23 April 1999.

8 Examples of such "captive use" of a scheduled chemical in the production of a corresponding salt that is not listed in the Schedules can be found in Schedule 1 (e.g. the production of HN-2 hydrochloride), as well as in Schedule 2 (e.g. the captive use of BZ in the production of clidinium bromide).

scheduled chemicals. There appears to be a question among States Parties about whether these numbers have a regulatory value. The SAB would like to caution against such a view, because there is not necessarily a one-to-one relationship between CAS registry numbers and chemical structures. While these numbers are useful in the identification of chemical compounds, this usefulness should not lead to the assumption that they should have any regulatory power within the context of the Convention. At the same time, it could be helpful if the OPCW Declaration Handbook were to provide references to the various CAS numbers that are related to an entry in the schedules (for example, for different isomers of a scheduled chemical and for mixtures containing a scheduled chemical).

Saxitoxin

3.6 Related to the issue of salts is the question of what constitutes saxitoxin, which is listed in Schedule 1 together with the CAS registry number of the dihydrate (free base). This situation is of little help when it comes to considering which form or forms of the molecule are considered to be included in the schedules of chemicals.

3.7 A survey of the literature shows how the understanding of the nomenclature and molecular structure of saxitoxin has evolved in recent decades. Since the elucidation of the structure, the term "saxitoxin" has been used variously to describe the dihydrochloride of the molecule, or the free base, or its cation. In the natural environment, saxitoxin exists exclusively in cationic form. More recently (and since the conclusion of the Convention), the nomenclature has become more specific, distinguishing between saxitoxin dihydrochloride and saxitoxin (di)hydrate. From the record of negotiations, it appears that what negotiators wanted to include in the schedules was the form of saxitoxin that had been weaponised in the past (the agent TZ, which is a salt), and other forms of weaponisable saxitoxin. Problems related to this question became apparent after the entry into force of the Convention, when Part VI of the Verification Annex had to be adjusted to take account of practical realities. The notification regime for transfers of saxitoxin for medical and diagnostic purposes was changed so that it required notification at the time of transfer instead of in advance.[9] It should be noted that the issue of what constitutes saxitoxin shows again that the CAS registry numbers given in the Convention cannot be considered to have regulatory power, and that they are essentially identification aids.

3.8 There were also discussions, based on the guidelines in the Convention, of whether Schedule 1 or Schedule 2A would be more appropriate for saxitoxin. In this regard the SAB agreed to take the matter up at its next regular Session[10].

---

[9] EC-MII/DEC.1, dated 15 January 1999. A first change was notified by the Depositary in notification C.N.916.1999.TREATIES-7, issued on 8 October 1999; a second, in C.N.157.2000.TREATIES-1, issued on 13 March 2000.

[10] The following arguments were given for placing saxitoxin in Schedule 2A: that it would greatly reduce the administrative burden, and that, with reference to subparagraph 1(c) of the Annex on Chemicals, saxitoxin is of quite some use in very small quantities for purposes not prohibited under the Convention.

Ricin

3.9 The SAB was also asked by the Director-General to consider what, within the meaning of the Convention, constitutes ricin. Such an understanding may be helpful to States Parties, and could be incorporated into the OPCW Declaration Handbook. The SAB recommends the following definition of ricin:

> "All forms of ricin originating from *ricinus communis*, including any possible variations in the structure of the molecule arising from natural processes or manmade modification, are to be considered ricin as long as they conform to the basic 'native' bipartite molecular structure of ricin (A-S-S-B) that is required for mammalian toxicity. Once the inter-chain S-S bond is broken or the protein denatured, it is no longer ricin."

3.10 It should be noted that this understanding is consistent with a Conference decision that plants that process castor oil should not be subject to the Convention's reporting procedures under Schedule 1 (C-V/DEC.17, dated 18 May 2000).

3.11 The SAB is of the view that the analysis of ricin poses a number of problems. Because it is a protein, it exists in a considerable number of isoforms, and new mutations occur that will create additional isoforms in the future. There is also the possibility that the A-S-S-B linkage may be intact but with the loss of the three-dimensional conformation of the ricin molecule, thus rendering the ricin inactive.

New toxic compounds

3.12 The number of known toxic compounds that could potentially be abused will steadily increase. The advances in the life sciences described above will create new risks in this regard, given the dual-use potential of many chemicals. States as well as non-State proliferators may alternatively opt for toxic industrial materials as less-effective chemical weapons. The importance of the comprehensive nature of the definition of "chemical weapons" in the Convention, and of its implementation by States Parties, is consequently reinforced. Non-proliferation efforts, including measures to control access to relevant chemicals, equipment, and technologies, remain important. At the same time, effective self-governance by the scientific community must complement these safeguards.

3.13 The SAB continues to hold the view that adding a large number of new toxic compounds to schedules of chemicals would introduce additional burdens on reporting requirements and verification.

3.14 The potential risks to the Convention associated with advances in science and technology would increase significantly, should dedicated chemical weapons programmes exist and should they take advantage of new toxic chemicals. There is therefore good reason to call for transparency in chemical-defence programmes, and to assess carefully the compatibility with the Convention of the development of weapons that employ toxic chemicals for law-enforcement purposes (including so-called non-lethal weapons). From the standpoint of promoting transparency and building confidence, there will, *inter alia*, be advantages in considering an

extension of the Convention's declaration requirements so that States Parties would have to declare all chemicals they have stockpiled for law-enforcement purposes (types, quantities, and delivery systems). However, such non-lethal chemicals require thorough study. The terminology surrounding so-called non-lethal incapacitants also needs further elaboration.

4. VERIFICATION

On- and off-site sampling and analysis

4.1 After a gap of four years, the SAB has reconvened its temporary working group on sampling and analysis. This group is addressing methods and procedures used for on- and off-site analysis, and in particular the unresolved problem of the analysis of toxins.

4.2 The SAB is of the view that the current procedures used for on-site analysis, based around gas chromatography-mass spectrometry (GC-MS) in combination with the OPCW dual-mode software containing the OCAD, are fit for purpose. It is, however, commonly acknowledged that the logistic burden posed by the equipment for the preparation of samples, and the time required for analysis, remain greater than is desirable. In particular, the time taken for the analysis of aqueous samples is limited by the requirement to evaporate aqueous extracts or samples to dryness prior to derivatisation of polar analytes (*i.e.,* degradation products). This requirement also adds significantly to the weight of the sample-preparation equipment needed. The SAB has asked the temporary working group on sampling and analysis to review recent developments in the preparation of aqueous samples and to assess their applicability to on-site analysis.

4.3 The SAB also notes the development of more-portable and miniaturised GC-MS systems, but believes that none of these is yet likely to meet the technical specifications for on-site inspections, or to be rugged enough for that purpose. Similar arguments apply to LC-MS systems, which have also yet to be developed into rugged portable systems. Moreover, the OCAD does not at present contain spectra acquired through LC-MS. The use of LC-MS would, however, solve the problem of the analysis of aqueous samples, and would expand the number of analytes that could be identified on-site. The SAB has asked its temporary working group to review developments in LC-MS technology and to assess the possibility that future LC-MS systems could be used for on-site analysis.

4.4 The SAB notes the success of the current system of proficiency testing used for designated laboratories and those seeking designation. However, some of the samples provided in these tests do not accurately reflect the samples that would be submitted for off-site analysis. Current proficiency-test protocols require that spiked samples and blank samples be labelled as such. In a real case requiring off-site analysis, there would be nothing to indicate which are the collected samples, which the spiked positive controls, and which the blank negative controls. It is therefore imperative that a reporting system be developed that takes this situation into account. The SAB fully supports the current plans to change the

format of proficiency tests in order to more accurately reflect how real samples would be handled. This new format was given a successful trial run in 2005.

4.5 Toxins have long posed a problem for sampling and analysis. Ricin and saxitoxin are listed in Schedule 1, and the OPCW therefore has an obligation to secure access to methods of identification. These toxins present a number of problems for the existing system of designated laboratories. Firstly, neither can be identified through the use of GC-MS analysis, because of the polar, involatile nature of each and, in the case of ricin, because of its high molecular mass. Well-established methods exist for analysing saxitoxin in the context of paralytic shellfish poisoning, through the use of LC combined with MS or fluorescent detection, and commercial immunoassay kits are available. A number of laboratories, both designated and not, have developed expertise in the analysis of ricin, based on mass spectrometry, including the use of matrix-assisted laser desorption ionisation techniques, known as MALDI techniques and immunoassays. (Functional assays may also be available). However, the status of immunoassays, and the criteria for the identification of proteins through MS, have not been discussed in the OPCW in the context of verification; nor has a possible requirement to demonstrate biological activity.

4.6 The SAB has therefore asked its temporary working group on sampling and analysis to address the issues of the analysis of toxins, and how a capability might be made available to the OPCW. The OPCW Laboratory has been asked to determine which designated laboratories have the capability to identify ricin and saxitoxin. If the overall capability is deemed to be inadequate, then laboratories outside the current system could be designated by the Director-General for the analysis of Schedule 1 toxins, in accordance with Part II, subparagraph 56(b), of the Verification Annex. (It is not clear whether a decision by the Conference at its First Session (C-I/DEC.61, dated 22 May 1997), on criteria for the designation of laboratories, would have to be modified in order for such a change to be made.)

4.7 In certain scenarios, particularly those involving allegations of use, riot-control agents and degradation products of scheduled compounds are extremely important in the context of verification. The SAB therefore strongly recommends that the Council approve the addition to the OCAD of spectroscopic data on such compounds. These data have already been validated by the Validation Group. The SAB also recommends the inclusion of spectroscopic data relevant to old and abandoned chemical weapons (OACWs), for instance for some of the arsenicals weaponised in the early part of the twentieth century.

4.8 Finally, the SAB notes that the OPCW has not yet addressed the matter of the trace analysis of environmental samples, which may be important in investigations of alleged use. The temporary working group on sampling and analysis has been asked to consider trace analysis and make recommendations regarding its possible implementation by the OPCW Laboratory.

Analysis of biomedical samples

4.9 The Convention provides for the collection of biomedical samples from suspected human and animal casualties in cases of investigations of alleged use. Such samples may provide the best evidence of an alleged use, particularly in remote areas where no munitions residues can be found. At present the OPCW has no capability to handle or analyse such samples, and no system of designated laboratories exists for the analysis of biomedical samples. The requirement for analyte or class-specific trace-analytical methods, the detection and identification of biological markers of exposure (which may include simple degradation products) rather than agents, and the increased sophistication of equipment (GC-MS, GC-MS-MS and LC-MS-MS) that may be required, are areas in which this type of analysis differs from the environmental-type analysis now carried out in designated laboratories. Furthermore, some of the analytical standards are not widely available. The SAB has convened a temporary working group to address biomedical samples. The group has held three meetings and fully met its terms of reference as defined by the SAB. The key recommendations it has made are:

(a) that the OPCW Laboratory, with assistance from experts from States Parties, now move forward on the issue of biomedical sampling and analysis;[11]

(b) that the SAB request the Director-General to make sufficient resources available to the OPCW Laboratory to initiate and maintain this process;

(c) that the OPCW Laboratory, with the assistance of experts from States Parties, compile details of analytical methods, and of synthetic methods or commercial sources, for analytical standards;

(d) that confidence-building exercises begin as soon as is practically possible; and

(e) that proficiency tests proceed only when a minimum level of expertise has been achieved by a number of laboratories.

4.10 The OPCW Laboratory, with support from TNO, plans to organise the first confidence-building exercise early in 2008. Issues that will be addressed in these exercises include criteria for identification, and operating procedures.

5. DESTRUCTION OF CHEMICAL WEAPONS

5.1 The SAB noted that the technologies used in the destruction of declared chemical weapons stockpiles appear to have matured to a point where the implementation of the requirements of the Convention requires no further technological innovation or development.

---

[11] The Council noted the Secretariat's intention to develop a proposal on the establishment of an OPCW capability to analyse biomedical samples (EC-44/2, dated 17 March 2006).

5.2 With regard to non-stockpile problems such as those posed by OACWs, the SAB noted that further research and development are needed for the safe recovery of OACWs both by excavation and by removal from the sea at relatively small depths. It also noted that there is a continuing need for innovation in, and new approaches to, the destruction of recovered items.

6. ASSISTANCE AND PROTECTION AGAINST THE EFFECTS OF CHEMICAL WEAPONS, AND INTERNATIONAL COOPERATION

6.1 Advances in the life sciences, information technology, materials science and nanotechnology have the potential to help States Parties improve the level of protection they can offer against chemical weapons. Effective defence should discourage the development and use of chemical weapons. Enhanced international cooperation in this field can act as an incentive for States not Party to join the Convention.

6.2 With regard to detection devices, the SAB recognised that it takes a considerable amount of time and effort to transfer a new detection technology from laboratory instrumentation to a reliable and robust field-detection device. Technologies that have already matured will continue to play a key role in the detection of chemical-warfare agents over the next five years. Portable and miniaturised versions of devices that feature mature technologies and that are capable of detecting chemical-warfare agents, such as gas chromatography-flame photometric detection, GC-MS, and ion-mobility spectrometers, are now becoming commercially available. New ionisation methods that enhance the ability of mass spectrometers to interrogate surfaces (liquids and solids) may greatly expand the effectiveness of inspections in the future, if devices that use the methods can be miniaturised and reduced in cost. Other trends that may lead to new detection devices include those involving lab-on-a-chip,[12] DNA arrays, protein arrays, and biosensors for chemical-warfare agents. New methods of detection based on quantum-dot technology still lack sensitivity, but once this problem has been solved they could lead to inexpensive personal detectors.

6.3 In the field of medical countermeasures, improvements are necessary both in the available treatments (for example, antidotes that can be used against a broader range of agents), and in the planning of medical countermeasures and the management of casualties. The search for more-effective antidotes such as enzyme reactivators for nerve-agent intoxication is continuing. Some beneficial effects of oximes in the treatment of soman poisoning appear to be caused not by reactivation of inhibited cholinesterase, but by some effect on ion channels. Current emergency-response procedures can be time-consuming and can delay the treatment of victims. Best practices need to be identified and followed, and more-effective antidotes need to be found and used. Training and exercises are essential to maintaining the required levels of preparedness.

---

12 A lab-on-a-chip aims to scale down the elements of the chemical and processing worlds. This scaling down involves flow and transport necessary for multiple chemical analyses, mixing, detection, separation, and so on.

6.4 In the area of decontamination, requirements are taking account of the changing nature of such operations, which are more likely to take place in urban areas and to affect civilians directly. Standard military decontamination technology is often not appropriate under such conditions or for decontamination of some industrial chemicals. There is a need for smaller and easier-to-transport decontamination equipment that requires fewer personnel to operate it. Decontamination materials should be environmentally friendly and less corrosive and less aggressive. Progress has been made with new materials for skin decontamination. Advances in science and technology are expected to contribute to further improvements in the field of decontamination and the medical treatment of intoxication by chemical-warfare agents.

7. EDUCATION AND OUTREACH IN THE CONTEXT OF THE CONVENTION

7.1 The ongoing OPCW-IUPAC project on Convention education and outreach, which was begun in 2004, aims to increase awareness of the Convention and its benefits. The three main events that are associated with the steps recommended under the project to further chemical education, outreach, and codes of conduct in light of the obligations of the Convention, are summarised below:

(a) A workshop on education and outreach in Oxford, the United Kingdom of Great Britain and Northern Ireland, in 2005 concluded that the OPCW should continue to support IUPAC in awareness-raising, educational initiatives, and codes of conduct. It also stressed IUPAC's position as a link to different national associations. Furthermore, the workshop highlighted the role National Authorities could play both in this regard, and by generating and maintaining support among governments for the inclusion in university and school curricula of appropriate references to the Convention and its requirements, as well as by providing ethical guidance in this area to students and teachers alike. The SAB also noted the important role that IUPAC and national chemical societies could play in promoting and developing codes of conduct (or in advocating the incorporation into existing codes of elements relevant to the Convention).

(b) A conference held in Moscow, the Russian Federation, in October and November 2005 addressed, *inter alia,* issues in education relevant to the Convention, and chemical ethics. It recognised both the lack of attention given to these issues by national associations, and the need for further action at the national level, especially in the area of public awareness.

(c) A seminar on chemical education and outreach that was held in Bologna, Italy, in September 2006 brought together members of the SAB and IUPAC. In this meeting the general ethical principles of chemistry were discussed, as were various existing codes of conduct. It was concluded that States Parties should be encouraged to become actively involved in the promotion of these issues.

7.2 Four sets of written material have been prepared on the issue of the multiple uses of chemicals and on the ethical questions it gives rise to. These materials include information on codes of conduct and sample case studies that could be used by chemistry teachers and students. Two further papers are being prepared. The SAB has been informed that, according to Professor Alistair Hay of the University of Leeds, leader of the joint OPCW-IUPAC project, successful pilot studies have been conducted at IUPAC meetings that were held in October and November 2005 in Moscow, the Russian Federation (the aforementioned conference on science education and responsible stewardship), and in August 2006 in Seoul, the Republic of Korea. These studies have confirmed the validity of the educational concept and the usefulness of these materials, which have subsequently been improved. Further pilot studies are being considered, and plans are also being made for the written materials to be translated into the six official languages of the OPCW and be made available on the IUPAC Web site.

- - - o - - -