OPCW

Scientific Advisory Board

Twenty-Second Session
8 – 12 June 2015

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REPORT OF THE TWENTY-SECOND SESSION OF THE SCIENTIFIC ADVISORY BOARD

1. AGENDA ITEM ONE – Opening of the session

1.1 The Scientific Advisory Board (SAB) met for its Twenty-Second Session from 8 to 12 June 2015 at the OPCW Headquarters in The Hague, the Netherlands.

1.2 Dr Christopher Timperley was elected as Chairperson of the SAB and Mr Cheng Tang as Vice-Chairperson.

1.3 A list of participants is contained in Annex 1.

2. AGENDA ITEM TWO – Adoption of the agenda

The SAB adopted the following agenda for its Twenty-Second Session:

1. Opening of the session
2. Adoption of the agenda
3. Welcome address by the Deputy Director-General
4. Overview of developments at the OPCW since the last session of the Scientific Advisory Board
5. Establishment of a drafting committee
6. Developments in science and technology
   - (a) Follow-up to the Scientific Advisory Board's recommendations on the Convergence of Chemistry and Biology and the Scientific Advisory Board's recommendations to the Third Review Conference[1]
   - (b) Monitoring developments in science and technology
   - (c) Planning for the SAB's report to the Fourth Review Conference[2]

[1] Third Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention

[2] Fourth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention

7. Scientific and technological elements of verification technologies, emerging technologies, and new equipment

   (a) Temporary Working Group on Verification: final report

   (b) Investigations of Alleged Use: perspectives from the 2013 United Nations investigation

   (c) Verification of the destruction of Syrian chemical weapons: some experiences from the OPCW's work from 2013 to 2015

   (d) Chemical forensics

8. Further scientific and technological advice relevant to the Chemical Weapons Convention

   (a) Temporary working group on education and outreach in science and technology: final report

   (b) Assistance and protection: medical countermeasures against and treatment for nerve agents

   (c) Outreach activities by the Technical Secretariat

   (d) Outreach activities by members of the Scientific Advisory Board

9. Scheduled chemicals and advice on the Annex on Chemicals: isotopically labelled scheduled chemicals and stereoisomers of scheduled chemicals

10. Experiences from other relevant advisory boards: the Advisory Board of the Secretary-General of the United Nations on Disarmament Matters

11. Future work of the Scientific Advisory Board

12. Any other business

13. Adoption of the report

14. Closure of the session

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

3.1 The Deputy Director-General of the OPCW, Ambassador Grace Asirwatham, welcomed the SAB members to the Twenty-Second Session of the Board and congratulated Dr Christopher Timperley on his election as Chairperson of the SAB and Mr Cheng Tang on his election as Vice-Chairperson.

3.2 The Deputy Director-General stressed that scientific expertise is key to the continued relevance and success of the Chemical Weapons Convention (hereinafter "the Convention"), especially now that the OPCW has entered a period of change and transition. Preventing the re-emergence of chemical weapons is a strategic aim of the OPCW.

3.3 The Deputy Director-General thanked the members of the two temporary working groups (TWGs) and their Chairpersons—Professor Djafer Benachour (education and outreach in science and technology) and Professor Roberto Martínez-Álvarez (verification)—for their tremendous work and for their reports and recommendations. Such reports add insight to the collective body of scientific knowledge that pertains to implementation of the Convention.

3.4 With regard to education and outreach, the Deputy Director-General noted that the Director-General had recommended to the Executive Council (hereinafter "the Council") that an Advisory Board on Education and Outreach be established with external experts as members.

3.5 As regards verification, the recommendations propose that the OPCW work to further strengthen and refine the verification regime, the cornerstone of the Convention. The Deputy Director-General stated that the Director-General will consider the SAB's advice and respond over the summer.

3.6 The Deputy Director-General also expressed appreciation for the advice that the SAB had provided on medical countermeasures against and treatment of organophosphorus nerve-agent exposure, under the lead of Professor Slavica Vučinić. The Technical Secretariat (hereinafter "the Secretariat") has made the advice available to the States Parties.

3.7 The Deputy Director-General recognised the SAB's continued engagement with experts from around the world, including policy makers, and summarised the Secretariat's work in science and technology.

3.8 The Deputy Director-General thanked the six members of the SAB who are completing their second and final term on the Board later this year, for their excellent contributions to the implementation of the Convention and to the work of the OPCW. The Director-General was especially grateful to Professor Alejandra Suárez for having served as Chairperson of the SAB over the past two years and skilfully overseeing the Board's production of three substantive reports on the convergence of chemistry and biology, education and outreach, and verification.

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

4.1 The Secretary of the SAB, Mr Stian Holen, reviewed developments at the OPCW since the SAB's Twenty-First Session. His presentation emphasised that science and technology underpin many Articles of the Convention and the future of the OPCW. He noted that the non-routine verification activities undertaken in relation to Syrian chemical weapons over the past two years have demonstrated the value of scientific advice, notably on chemical analysis and on-site verification. He also updated the SAB members on the overall status of the destruction of chemical weapons. He described past and planned activities by the Secretariat and the SAB to engage with States Parties to the Convention and other stakeholders. These included briefings by SAB members in the margins of sessions of the Council and participation in relevant scientific conferences. Finally, the Secretary welcomed funding from the European Union (EU) for a range of activities related to science and technology, including expert workshops.

4.2 In the subsequent discussion, the following point was raised: As science and technology have seen increased visibility at the OPCW over the past several years, the SAB appreciates the science and technology materials that are being made available through the OPCW public website. The Board suggested giving the new science and technology section of the website higher visibility.

5. AGENDA ITEM FIVE – Establishment of a drafting committee

The SAB established a drafting committee to prepare the draft report of its Twenty-Second Session.

6. AGENDA ITEM SIX – Developments in science and technology

Subitem 6(a): Follow-up to the Scientific Advisory Board's recommendations on the Convergence of Chemistry and Biology and the Scientific Advisory Board's recommendations to the Third Review Conference

6.1 The SAB Secretary provided an update on the implementation of the SAB's recommendations to the Third Review Conference and the convergence of chemistry and biology. For example, the OPCW Laboratory has established a training laboratory for stakeholders and has drawn up an action plan to implement recommendations resulting from an independent review of the proficiency testing system, from which one outcome will be the designation of laboratories for off-site analysis of biomedical samples. Also on verification, the Secretariat has developed a procedure for handling cases involving Schedule 1 chemicals that are unavoidable by-products. On the convergence of the sciences, Mr William Kane presented the SAB's recommendations to the States Parties to the Biological Weapons Convention (BWC) last August, and the Secretariat's innovative workshop series "Science for Diplomats" in The Hague has included discussion of the analysis of biomedical samples, the science of the bio-economy, and Schedule 1 chemicals in industrial processes. The Secretariat has also launched an informal science and technology newsletter to aid the monitoring of developments and to engage both technical and non-technical experts.[3] The implementation of several recommendations requires further action by both the OPCW policy-making organs and the States Parties.

Subitem 6(b): Monitoring developments in science and technology

6.2 Dr Christopher Timperley briefed the SAB on the Spiez Convergence Workshop. He mentioned that the most recent BWC Conference of States Parties recommended consideration of the implications of the convergence of biology and chemistry as a development that carries the potential for uses contrary to the provisions of the BWC.[4] The Third Review Conference noted the increasing convergence of chemistry and biology and recommended exploring and considering the potential implications of these advances for the Convention, through the SAB[5] and through States Parties.[6] In

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3 Available at www.opcw.org/special-sections/science-technology/science-technology-monitor

4 Annex I, Part II(A). paragraph 8(d) of the report from the 2013 Biological Weapons Convention Meeting of States Parties, available at www.labor-spiez.ch/en/die/sc/pdf/footnote_1.pdf

5 See paragraph 123 of RC-3/CoW.1, dated 19 April 2013, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=16396

6 See paragraph 136(c) of RC-3/CoW.1.

its report to the Third Review Conference (RC-3/DG.1, dated 29 October 2012), the SAB stated that convergence is evident in the increasing commercial production of chemicals through biologically mediated processes as well as the chemical synthesis of simple replicating organisms, biological parts, and agents of biological origin such as bioregulators and toxins.[7] The SAB's temporary working group on convergence in chemistry and biology released its end-of-mandate report in June 2014.[8] It recommended that in addition to its own work, discussions on the effects of convergence should be supported by technical reviews in other forums.[9]

6.3 In response to this recommendation, the Spiez Laboratory (Switzerland) held a convergence workshop from 6 to 9 October 2014 to review relevant developments and assess their potential impact on the BWC and the Convention. The workshop brought together international experts from the SAB, academia, and the industry and policy community, and started with an introduction to the concept of convergence from the perspectives of the BWC, the Convention, and non-government organisations (NGOs). This was followed by summaries of prior reviews conducted by the SAB and the Biochemical Security 2030 project (Bath University, United Kingdom of Great Britain and Northern Ireland). Additional technical presentations by expert speakers described "chemistry making biology and biology making chemistry" and "enabling technologies".

6.4 The workshop findings were published and provided to the BWC and Convention communities.[10] A key conclusion was that progress in the life sciences is outpacing the treaty review cycles. Constant monitoring of advances in the life sciences, related technologies, and industrial application thereof was therefore recommended. The workshop series entitled "Spiez CONVERGENCE" is expected to continue, and the next meeting is scheduled for September 2016.

6.5 In the subsequent discussion, the following points were raised:

(a) The SAB appreciates the initiative of the Swiss Government and the Spiez Laboratory for initiating this valuable workshop. This forum fits well with the recommendations of the TWG on convergence and helps assess technical advances and engage policy-makers. The SAB would support and encourage similar initiatives from other States Parties and NGOs;

(b) Monitoring developments resulting from the breadth of scientific disciplines and research relevant to convergence requires active engagement within the scientific community. The SAB suggested that members might consider attending and participating in conferences to support the monitoring of relevant advances; and

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7 See part A, paragraph 5 of RC-3/DG.1, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=15865

8 The report has been issued as SAB/REP/1/14, dated 27 June 2014, and is available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=17438

9 See part A, paragraph 6 of RC-3/DG.1.

10 http://www.labor-spiez.ch/en/akt/pdf/Spiez_Convergence_2014_web.pdf

(c) In light of the rapid advances in convergence, the recommendations set out in the TWG's report on verification would provide useful guidelines to determine which new developments are most relevant.

6.6 Mr Cheng Tang presented an overview of and the key points from the two workshops that he attended on behalf of the SAB during the intersessional period. The first conference, "A Road Map for Comprehensive and Sustainable CBRN[11] Security Culture", to which the SAB was invited by the Global Partnership, was held in Berlin on 3 November 2014. The second conference, "Comprehensive CBRN Security Culture: Moving Forward to Address New Challenges", was held in Munich on 24 April 2015 and served as a follow-up to the previous conference. On both occasions, the workshops took place alongside the meetings of the two working groups of the Global Partnership Against the Spread of the Weapons and Materials of Mass Destruction.

6.7 Mr Tang informed the SAB that the Berlin Group, an international coalition for CBRN security culture, was established after the conference in Berlin and that the SAB has been offered membership to the group. The second conference in Munich was then referred to as the meeting of the Berlin Group. Mr Tang reported that the Berlin Group recognised the role of the OPCW as a facilitator among the States Parties and other security stakeholders. He discussed the importance of promoting a self-assessment approach with respect to fostering a security culture in the chemical and biological domains.

6.8 In the subsequent discussion, the following points were raised:

(a) CBRN safety and security culture is a complex issue. It requires alignment across multiple disciplines and stakeholders in order to produce a universal code of conduct that would support implementation; and

(b) Codes of conduct were discussed within the context of building a culture of responsible use of chemistry. As part of the efforts toward building a chemical security culture, the experiences of drafting codes related to the responsible use of chemistry under the Convention could be shared with the Berlin Group and the CBRN Centres of Excellence. In this regard, the Secretariat could put stakeholders from the CBRN Centres of Excellence in contact with relevant experts, and the SAB could engage further with the Berlin Group.

6.9 Professor Ferruccio Trifirò briefed the SAB on biorefineries. The term biorefineries is generally used to denote the production of fuels from biomass. In these processes, the fuels and their by- and co-products can be also used as feedstocks and/or precursors in industrial chemical facilities. Biorefineries use biomass as a feedstock for the production of fuels and chemicals.[12] The use of biomass as a renewable raw material to produce chemicals is an example of the industrial application of green chemistry. Biomass used in biorefineries may come from crop residues (first

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11 CBRN = Chemical, biological, radiological, and nuclear.

12 Biomass includes agricultural and forest residues, biowaste streams (municipal and food production wastes), energy crops (jatropha, algae, miscanthus, and switchgrass), and crops used for food and feed (carbohydrates, triglycerides, and proteins).

generation), crops produced for energy (second generation), and/or genetically modified crops (third generation).

6.10 The production of chemicals from biomass involves the following stages: physical extraction of active components; chemical and/or biological transformations to produce chemicals; gasification of lignocellulosic biomass at high temperatures in the presence of oxygen to produce syngas; pyrolysis of lignocellulosic biomass to obtain aromatics; and/or, hydroliquefaction of biomass with hydrogen at lower temperatures in order to obtain liquid hydrocarbons.

6.11 Four different strategies to produce chemicals from biomass were described:

(a) Producing chemical building blocks traditionally obtained from fossil fuels. The advantage of this strategy is integration with existing petrochemical-based processes;

(b) Producing alternative platform chemicals as new building blocks. The advantage here is the use of new platform molecules to synthesise downstream products traditionally derived from petrochemical-based platform chemicals. This can reduce the amount of raw material required and, when obtained from locally available biomass, decrease both transport and production costs;

(c) Producing traditional petrochemical products through new synthetic routes. This is the direct synthesis of downstream products traditionally derived from petrochemicals. The advantage of this strategy is the production of chemical products without using petrochemical-based intermediates; and

(d) Synthesising alternative products to petrochemicals. This is the synthesis of alternative products to those obtained from petrochemicals. It provides the possibility that many economically important new substances can be produced from biomass with the goal that such products would be biodegradable and non-toxic. These sustainable products would include biofuels, bioadhesives, biopolymers, biopharmaceutics, biocosmetics, biolubricants, and biosolvents.

6.12 In the subsequent discussion, the following points were raised:

(a) The use of biomass to produce chemicals illustrates a much broader set of processes than fermentation. It is important to recognise that there are multiple approaches that industry can adopt to produce chemicals from biomass;

(b) The extent to which biomass will be used to produce chemicals is influenced by crude oil economics; and

(c) Future developments in the use of biomass may involve genetically modified plants. Such approaches seek to produce sources of biomass that maximise the content of desired chemical components and waste streams with the potential to produce value-added materials.

6.13 Professor David Gonzalez briefed the SAB on the field of green chemistry, describing the definition of green chemistry, its role in sustainable development, and its

relevance to the goals and objectives of the Convention. Professor Gonzalez elaborated on four of the 12 principles of green chemistry,[13] these being:

(a) Less Hazardous Chemical Syntheses. This principle is exemplified by a new method for the preparation of sodium iminodisuccinate that avoids the use of hydrogen cyanide and formaldehyde;

(b) Designing Safer Chemicals. This principle is exemplified by the Amiton discovery story, where a class of chemical warfare agents resulted from pesticide research. Green chemistry approaches would seek to design pesticides from natural and biodegradable products;

(c) Design for Degradation. This principle aims to design chemicals that can be easily degraded into non-toxic components. The relevance of this principle is seen with examples such as the development of sodium iminodisuccinate and Harpin technology; and

(d) Inherently Safer Chemistry for Accident Prevention. This principle concerns the prevention of chemical accidents and the potential of chemical plants to be targets of terrorism. Cyanide-free sodium iminodisuccinate synthesis is a clear example of how green chemistry can benefit the goals of Convention implementation.

6.14 Professor Gonzalez described some of the challenges for sustainability, and further suggested that promoting greener manufacturing processes, reducing social inequity, supporting sustainability, and preventing the proliferation of weapons of mass destruction can be mutually reinforcing.

6.15 In the subsequent discussion, the following points were raised:

(a) Green chemistry encompasses a broad range of multidisciplinary technology developments, and is not limited to biologically based processes or the convergence of chemistry and biology; and

(b) Green chemistry and sustainable processes as concepts can provide opportunities for engaging with the scientific community and can be used to illustrate how science can benefit chemical weapons disarmament. Examples include research that reduces the availability of toxic materials through substitution of safer chemicals into industrial processes and technologies that detect and degrade hazardous pollutants.

6.16 Biorefinery-based chemical production and the adoption of green chemistry principles by the chemical industry illustrate the impact of the convergence of chemistry and biology. As the adoption of these methods for chemical production becomes more widespread, the Secretariat might consider the relevance to the object and purpose of the Convention of the facilities using such production methods under Part IX of the Verification Annex. Further insight into these issues has been addressed in the TWG's report on verification (see agenda item 7).

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[13] See http://www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry/principles/12-principles-of-green-chemistry.html

6.17 The Secretariat's Science Policy Adviser updated the SAB on the Secretariat's activities in keeping abreast of developments in science and technology. The integration of existing and emerging technologies forms the foundation for new developments. Examples included:

(a) Technologies designed for genomic analysis that illustrate how integrating methods for chemical measurements with large databases of information (including the linkages between genome, transcriptome, proteome and metabolome) can compensate for limitations in some methodologies and allow components in complex mixtures (e.g., ricin in yoghurt) to be identified;

(b) The ability to make measurements in real time with cloud-based analytics leading to improved miniaturisation, enabling large-scale analytical studies, such as citywide mapping of microbiomes; and

(c) New technologies that have attracted attention from a security standpoint, including thematic areas that may be of relevance to the report to the Fourth Review Conference (see agenda item 6c).

6.18 In the overview, capabilities, limitations, current investments (including non-traditional, crowd-sourcing funding options), and operating scales were highlighted as relevant to science and technology development assessments. The rapid pace of scientific development and the growth of accessible data reinforce the need to engage technical experts and participate in scientific conferences to adequately address topics of relevance to the Convention.

6.19 In the subsequent discussion, the SAB acknowledged the value of frequent discussions and sharing of information when assessing developments in science and technology, and highlighting the value of the Secretariat's efforts in collecting and summarising a wealth of scientific subject matters. Additionally, the SAB expressed its appreciation to all Secretariat staff and interns involved in these initiatives.

Subitem 6(c): Planning for the Scientific Advisory Board's report to the Fourth Review Conference

6.20 The SAB Secretary proposed a process for the SAB to prepare its report to the Fourth Review Conference (RC-4, assumed to be held in 2018) on developments in science and technology. Two SAB meetings will be scheduled in 2016 and two in 2017. The Secretariat will also be prepared to provide administrative support for expert workshops to facilitate the SAB's deliberations. The SAB's report should be issued nine months prior to the Fourth Review Conference, so that: (i) States Parties will be able to take the scientific advice into account when formulating national positions; (ii) the States Parties will be able to discuss science and technology developments in preparation for the review conference; and (iii) the Secretariat will be able to take science and technology advice into account when making substantive proposals to the Review Conference. As a result of the Secretariat's horizon scanning and monitoring of science and technology developments, several substantive topics that the SAB may consider, such as those relating to convergence of the sciences and verification, were highlighted.

6.21 The SAB highlighted the importance of the Secretariat's support, particularly in compiling scientific literature and/or developments relevant to the Convention for inclusion in its report to the Fourth Review Conference.

7. AGENDA ITEM SEVEN – Scientific and technological elements of verification technologies, emerging technologies, and new equipment

Subitem 7(a): Temporary Working Group on Verification: final report

7.1 The Chairperson of the TWG on Verification, Professor Roberto Martínez-Álvarez, summarised the group's work, highlighting the key findings and recommendations:[14]

(a) In response to the question "What are the technologies/methodologies used for verification purposes in other international treaties that could benefit the Convention verification regime?" the TWG recommended that:

(i) "The Secretariat should consider adopting a comprehensive, more analytical approach to verification utilising all available and verifiable information" (Recommendation 1 of the Verification Report).

(b) In response to the question "Which methodologies (whether existing or new) could assist States Parties in ensuring that all declarable plant sites are identified for declaration?" the TWG recommended that:

(i) "The Secretariat should acquire the capability to use open-source information on a routine basis" (Recommendation 2).

(c) In response to the question "Which new or emerging technologies may add value to existing capabilities for verification purposes (such as data analysis/ data mining, statistical analysis, attribution analysis)?" the TWG recommended that:

(i) "The Secretariat should put in place an information management structure that can provide the support required for the verification process" (Recommendation 3);

(ii) "Remote/automated monitoring technologies should be added to the list of approved inspection equipment" (Recommendation 4);

(iii) "The Secretariat should look into the option of using satellite imagery for the planning of non-routine missions, in particular for IAU[15] and CI[16]" (Recommendation 5);

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[14] The report has been issued as SAB/REP/15/1, available at www.opcw.org/index.php?eID=dam_frontend_push&docID=18795

[15] IAU = investigation of alleged use

[16] CI = challenge inspection

(iv) "The Secretariat should visit the National Authorities to obtain assurance on the accuracy and completeness of declarations" (Recommendation 6); and

(v) "The Secretariat must commission an independent review of all activities pertaining to the missions carried out in the Syrian Arab Republic" (Recommendation 7).

(d) In response to the question "What are the key technical components of a consistent approach to declaring complex mixtures of discrete organic chemicals?" the TWG recommended that:

(i) "The list of declarable OCPFs[17] submitted by States Parties should include all facilities which fall under the definition/requirement of paragraph 1of Part IX of the Verification Annex, regardless of the purity level of a DOC[18] or DOC mixtures produced" (Recommendation 8).

(e) In response to the question "What are the verification aspects of the meaning of "produced by synthesis"?" the TWG recommended that:

(i) "Not all facilities that fall under Part IX of the Verification Annex should be considered of the same relevance to the object and purpose of the Convention. The TWG recommends a practical approach for enhancing the utilisation of verification resources for OCPF declaration and on-site inspection processes":

> "(a) The OPCW policy-making organs should exempt certain OCPFs from declaration requirements; (b) The Secretariat should assess which product group codes are highly relevant to the Convention. Facilities declared with these product group codes should be subject to a higher probability to be selected for inspection; (c) For facilities in product group codes that are considered less relevant, the Secretariat should identify appropriate mechanisms to augment the declared information with validated and credible sources to allow for an assessment regarding the need for on-site inspection" (Recommendation 9).

(ii) "The verification thresholds for OCPFs producing highly relevant chemicals and the possibility of the revision of the product group codes should be addressed by the SAB as well as the Industry Cluster" (Recommendation 10).

(f) In response to the question "How can sampling and analysis most effectively be utilised for verification purposes?" the TWG recommend that:

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17 OCPF = other chemical production facility

18 DOC = discrete organic chemical

(i) "The OPCW should increase the staff of the OPCW Laboratory to cope with various aspects of IAU, biomedical samples, trace environmental analysis, toxins, and on-site analysis. Establishing a network of Designated Laboratories for biomedical sample analysis should be a high priority" (Recommendation 11);

(ii) "Lessons on chemical sampling and analysis from the OPCW's support to the 2013 United Nations Mission to Investigate the Use of Chemical Weapons in the Syrian Arab Republic, and all subsequent OPCW activities in relation to the Syrian Arab Republic, must be identified and implemented" (Recommendation 12);

(iii) "PTs [proficiency tests] should incorporate a broader range of chemicals and a wider range of concentrations to prepare laboratories for IAU-type scenarios" (Recommendation 13);

(iv) "The Technical Secretariat should expedite toxin identification exercises" (Recommendation 14);

(v) "Continuous additions to the OPCW Central Analytical Database (OCAD) are recommended to allow OPCW to meet all its mandated inspection aims, including IAU" (Recommendation 15);

(vi) "Developments in analytical instrument portability, miniaturisation, and disposable biosensors should be periodically reviewed by the Secretariat and the SAB for potential applicability to on-site analysis" (Recommendation 16); and

(vii) "The Technical Secretariat should monitor developments in … chemical forensics" (Recommendation 17).

(g) In response to the question "Which methodologies might be helpful for the Secretariat to keep abreast of developments in science and technology of relevance to the Convention verification regime?" the TWG recommended that:

(i) "The Secretariat should augment its capability to monitor and forecast developments in science and technology of relevance to the Convention and its verification regime" (Recommendation 18).

7.2 The SAB endorsed the report of the TWG on Verification. With reference to recommendation 18 (see f(vii) above), the SAB recommends that the phrase "attribution analysis" not be used, since it is not clear and may cause misunderstanding.

Subitem 7(b): Investigations of Alleged Use – perspectives from the 2013 United Nations investigation

7.3 Professor Åke Sellström (guest speaker) provided his perspective on the United Nations Mission to Investigate Allegations of the Use of Chemical Weapons in the Syrian Arab Republic (hereinafter "the United Nations investigation"), which he led. He described key elements of the preparation and planning phase (including visits to capitals and collection of testimonies), the conduct of the investigation (including the processes and outcomes from the use of interviews, epidemiology, sampling, and documentation), and reporting. The briefing included an overview of the UN Secretary-General's Mechanism for Investigation of Alleged Use of Chemical and Biological Weapons (hereinafter "the United Nations Secretary-General's Mechanism")[19] and how it was invoked for the United Nations Investigation. He highlighted several potential lessons relevant to the OPCW, including:

(a) the formation of a highly competent and cohesive team prior to deployment, building on the synergies between the United Nations, the OPCW, and the World Health Organization (WHO);

(b) the OPCW's top strengths are logistical and technical;

(c) the OPCW's operating procedures for conducting investigations and collecting samples were used with good effect, and some of these procedures could be updated after a review of lessons learned;

(d) training should be augmented, e.g., in order to improvise under pressure and make assessments in the field in rapidly changing circumstances;

(e) biomedical sampling and analysis should be augmented and institutionalised, and environmental biosampling should be considered;

(f) epidemiology is a powerful tool, also for IAUs; and

(g) adding expertise in metallurgy and material science would be useful for the analysis of debris resulting from the firing of munitions.

7.4 In the subsequent discussion, the following points were raised:

(a) The SAB expressed its appreciation to Professor Sellström for his presentation;

(b) The lessons learned review conducted by the United Nations after the mission provided valuable feedback that is being incorporated into the training activities involving the roster of experts maintained as part of the United Nations Secretary-General's Mechanism. Professor Sellström recommended that lessons learned by the OPCW should be essential for maintaining preparedness of the Secretariat. The SAB endorsed this proposal;

[19] http://www.un.org/disarmament/WMD/Secretary-General_Mechanism/

(c) Environmental biosampling was discussed. In principle, there could be protein adducts formed in plants exposed to chemical agents, and the collection and analysis of these plants could provide important data in an investigation. However, methods based on appropriate biomarkers would need to be developed. It was further noted that esterases can be found in some plant species;

(d) The use of small unmanned autonomous vehicles (UAVs) capable of carrying imaging equipment and/or satellite imagery could augment the capabilities of inspection teams in an IAU. Such technologies could provide insight useful in identifying sites and areas where more detailed inspections may be of value. The autonomous nature of these systems can provide safety and security benefits for inspection teams; and

(e) A need for improved sampling and analysis and detection equipment was identified.

Subitem 7(c): Verification of the destruction of Syrian chemical weapons: some experiences from the OPCW's work from 2013 to 2015

7.5 The Head of the Chemical Demilitarisation Branch of the Secretariat briefed the TWG on key aspects of the OPCW's activities concerning the verification of the destruction of Syrian chemical weapons. He described the key modalities (including legal aspects, agreements, and transport and environmental considerations) and the verification and destruction activities that were undertaken (both inside and outside the country). Key issues included the safety and security of staff deployed to the field; coordination and communication among agencies and technical and policy staff; the range of expertise and skills needed (both at headquarters and in the field) to meet the unusual requirements; and equipment. The Head of the Chemical Demilitarisation Branch highlighted the potential lessons to be learned to help achieve readiness for future investigations, including: ensuring a sound and robust framework, knowledge management and retention of specialised expertise (most staff involved in the actions will be leaving OPCW by mid-2016), the need to innovate and communicate effectively across numerous disciplines and areas of work; avoiding duplication of previous efforts; handling compressed time lines (especially within the Secretariat); and ensuring that appropriately trained staff and robust equipment are available.

7.6 In the subsequent discussion, the following points were raised:

(a) Current operations regarding Syrian declarations to the OPCW include a Declaration Assessment Team that has been collecting information to help identify the infrastructure of the Syrian chemical weapons programme and verify its dismantlement. An unintended consequence of the quick destruction of the Syrian facilities is that obtaining complete information has been compromised due to the movement and disposal of equipment from the sites rendered inoperable.

(b) A variety of equipment not currently available to the OPCW could have aided the work of the inspectors (both in the United Nations Investigation; and in the OPCW-United Nations Joint Mission for the Elimination of the Chemical

Weapons Programme of the Syrian Arab Republic, hereinafter "the Joint Mission"). These would include, but are not limited to, the use of drones for remote monitoring and verification to keep inspectors out of harm, more versatile equipment for real-time analysis to help guide inspections before more robust equipment can be deployed, more comprehensive analytical databases that cover unscheduled chemicals such as the raw materials in the production of the precursors that can be ultimately used to produce warfare agents, and communication equipment compatible with respirators (given the long periods of time that inspectors were suited up).

(c) Several questions were raised regarding the Syrian declaration of a decommissioned ricin production facility. Approved equipment available to inspectors may not be suitable for sampling and analysis at such a facility for verification purposes. Methods and equipment for sampling and analysis of toxins have been suggested in the reports of the TWGs on verification and convergence. The upcoming Eighth Review Conference of the BWC, which will review scientific developments and is scheduled to take place in 2016, may provide insights for new methodologies in this field.

(d) The tender process through which hazardous waste disposal facilities were chosen to eliminate hydrolysis waste products and industrial chemicals that have been removed from the Syrian Arab Republic created new partnerships between the disarmament community and the commercial sector. One of the companies contributed an article to the August 2014 issue of *OPCW Today,* describing one of the high-temperature incinerator facilities that treated chemicals during the Joint Mission.[20]

(e) A guidance book incorporating lessons learned from the United Nations Investigation and the Joint Mission would be an invaluable tool for future IAUs. The SAB suggested that the Secretariat commission an independent review of all activities pertaining to the missions carried out in the Syrian Arab Republic, in line with the independent recommendation of Professor Sellström.

(f) The current OPCW tenure policy poses challenges to the maintenance of organisational knowledge. Due to the loss of such knowledge, future investigations may require reinventing and/or rediscovering the processes and protocols developed during activities related to the Syrian Arab Republic.

Subitem 7(d): Chemical forensics

7.7 Dr Daan Noort (guest speaker) provided the SAB with an overview of developments in the field of chemical forensics. In the aftermath of incidents involving chemical agents, identifying the sources of these materials may provide valuable forensic information which can assist in identifying perpetrators. For instance, comparing the chemical signature of a reference sample of a chemical agent with the chemical signature of a sample collected during an IAU might afford crucial information regarding the origin of the agent. Relevant forensic questions in this respect are:

[20] See page 14 of www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_3_No_1.pdf

(a) How stable is a particular chemical signature over time and under various conditions, e.g., to what extent is it possible to correlate a batch of a stockpiled chemical agent with collected samples from a CI or IAU?;

(b) Can the chemical signature of a batch of a chemical agent be correlated to a specific batch of precursor materials?; and

(c) Is it possible to correlate the chemical signature of a batch of a chemical agent to a particular route of synthesis (involving a similar route or precursors)?

7.8 In the subsequent discussion, the following points were raised:

(a) The SAB expressed its appreciation to Dr Noort for his presentation;

(b) In law enforcement forensics, sampling and analysis is performed in two ways: following strict protocols to produce evidence that can stand up in a court of law, and quicker, less rigorous tests that are used to help inform lines of questioning and identify leads for next steps in an investigation. A review of law enforcement practices and test methods in this regard may be of value to the Secretariat;

(c) The forensic analysis of explosive residues produced from chemical devices could also be a valuable tool for investigations;

(d) The use of chemical forensic methods for attribution analysis can be complicated by variations within production processes. This has been demonstrated with clandestine laboratory samples of illegal drugs in a law enforcement context. In a chemical weapons context, sophisticated production facilities may have similar signatures between batches of material, while improvised ("garage") facilities may show variations that make comparative analysis difficult.

(e) Statistical tools and reference material data sets in combination with forensic analytical techniques may serve to enhance the capabilities of these analyses.

7.9 The Head of the OPCW Laboratory briefed the SAB on developments in and proposals for the OPCW Laboratory proficiency testing (PT) programme. In the SAB's report to the Director-General on advances in science and technology (RC-3/DG.1), the SAB recommended a review of the PT programme. The Director-General appointed a panel in January 2014, and the panel's report was delivered in December 2014. The OPCW Laboratory prepared an action plan based on the recommendations in the report, and the Director-General concurred with the action plan. The OPCW Laboratory is in the process of implementing this plan. In brief, there will be two parallel PT programmes: one for environmental analysis, and one for biomedical analysis. There will be little change to the existing environmental PT programme (two tests per year, maintenance of an AAB or AAA rating). The biomedical PT is scheduled to start in February 2016 with only one test per year, and a rating of AB or AA will be required to obtain designation. An additional capability building programme—basically a simplified environmental PT—will be evaluated as an adjunct to the PT programme. Exercises in trace analysis and in toxin analysis will be explored in parallel with the environmental PT programme.

7.10 In the subsequent discussion, it was that suggested that engaging the States Parties with partner laboratories would provide a valuable context for consideration of this proposal.

7.11 The Science Policy Adviser of the Secretariat provided information on the "Chemical informatics for facilitating international collaboration" project under EU Council Decision (CFSP) 2015/259 dated 17 February 2015.[21] This project is motivated by the wealth of publically available data that contains chemical signatures, such as from worldwide environmental monitoring systems, the ability to build low-cost do-it-yourself (DIY) sensors for chemical detection with readily available kits, and the use of web connectivity to facilitate citizen science and crowdsourced data sharing projects. The project, which has EU funding from 2015 to 2017, will serve as a proof of concept in which a group of universities (each from a different regional group) will make simple chemical measurements (such as components of air or water analysis) and synthesise the data with relevant, publically available data sets. Data will be compared across regions, and informatics tools to identify unique chemical signatures will be developed. The intention is to produce tools (both sensors and informatics) that can be used in classroom settings to illustrate the uses of chemical analysis along with measurement uncertainty and variation as an awareness-raising activity for Convention-related science. With a wide range of chemical sensors in use for generating public data, the project will also serve to help the Secretariat stay abreast of developments and trends in chemical monitoring and analytics for complex and noisy data sets across a broad range of applications. The project is currently in the planning stages, and several potential university partners have been identified.

7.12 In the subsequent discussion, the following points were raised:

(a) Projects of this nature provide opportunities for combining hands-on science with data analysis. This can be used to facilitate collaboration across different regions to raise awareness about the role of science and chemical measurements in Convention implementation; and

(b) The use of simple commercially available sensor kits, open-access websites for streaming data, and public data sets from environmental monitoring systems has the potential to keep costs to a minimum; potentially expanding the size of the collaboration that can be achieved with current funding.

7.13 The SAB believes that new technologies and informatics tools should be monitored and, where appropriate, integrated into Convention-relevant activities. The SAB encouraged its members to propose novel ideas relevant to the SAB's report on science and technology to the Fourth Review Conference.

[21] See http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.043.01.0014.01.ENG

8. AGENDA ITEM EIGHT – Further scientific and technological advice relevant to the Chemical Weapons Convention

Subitem 8(a): The Temporary working group on education and outreach in science and technology: final report

8.1 The Chairperson of the TWG on education and outreach in science and technology relevant to the Convention, Professor Djafer Benachour, summarised the group's work, highlighting the key findings and recommendations. The final report was endorsed by the SAB in November 2014 and was made available to the States Parties at the annual meeting of National Authorities in November 2014.[22]

8.2 The presentation described the TWG's terms of reference and its accomplishments, including new educational materials (for example, multiple uses of chemistry,[23] chemistry in conflict,[24] and the "Fires" movie series[25]). New outreach tools have been identified and adopted, including museum exhibits, contributions to international journals, and OPCW participation at international scientific and historical events. The Director-General has promoted key aspects of education and outreach during his visits to States Parties. The TWG made recommendations on the sustainability of OPCW education and outreach, as well as additional recommendations for consideration by the Director-General. Along these lines, a key recommendation was to establish a permanent OPCW Advisory Board on Education and Outreach.[26]

8.3 In the subsequent discussion, the following points were raised:

(a) The SAB noted that this TWG has made a large impact through its recommendations and outreach activities; and

(b) Education and outreach covers all facets of science that relate to the OPCW. Outreach opportunities include conferences in fields such as chemistry, biology, toxicology, and other scientific disciplines.

Subitem 8(b): Assistance and protection: medical countermeasures against and treatment for nerve agents

8.4 Professor Slavica Vučinić presented the report (SAB-22/WP.2/Rev.1, dated 10 June 2015)[27] of the correspondence group in response to the request from the Director-General for advice on best practices for preventing and treating the health effects that arise from acute, prolonged, and repeated organophosphorus nerve agent exposure. The report summarises pre- and post-exposure treatments, as well as new developments in the decontaminants and adsorbing materials that are currently

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22 SAB/REP/14/2, dated 25 November 2014, available at www.opcw.org/index.php?eID=dam_frontend_push&docID=18014

23 http://multiple.kcvs.ca/site/index.html

24 https://www.opcw.org/our-work/education-and-outreach/chemistry-in-conflict/

25 https://www.thefiresproject.com/

26 EC-79/DG.11, dated 29 May 2015, available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=18764

27 Available at https://www.opcw.org/index.php?eID=dam_frontend_push&docID=18641

available for nerve agents. The SAB recommends that new developments in chemical warfare agent medical countermeasures and treatments continue to be monitored.

8.5 In the subsequent discussion, the following points were raised:

(a) The SAB noted that the compilation of the information in the report could be a valuable reference for medical professionals and emergency responders who may not have knowledge of the symptoms or treatment options related to exposure to chemical warfare agents;

(b) The SAB recommended that all developments in the research of medical countermeasures against chemical warfare agent exposure should be monitored; and

(c) The Secretariat is reviewing the information and considering how to best use it in the assistance and protection training courses and workshops organised through its capacity building programmes. The additional decontamination information is of particular interest in this context.

Subitem 8(c): Outreach activities by the Technical Secretariat

8.6 The Science Policy Adviser of the Secretariat's science engagement activities. These included providing guest lectures and seminars for science and engineering students, organising student projects with local universities, engaging with national and international scientific societies, collaborating with other international organisations, launching a special science and technology section on the OPCW public website,[28] and submitting publications in scientific forums to maintain visibility within these communities. Engagement with scientists is a key aspect of efforts to keep abreast of developments in science and technology and provides opportunities to meet the objectives of the OPCWs education and outreach work. Notable developments from these activities include:

(a) Recognition from the Board of Directors of the American Chemical Society (ACS) of the OPCW for its efforts in the promotion of the science of chemistry for peace. An award was received at the 249th National Meeting of the ACS in Denver in March 2015; and

(b) The appointment of the OPCW science policy adviser as an observer to the International Union of Pure and Applied Chemistry (IUPAC) Committee on Chemistry Education.

8.7 Of equal importance to engagement with the scientific community is the facilitation of discussions of science with policy-makers. The Science Policy Adviser described the Secretariat's activities and initiatives in this area. The Secretariat also intends to hold a technology foresight-themed chemical safety and security event in 2016 to further facilitate dialogue between security, policy, and scientific communities.

8.8 The presentation concluded with a report of the Workshop on Guidelines for the Practice of Chemistry under the Norms of the Chemical Weapons Convention, which

[28] See www.opcw.org/index.php?eID=dam_frontend_push&docID=18748

was held on 11 March 2015 in The Hague and chaired by Professor Alejandra Suárez. The workshop brought together practitioners of the chemical sciences to discuss an initiative proposed by the permanent representation of the Federal Republic of Germany to the Nineteenth Conference of the States Parties to the Chemical Weapons Convention for a text of ethical guidelines for chemical professionals related to the Convention (paragraph 23.3 of C-19/5, dated 5 December 2014,).[29] Participants addressed three thematic issues: key elements of Convention-relevant ethical guidelines, principles and best practices for drafting ethical guidelines, and establishing synergy with other current initiatives. A second meeting at which a draft text will be discussed with stakeholders across the chemical sciences is tentatively planned for autumn 2015. The workshop report is available on the OPCW public website.[30]

8.9 The Secretariat updated the SAB on its activities in education and outreach since the Board's last session. These activities fall under four recommendations from the Third Review Conference, based on recommendations made by the TWG on education and outreach. The activities include: holding education and outreach breakout sessions at meetings of National Authorities; developing educational and informational materials; participation of the Director-General or OPCW staff members as speakers at university events in several countries; reaching out to students via the OPCW visit programme; continuing the summer programme with the Asser Institute; and other activities under Article XI of the Convention.

8.10 In addition, the highlights of two high-profile outreach events were presented: "Education for Peace: New Pathways for Securing Chemical Disarmament" in September 2014,[31] and the commemoration of the centenary of the first large-scale use of chemical weapons in Ieper, Belgium on 21 April 2015.[32]

8.11 The Secretariat updated the SAB on its Article XI programmes.[33] The key objectives of these programmes are to promote international cooperation in the field of chemistry, to enhance and exchange scientific and technical knowledge, to develop specialist skills, and to build the national capacity of the States Parties. To achieve these objectives, the Secretariat offers four categories of programmes: integrated chemical management; chemical knowledge and exchange; enhancing laboratory capabilities; and chemical safety and security programmes. New initiatives planned for 2016 include a course on policy and diplomacy for scientists, a chemical research conference, behavioural safety programmes for scheduled chemical users, and a hazardous waste management programme.

8.12 In the subsequent discussion, the following points were raised:

(a) A number of opportunities were identified for SAB members to help support education and outreach objectives, such as conference participation, dissemination of OPCW outreach resources within their respective networks,

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29 See https://www.opcw.org/index.php?eID=dam_frontend_push&docID=18119
30 See https://www.opcw.org/index.php?eID=dam_frontend_push&docID=18748
31 See http://www.opcw.org/special-sections/education-for-peace/
32 See https://www.opcw.org/ieper-a-centenary-commemoration/
33 See http://www.opcw.org/our-work/international-cooperation/

and reference to OPCW in their publications and/or presentations for professional audiences.

(b) As the Article XI programmes provide many opportunities to engage with scientists throughout the States Parties, raising awareness of these programmes among researchers would further support OPCW education and outreach objectives.

(c) Many of the Secretariat's activities provide opportunities to expand the visibility and reach of the OPCW. Some examples include inspectors giving presentations to industrial scientists while on mission or a staff member meeting with students in the margins of a workshop or conference. The SAB might help bring more visibility to opportunities for education and outreach where the primary purpose of the activity may seem to lie elsewhere (such as participating in a technical seminar at a science conference). This could further aid in the decision-making process with positive outcomes for education and outreach objectives.

Subitem 8(d): Outreach activities by members of the Scientific Advisory Board

8.13 SAB members described the outreach activities in which they were involved. These included: integrating the "Fires" film series in chemistry education curricula; using examples of chemicals and their reactivity relevant to the Convention in chemistry education; holding university lectures and seminars; disseminating OPCW education and outreach tools; identifying scientific publications that mention the OPCW and its activities in relation to the scientific subject of the report; holding discussions with students on ethical issues; working with National Authorities to provide guidance on the technical aspects of Convention implementation, including declarations and inspections; giving lectures at scientific conferences with a focus on the Convention across a wide range of disciplines and applications; working with National Academies of sciences to share information about the OPCW; working with laboratories to provide advice on proficiency testing; holding teaching and training workshops for emergency responders and CBRN-focused audiences; addressing environmental issues, such as sea-dumped chemical weapons and environmental chemical remediation; bridging the gap between scientific researchers and policy-makers; developing chemical safety- and security-focused workshops and training courses; raising awareness of the OPCW in national scientific societies and industry associations; supporting the OPCW Associate Programme; organising public engagement and communication through local news outlets; and engaging with colleagues and students informally as opportunities present themselves.

9. AGENDA ITEM NINE – Scheduled chemicals and advice on the Annex on Chemicals

Isotopically labelled scheduled chemicals and stereoisomers of scheduled chemicals

9.1 In the context of ensuring the completeness of declarations, the Director-General requested advice from the SAB on isotopic labelling and stereoisomers of scheduled chemicals (see Annexes 2 and 3).

9.2 The SAB formed a correspondence group, led by David Gonzales, and will report to the Director-General at the Twenty-Third Session of the SAB.

10. AGENDA ITEM TEN – Experiences from other relevant advisory boards

The Advisory Board of the Secretary-General of the United Nations on Disarmament Matters

10.1 Dr Istvan Gyarmati (guest speaker and Chairperson of the Advisory Board of the Secretary-General of the United Nations on Disarmament Matters[34]) briefed the SAB on verification technologies, implications of emerging technology developments, and science diplomacy.

10.2 The Advisory Board of the Secretary-General of the United Nations on Disarmament comprises 15 members from different regional areas. Members are elected by the United Nations High Representative on Disarmament Matters. The Board meets twice a year—once in Geneva and once in New York—and reports to the Secretary-General of the United Nations. The Board members agree on the topics requiring consideration at the meetings and intersessionally. Two topics are usually addressed—three in exceptional circumstances—and reports on these topics are published at the end of each year. This year three topics have been approved by the United Nations Secretary-General:

(a) the role of arms control in managing conflicts;

(b) new challenges to disarmament and the increasing role of non-state actors; and

(c) the humanitarian consequences of nuclear use.

10.3 A recurring theme seen in all three topics is the impact of new technology, such as the use of drones in verification, or drones as weapon systems. Ways in which state cooperation can be strengthened in an effort to prevent terrorist attacks is another topic under consideration. The United Nations Advisory Board is planning to launch consultations and hold expert meetings to address these issues.

10.4 In the subsequent discussion, the following points were raised:

(a) The SAB expressed its appreciation to Dr Gyarmati for his presentation;

(b) Dr Gyarmati proposed making the Board's reports available to the SAB; and

(c) The SAB noted that the paper "The OPCW in 2025: Ensuring a World Free of Chemical Weapons" (S/1252/2015, dated 6 March 2015)[35] referred to the potential role of the OPCW in combating the possible use of chemical weapons by non-state actors. This topic might benefit from a closer relationship between the SAB and the UN Board in the future. Dr Gyarmati offered to help foster this relationship.

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34 http://www.un.org/disarmament/HomePage/AdvisoryBoard/AdvisoryBoard.shtml

35 https://www.opcw.org/index.php?eID=dam_frontend_push&docID=18422

11. AGENDA ITEM ELEVEN – Future work of the Scientific Advisory Board

11.1 The SAB discussed its future work. Given the need to assess developments in science and technology and make recommendations to the Director–General and the States Parties prior to the Fourth Review Conference, two SAB sessions per year need to be held in 2016 and 2017. Assuming that the Fourth Review Conference will be held in the first half of 2018, the SAB tentatively scheduled its next five sessions as follows:

(a) Twenty-Third Session: 18 – 22 April 2016;

(b) Twenty-Fourth Session: 24 – 28 October 2016;

(c) Twenty-Fifth Session: February 2017;

(d) Twenty-Sixth Session: July 2017; and

(e) Twenty-Seventh Session: in 2018.

11.2 The SAB discussed preparations for its report to Fourth Review Conference, drawing up an initial plan for topics to assess. Analytical chemistry and chemical forensics, as well as chemical warfare agents mechanisms of action were identified as two topics that could be useful to discuss in dedicated workshops in the first half of 2016. The Finnish Institute for Verification of the Chemical Weapons Convention (VERIFIN) has offered to host the workshop on analytical chemistry and chemical forensics, with OPCW support, in May or June 2016.

11.3 The SAB asked the Secretariat to make the necessary resources available.

12. AGENDA ITEM TWELVE – Any other business

12.1 In the margins of this session, the SAB Chairperson and Vice-Chairperson continued to engage with the States Parties, and on 11 June they presented an overview of the activities of the SAB to representatives of 28 States Parties.[36] This overview included the distribution of the TWG report on verification to the participants and discussion of its recommendations.

12.2 The SAB Chairperson bade farewell to Alejandra Graciela Suárez, Djafer Benachour, Muhammad Zafar-Uz-Zaman, Slavica Vučinić, William Kane, and Michael Geist, whose second terms of office on the SAB end in 2015. He thanked all of them for their contributions to the SAB.

13. AGENDA ITEM THIRTEEN – Adoption of the report

The SAB considered and adopted the report of its Twenty-Second Session.

14. AGENDA ITEM FOURTEEN – Closure of the session

The Chairperson closed the session at 16:42 on 12 June 2015.

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[36] Available at http://www.opcw.org/index.php?eID=dam_frontend_push&docID=18796

ANNEXES

Annex 1: List of participants in the Twenty-Second Session of the Scientific Advisory Board

Annex 2: (English only) Director-General's request to the Scientific Advisory Board to provide advice on isotopically labelled scheduled chemicals.

Annex 3: (English only) Director-General's request to the Scientific Advisory Board to provide advice on stereoisomers of scheduled chemicals

Annex 1

LIST OF PARTICIPANTS OF THE TWENTY-SECOND SESSION OF THE SCIENTIFIC ADVISORY BOARD[37]

	Participant	Institution
1.	Abdollahi, Mohammad	Tehran University of Medical Sciences, the Islamic Republic of Iran
2.	Al-Amri, Abdullah Saeed	Saudi Basic Industries Corporation, Riyadh, Saudi Arabia
3.	Martínez-Álvarez, Roberto	Complutense University, Madrid, Spain
4.	Baulig, Augustin	Secrétariat général de la défense et de la sécurité nationale, Paris, France
5.	Benachour, Djafer	LMPMP, Faculty of Technology, Ferhat Abbas University, Setif-1, Algeria
6.	Borrett, Veronica	BAI Scientific and Honorary Fellow University of Melbourne, Australia
7.	Gonzalez Berutti, David	Department of Chemistry, University of the Republic of Uruguay, Montevideo, Uruguay
8.	Cariño, Flerida Arsciwals	Institute of Chemistry, University of the Philippines, Diliman Quezon City, Phillippines
9.	Mourão, Nicia Maria Fusaro	ABIQUIM (Brazilian Chemical Industry Association), São Paulo, Brazil
10.	Geist, Michael	BASF SE, Ludwigshafen, Germany
11.	Kane, William	Consultant to Monsanto Company, Louisiana, United States of America
12.	Muhammad Zafar-Uz-Zaman	National Engineering and Scientific Commission (NESCOM), Islamabad, Pakistan
13.	Neffe, Slawomir	Military University of Technology, Warsaw, Poland
14.	Rubaylo, Valentin	State Scientific Research Institute of Organic Chemistry and Technology, Russian Federation
15.	Takeuchi, Koji	National Institute of Advanced Industrial Science and Technology (AIST), Japan
16.	Tang, Cheng[38]	Office for the Disposal of Japanese Abandoned Chemical Weapons, Ministry of National Defence, China
17.	Timperley, Christopher[39]	Defence Science and Technology Laboratory (Dstl), Porton Down, United Kingdom of Great Britain and Northern Ireland
18.	Trifirò, Ferruccio	Department of Industrial Chemistry, University of Bologna, Italy
19.	Vanninen, Paula	VERIFIN, Department of Chemistry, Faculty of Science, University of Helsinki, Finland
20.	Vučinić, Slavica	National Poison Control Centre, Military Medical

[37] Alejandra Graciela Suárez and Syed K Raza were not able to attend.

[38] Vice-Chairperson of the SAB.

[39] Chairperson of the SAB.

		Academy, Belgrade, Serbia
21.	van Straten, Francois Mauritz	South African Nuclear Energy Corporation SOC Ltd, Pretoria, South Africa
22.	Zaitsev, Volodymyr	Taras Shevchenko National University of Kyiv, Ukraine
23.	Zina, Mongia Said	Faculty of Sciences of Tunis, Tunisia
24.	Gyarmati, Istvan (guest speaker)	Chairperson of the Advisory Board of the Secretary-General of the United Nations on Disarmament Matters
25.	Sellström, Åke (guest speaker)	Consultant
26.	Noort, Daan (guest speaker)	Netherlands Organisation for Applied Scientific Research (TNO)

Annex 2

DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE ADVICE ON ISOTOPICALLY LABELED SCHEDULED CHEMICALS

1. The Chemical Weapons Convention (the Convention/CWC) allows States Parties to possess chemicals that are intended for purposes not prohibited by the Convention:

   a. ***Each State Party has the right, subject to the provisions of this Convention, to develop, produce, otherwise acquire, retain, transfer and use toxic chemicals and their precursors for purposes not prohibited under this Convention*** (CWC, Article VI, paragraph 1).

2. With this right come obligations, including:

   b. ***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*** (CWC, Article VI, paragraph 2).

3. To meet these obligations, and to ensure complete and accurate declarations by CWC States Parties to the OPCW[40], chemicals that fall under Schedules 1, 2, and 3 of the Convention must be clearly identifiable.

4. Some isotopically labeled Schedule 1 and Schedule 2 chemicals have presented ambiguity as to how they should be declared.

5. Isotopic labeling is a commonly employed technique in the study of chemicals; including in the development of analytical methods for chemical agents and in the study of mechanisms of action of chemical agents used to develop protective measures.

6. The Annex on Chemicals to the Convention identifies chemicals using generic descriptions of classes of chemicals and for each scheduled chemical a specific name and corresponding Chemical Abstracts Service (CAS) registry number.

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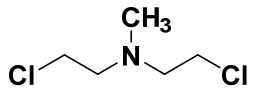
40 Parts VI, VII and VIII of the Convention's Annex on Implementation and Verification set out the relevant requirements.

7. CAS numbers are intended to provide a unique, unmistakable identifier for chemical substances. However, a chemical will have different CAS registry numbers assigned to its various analogues containing isotopic labels[41].

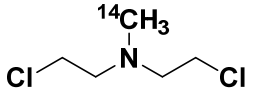
8. The Scientific Advisory Board (SAB) has cautioned that "there is not necessarily a one-to-one relationship between CAS registry numbers and chemical structures", and has advised that CAS registry numbers be considered aids to identification (RC-3/DG.1, dated 29 October 2012, paragraph 76; see also RC-2/DG.1, dated 28 February 2008, in paragraph 3.5 of the Annex).

9. The following two examples are illustrative of the ambiguity that can arise with isotopically labeled chemicals:

c. Bis(2-chloroethyl)methylamine (HN2) is listed in Schedule 1.A.06 with CAS registry number 51-75-2. The ^{14}C isotopically labeled molecule, bis(2-chloroethyl)methyl-[14C]-amine, has not been assigned a CAS registry number; if only the exact name and/or CAS number as listed in Schedule 1.A.06 were considered, the ^{14}C labeled nitrogen mustard agent might not be identified as a scheduled chemical; see the structures below.

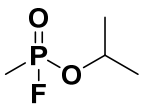


Bis(2-chloroethyl)methylamine



Bis(2-chloroethyl)methyl-[14C]-amine

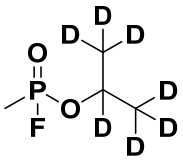
d. Another example involves three isotopic variations of sarin: isopropyl methylphosphonofluoridate (**i** in the illustration overleaf), isopropyl-d_7 methylphosphonofluoridate (**ii**) and isopropyl methyl-d_3-phosphonofluoridate (**iii**). The first of these is sarin as listed in Schedule 1.A.01 (with CAS number 107-44-8). The other two are deuterated analogs of sarin. It has been argued that **ii** should be considered under Schedule 2.B.04 rather than under Schedule 1.A.01, and that **iii** should not be considered under any CWC Schedule because the "methyl" (of methyl, ethyl, propyl and isopropyl) corresponds to "CH_3" only, and not the deuterated analog.



Isopropyl methylphosphonofluoridate

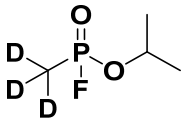
(i)

41 A CAS number is a unique numerical identifier assigned by CAS to every chemical substance described in the open scientific literature from at least 1957 to the present, including those of synthetic and biological origin. As a CAS number is only assigned if the chemical in question has been reported in the open scientific literature, some isotopically labeled chemicals related to those scheduled will not have a CAS number assigned to them.



Isopropyl-d7 methylphosphonofluoridate

(ii)



Isopropyl methyl-d3-phosphonofluoridate

(iii)

10. The Director-General requests the Scientific Advisory Board (SAB) to make technical recommendations on how any chemicals relevant to Schedules 1, 2 and 3 under the Chemical Weapons Convention should be considered in relation to the Convention if they contain isotopic labels; taking into account the SAB's previous advice on CAS registry numbers (RC-2/DG.1, dated 28 February 2008, in paragraph 3.5 of the Annex).

Annex 3

DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE ADVICE ON STEREOISOMERS OF SCHEDULED CHEMICALS

1. The Chemical Weapons Convention (the Convention/CWC) allows States Parties to possess chemicals that are intended for purposes not prohibited by the Convention:

   a. ***Each State Party has the right, subject to the provisions of this Convention, to develop, produce, otherwise acquire, retain, transfer and use toxic chemicals and their precursors for purposes not prohibited under this Convention*** (CWC Article VI, paragraph 1).

2. With this right come obligations, including:

   b. ***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*** (CWC Article VI, paragraph 2).

3. To meet these obligations, and to ensure complete and accurate declarations by CWC States Parties to the OPCW[42], chemicals that fall under Schedules 1, 2, and 3 of the Convention must be clearly identifiable.

4. Some Schedule 2 chemicals that can exist as distinct stereoisomers have presented ambiguity in how they should be declared.

5. Stereoisomers are molecules with identical molecular formula, which differ in their three-dimensional spatial orientation of atoms. Stereoisomers are defined by orientation of atoms around chiral centers within the molecular structure (a chiral center is an atom, usually a carbon atom, with four unique substituents bonded to it in a tetrahedral arrangement). Stereoisomers of some chemicals can be isolated (e.g., BZ).

6. The Annex on Chemicals to the Convention identifies chemicals covered by the Verification Annex using generic descriptions of classes of chemicals and for each scheduled chemical a specific chemical name and its corresponding Chemical Abstracts Service (CAS) registry number.

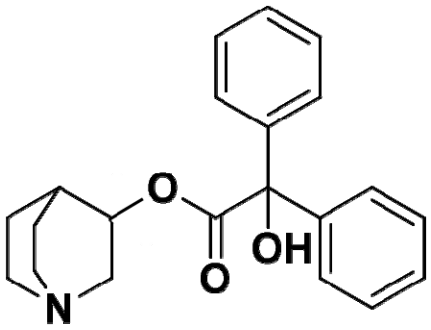
[42] Parts VI, VII and VIII to the Convention's Annex on Implementation and Verification set out the relevant requirements.

7. CAS numbers are intended to provide a unique, unmistakable identifier for chemical substances. However, a given stereoisomer of a chemical will have a unique CAS registry number that differs from the CAS registry number assigned, for example, for the related compound having undefined stereochemistry (e.g., a mixture of stereoisomers)[43].

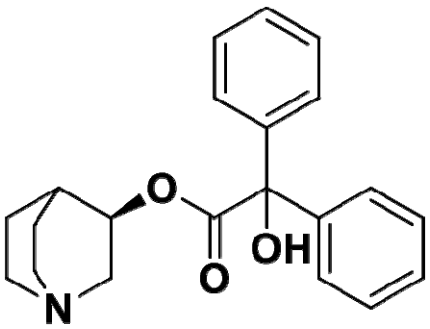
8. The Scientific Advisory Board (SAB) has cautioned that "there is not necessarily a one-to-one relationship between CAS registry numbers and chemical structures" and has advised that CAS registry numbers be considered aids to identification (RC-3/DG.1, dated 29 October 2012, paragraph 76; see also RC-2/DG.1, dated 28 February 2008, in paragraph 3.5 of the Annex).

9. 3-Quinuclidinyl benzilate (BZ; **i** in the illustration overleaf) illustrates the ambiguity for stereoisomers. BZ is listed in Schedule 2.A.03 to the Convention, with its chemical name and CAS number 6581-06-2; its structure is not shown in the Convention. BZ can exist, however, in two different steroisomeric forms (**ii** and **iii** in the illustration below): these stereoisomers have been assigned CAS numbers 62869-69-6 (**ii**) and 62869-68-5 (**iii**). If only the exact name and/or CAS number as listed in Schedule 2.A.03 were considered, stereoisomers might not be identified as scheduled chemicals.

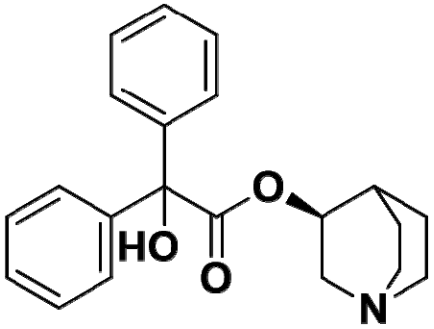
43 A CAS number is a unique numerical identifier assigned by CAS to every chemical substance described in the open scientific literature from at least 1957 to the present, including those of synthetic and biological origin. As a CAS number is only assigned if a chemical (in this case, a specific stereoisomer) has been reported in the open scientific literature, some stereoisomers of scheduled chemicals may not have a CAS number assigned to them.



i (3-quinuclidinyl benzilate with stereochemistry not indicated, CAS number 6581-06-2)



ii (CAS Number 62869-69-6)
(*R*)-3-quinuclidinyl benzilate



iii (CAS Number 62869-68-5)
(*S*)-3-quinuclidinyl benzilate

10. The Director-General requests the Scientific Advisory Board (SAB) to make technical recommendations on how stereoisomers of any chemicals listed on Schedules 1, 2 and 3 under the Chemical Weapons Convention should be considered in relation to the Convention; taking into account the SAB's previous advice on CAS registry numbers (RC-2/DG.1, dated 28 February 2008, in paragraph 3.5 of the Annex).

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