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Scientific Advisory Board

Twenty-Third Session
18 – 22 April 2016

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REPORT OF THE SCIENTIFIC ADVISORY BOARD AT ITS TWENTY-THIRD SESSION 18 – 22 APRIL 2016

1. AGENDA ITEM ONE – Opening of the session

1.1 The Scientific Advisory Board (SAB) met for its Twenty-Third Session from 18 to 22 April 2016 at the OPCW Headquarters in The Hague, the Netherlands. The session was chaired by Dr Christopher Timperley, with Mr Cheng Tang as the Vice-Chairperson.

1.2 A list of participants is contained in Annex 1 to this report.

2. AGENDA ITEM TWO – Adoption of the agenda

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

1. Opening of the session
2. Adoption of the agenda
3. *Tour de table* to introduce Scientific Advisory Board members
4. Establishment of a drafting committee
5. Welcome address by the Director-General
6. Overview of developments at the OPCW since the last session of the Scientific Advisory Board
   (a) General updates
   (b) Follow-up to the Scientific Advisory Board's recommendations on verification, the convergence of chemistry and biology and the Scientific Advisory Board's recommendations to the Third Review Conference[1]

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

(c) Industrial biobased chemical production relevant to Scientific Advisory Board recommendations

7. Developments in science and technology

(a) Chemical products from biomass

(b) Biological and Toxin Weapons Convention: Trends Workshop report

(c) Science and technology monitoring activities by the Technical Secretariat

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

(a) Science and technology relevant to contingency operations

(b) OPCW Biomedical Proficiency Test

(c) Analysis of chlorine exposure

(d) Plants as indicators of chemical agent use

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

(a) Response to the Director-General's request to provide advice on long-term stability of samples collected in relation to the potential use of chemical weapons

(b) OPCW *Practical Guide for Medical Management of Chemical Warfare* Casualties

(c) Late effects of exposure to organophosphorus agents: diagnosis and management

(d) TOXI-triage

(e) Science advice mechanisms: discussions regarding the Biological and Toxin Weapons Convention

(f) The Hague Ethical Guidelines

(g) Follow-up activities to Scientific Advisory Board recommendations on education and outreach, the Advisory Board on Education and Outreach, and OPCW education and outreach activities

(h) OPCW engagement with the scientific community

(i) Outreach activities by Scientific Advisory Board members

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

Response to the Director-General's request to provide advice on isotopically labelled scheduled chemicals and stereoisomers of scheduled chemicals

11. Central nervous system acting chemicals

(a) Review of previous Scientific Advisory Board advice on central nervous system acting chemicals

(b) Testing of recommended operation procedures for the detection of central nervous system acting agents

12. Future work of the Scientific Advisory Board

Preparation of the Scientific Advisory Board's recommendations to the Fourth Review Conference[2]

13. Any other business

14. Adoption of the report

15. Closure of the session

3. AGENDA ITEM THREE – *Tour de table* to introduce Scientific Advisory Board members

A *tour de table* was undertaken to introduce the SAB members. Six new members, Dr Zrinka Kovarik (Croatia), Professor Isel Pascual Alonso (Cuba), Professor Ponnadurai Ramasami (Mauritius), Ms Farhat Waqar (Pakistan), Dr Christophe Curty (Switzerland), and Dr Robert Mikulak (United States of America) attended their first session of the SAB. A list of participants is contained in Annex 1 to this report.

4. AGENDA ITEM FOUR – Establishment of a drafting committee

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

5. AGENDA ITEM FIVE – Welcome address by the Director-General

5.1 The Director-General of the OPCW welcomed the SAB members to the Twenty-Third Session of the Board, thanking the Chairperson, Vice-Chairperson, and the members of the board for their efforts in science engagement and briefings to States Parties—efforts that have given the SAB higher visibility across the disarmament community. The Board's experience featuring prominently in proposals put forth on science advisory mechanisms for the Biological and Toxin Weapons Convention (BTWC) in the lead-up to its Eighth Review Conference provides a timely example.

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

5.2 The importance of scientific advice in the work of the OPCW was emphasised, especially with regard to the designated laboratories' support of contingency operations, with the recognition that, in this time of change and transition in the mission of the OPCW, effectively preventing the re-emergence of chemical weapons will require ever greater levels of science policy-maker partnerships.

5.3 The Director-General expressed his appreciation of the work that came from the three recent temporary working groups (TWGs), on verification, education and outreach, and the convergence of chemistry and biology. He updated the SAB on some outcomes of the work of the TWGs—including augmentation of OPCW Laboratory capabilities and the establishment of an Advisory Board on Education and Outreach (ABEO). He further recognised that the SAB's continued engagement with technical experts from all regions of the world, along with their promotion of the science and technology (S&T) work of the Technical Secretariat (hereinafter "the Secretariat"), has helped to raise the prominence of the Chemical Weapons Convention (hereinafter "the Convention") within academia, scientific communities, industry, and civil society.

5.4 In his meeting with the SAB Chairperson and Vice-Chairperson, the Director-General expressed his support for the work of the Board and encouraged further engagement with the States Parties.

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

Subitem 6(a): General updates

6.1 The Secretary to the SAB, Dr Jonathan Forman, reviewed developments at the OPCW since the SAB's Twenty-Second Session. The update began with destruction and non-proliferation activities; these were then followed by an overview of the Medium-Term Plan (MTP) for the period 2017 to 2021 (EC-83/S/1 C-21/S/1, dated 8 April 2016).[3] The four results areas of the MTP were described: verification for continued confidence in compliance; capacity development to prevent and respond to the hostile use of toxic chemicals and to foster international cooperation; engagement to leverage others' capabilities; and an organisation that remains fit for purpose. Dr Forman noted that many of the individual medium-term goals across the results areas have S&T dimensions. Particularly noteworthy are medium-term goals 2 (augmented routine verification activities with a risk management system) and 4 (strengthened capability of the Organisation to monitor S&T developments of relevance to the Convention). These goals are supported through recommendations from the report of the TWG on verification[4] and the work of the SAB itself.

6.2 The briefing continued with an overview of the science and policy-maker engagement activities of the Board. These have included briefings to States Parties at the

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[3] Available at www.opcw.org/fileadmin/OPCW/EC/83/en/ec83s01_c21s01_e_.pdf

[4] Verification, Report of the Scientific Advisory Board's Temporary Working Group (SAB/REP/1/15, dated June 2015). Available at www.opcw.org/fileadmin/OPCW/SAB/en/Final_Report_of_SAB_TWG_on_Verification_-_as_presented_to_SAB.pdf

Twenty-Second Session of the SAB,[5] the Eightieth Session of the Executive Council (hereinafter "the Council") in October 2015,[6] the Industry Cluster in October 2015,[7] the BTWC Meeting of Experts in August 2015;[8] the BTWC Meeting of States Parties in December 2015;[9] and "Science for Diplomats" briefings held as side events during sessions of the Council and the Conference of the States Parties (hereinafter "the Conference").[10] Future engagements are planned for the forthcoming Spiez Convergence Workshop in September 2016 and the BTWC Eighth Review Conference in November 2016.

6.3 Dr Forman concluded with a description of OPCW Day, a celebration of the Nineteenth Anniversary of the OPCW to be held from 2 to 4 May 2016 at OPCW Headquarters.[11] The importance of S&T to the Convention, its implementation, and the future of the OPCW is a theme of this event.

Subitem 6(b): Follow-up to the Scientific Advisory Board's recommendations on verification, the convergence of chemistry and biology and the Scientific Advisory Board's recommendations to the Third Review Conference

6.4 Dr Stéphanie Daré-Doyen (from the Secretariat) updated the SAB on the status of SAB recommendations regarding Schedule 1 chemicals as unavoidable by-products. She recalled the SAB's conclusions on the matter (considered by the SAB at its Nineteenth Session) and explained how the issue was further addressed by the Secretariat following the recommendations of the Third Review Conference. The presentation focused especially on the "Technical Secretariat's Procedure for Handling Cases of Schedule 1 Chemicals as Unavoidable By-products" (S/1272/2015, dated 1 May 2015) which the Secretariat implemented on 1 July 2015 as an interim measure pending agreement among States Parties on a definitive procedure. This procedure applies when an inspection team discovers an unavoidable Schedule 1 nitrogen mustard or sulfur mustard by-product during an Article VI inspection.

6.5 Dr Daré-Doyen briefed the SAB on the status of the implementation of the recommendations on verification. After providing a summary of the work done by the TWG on verification, emphasis was put on actions to take forward the recommendations described in the Annex to the Note by the Director-General entitled

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5 Presentation is available at www.opcw.org/fileadmin/OPCW/Science_Technology/Diplomats_Programme/SAB-22_Briefing_to _States_Parties_11_June_2015.pdf

6 Presentation is available at www.opcw.org/fileadmin/OPCW/SAB/en/TIMPERLEY_EC-80_SAB_Briefing__7_October_2015__FINAL.pdf

7 Presentation is available at www.opcw.org/fileadmin/OPCW/SAB/en/TIMPERLEY_Industry_Cluster__VER_REP_.pdf

8 Presentation is available at http://www.unog.ch/80256EDD006B8954/(httpAssets) /6EA60986CAAE110CC1257EA40035B821/$file/TIMPERLEY+BWC+MX+Plenary+Briefing+(12+August+2015).pdf

9 Presentation is available at http://www.unog.ch/80256EDD006B8954/(httpAssets)/F43187301237067BC1257F1F0029E420/$file/OPCW_Briefing_to_2015_BWC_MSP.pdf

10 For more information on the Science for Diplomats briefings see www.opcw.org/special-sections/science-technology/science-for-diplomats/

11 The International Day for the Foundation of the Organisation for the Prohibition of Chemical Weapons: Chemical Safety and Security in a Technologically Evolving World. www.opcwday.org

"The Impact of Developments in Science and Technology in the Context of the Chemical Weapons Convention" (EC-80/DG.7, dated 28 August 2015),[12] as well as the initial action plan by the Secretariat issued as an informal non-paper in November 2015. The SAB was also briefed on the conclusions of the technical workshop held on 9 and 10 March 2016, which covered recommendations 8 and 9 of the TWG on verification and recommendation 18 of the TWG on the convergence of chemistry and biology.

6.6 The Secretary to the SAB briefed the Board on the status of recommendations made by the SAB to the Third Review Conference, as contained in the Director-General's response to those recommendations (RC-3/DG.2, dated 31 January 2013)[13] and on the recommendations contained in the report of the TWG on the convergence of chemistry and biology.[14]

6.7 After the Third Review Conference, 29 points of action had been identified (EC-77/DG.11, dated 5 September 2014).[15] The points of action for science and technology monitoring and for the OPCW Laboratory had been incorporated into appropriate work plans within the Secretariat. In regard to the points of action on knowledge and expertise, the OPCW missions in the Syrian Arab Republic provided an opportunity to review practical destruction methodologies. Information and best practices relevant to assistance and protection have been provided to the Secretariat through its Assistance and Protection Branch with its Protection Network, the recent hiring of staff with medical training, the recent requests for advice from the SAB, and through inspector training. Recommendations relevant to Schedule 1 chemicals and the meaning of "produced by synthesis" were described in the presentations of Dr Daré-Doyen. Dr Forman indicated one point on which no action was taken: the recommendation on exemptions from the current 30-day notification period for transfers of the Schedule 1 chemicals ricin and saxitoxin. He explained that taking this recommendation forward would require a technical change of the Convention.

6.8 Actions to take forward the recommendations of the TWG on the convergence of chemistry and biology were identified in the Director-General's response to the report of the Twenty-First Session of the SAB (EC-77/DG.10, dated 5 September 2014).[16] The recommendations fall into three general categories: monitoring, engagement (particularly with the BTWC), and verification. Recommendations on monitoring and keeping abreast of developments in S&T have helped shape the current monitoring activities of the Secretariat and will be taken forward into the report to the Fourth Review Conference. Engagement has taken place through interactive workshops and

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12 Available at www.opcw.org/fileadmin/OPCW/SAB/en/ec80dg07_e_.pdf

13 Available at www.opcw.org/fileadmin/OPCW/CSP/RC-3/en/rc3dg02_e_.pdf

14 Convergence of Chemistry and Biology, Report of the Scientific Advisory Board's Temporary Working Group (SAB/REP/1/14, dated June 2015). Available at www.opcw.org/fileadmin/OPCW/SAB/en/TWG_Scientific_Advisory_Group_Final_Report.pdf

15 Status of the Follow-Up to the Recommendations on Science and Technology Made to The Third Review Conference (EC-77/DG.11, dated 5 September 2014). Available at www.opcw.org/fileadmin/OPCW/SAB/en/ec77dg11_e_.pdf

16 Response to the Report of the Twenty-First Session of the Scientific Advisory Board (EC-77/DG.10, dated 5 September 2014). Available at www.opcw.org/fileadmin/OPCW/SAB/en/ec77dg10_e_.pdf

plenary presentations at the annual meetings of National Authorities in 2013, 2014, and 2015, and regular engagement with BTWC stakeholders is ongoing. With regard to verification, recommendation 18 (the meaning of "produced by synthesis") was considered by the TWG on verification; recommendation 19 (review of the technical feasibility of converting a bio-based chemical processing facility to produce chemicals of concern) is still to be taken forward.

Subitem 6(c): Industrial biobased chemical production relevant to Scientific Advisory Board recommendations

6.9 Dr Jonathan Forman presented an overview on the use of biotechnology in chemical production, using examples of industrial processes and the bioeconomy. His presentation discussed driving forces (in particular oil economics) and how they have shaped adoption, diffusion, and development of relevant technologies. He highlighted the trends that have changed since the publication of the report of the TWG on the convergence of chemistry and biology, noting that with recent low oil prices, biobased production of commodity chemicals is less economically attractive than at the time the report was produced, while the ability to use biomediated production methods for fine and speciality chemicals remains an area of interest and potential growth. Within the briefing, practical aspects and limitations of the use of biomediated processes for chemicals of concern and toxins were discussed. The presentation had previously been given to States Parties (at the March 2016 Industry Cluster meeting). The aforementioned recommendation to review the technical feasibility of converting a biobased chemical processing facility to produce chemicals of concern was raised by several States Parties as a path for resolving the issue of how to treat the need for declaration of biobased processes. Declaration practices for discrete organic chemicals produced by a biomediated process can be inconsistent across States Parties.

6.10 In the subsequent discussion, it was noted that the relevance to the Convention of the types of chemicals produced by biobased processes is of critical importance for resolving issues of how to treat these processes with regard to declarations. Large-scale industrial chemistry is likely to be better regulated than smaller-scale operations from which toxins (intended for therapeutic applications, for example) might be commercially produced.

7. AGENDA ITEM SEVEN – Developments in science and technology

Subitem 7(a): Chemical products from biomass

7.1 Professor Ferruccio Trifirò briefed the SAB on chemicals from biomass using the production of bioacrylonitrile and biobutanol as examples. Acrylonitrile can be obtained using different synthetic procedures from glycerol, glutamic acid or 3-hydroxy propionic acid. Butanol is used as a solvent and a fuel; the biotechnological processes that can be used to produce it were summarised.

7.2 In the subsequent discussion, the SAB agreed that industrial chemical and biobased chemical processes should be monitored.

Subitem 7(b): Biological and Toxin Weapons Convention: Trends Workshop report

7.3 Dr Piers Millet (guest speaker, Biosecure Ltd), briefed the SAB on a symposium to identify relevant trends in the biological sciences in preparation for the Eighth Review Conference of the BTWC. The symposium, held in Warsaw, Poland, in September 2015, was hosted by the Inter Academy Panel of the Global Network of Science Academies, in partnership with the Polish Academy of Science, the Royal Society of the United Kingdom of Great Britain and Northern Ireland, and the National Academy of Sciences of the United States of America.

7.4 Key conclusions included:

(a) Technological barriers to acquiring and using a biological weapon have been significantly eroded since the last review conference.

(b) While technology may bring greater risks, developments have also markedly improved the collective capacity to respond to public health threats (natural and deliberate) with increased speed and efficacy.

(c) No developments were identified that would not be covered by the BTWC or by additional understandings reached at subsequent review conferences.

(d) The speed of advances and of the convergence of scientific disciplines is accelerating; this increases the likelihood of developments relevant to the BTWC and the Convention.

(e) A process for reviewing developments in science and technology is needed, prior to Ninth Review Conference of the BTWC in 2021.

(f) There is an increased need for education and outreach to all those involved in the life sciences and biotechnology on issues relevant to the BTWC.

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

(a) The SAB expressed its appreciation to Dr Millet for his presentation.

(b) Technological advancements in the life sciences have greatly improved the ability to detect and respond to incidents of disease outbreaks.

(c) The fusion of knowledge as seen in modern science has an arms control impact through the way in which it undermines the protection of sensitive knowledge. This greater transparency may have the effect of improving security.

(d) The role and importance of tacit knowledge need more attention, as this has an impact on risk assessment.

(e) The review of developments in science and technology should also cover trends in the conduct of science, such as the globalisation of research.

Subitem 7(c): Science and technology monitoring activities by the Technical Secretariat

7.6 Dr Jonathan Forman updated the SAB on the Secretariat's activities in keeping abreast of S&T developments. He highlighted integration of existing and emerging technologies and informatics for applications in automated sample analysis (including drone-based systems), sensor arrays for chemical detection, and real-time environmental imaging and analysis. New technologies enabling the measurement of chemical signals with multiple data streams and smart sensors in the environment can be used to detect chemical change and thus represent a means to detect unusual chemical activity.

7.7 Dr Forman provided examples of the integration of advanced molecular biological methodologies and computational tools in toxicology and medical sciences. While there are many hurdles to overcome for robust predictive informatics tools, studies that have identified gene and protein expression patterns *in vitro* and in animal models are providing new insights into potential therapeutics for chemical agent exposure. For example, recent reports of cell lines with resistance to sulfur mustard illustrate research aimed at understanding molecular biological mechanisms related to the toxicology of blister agents.[17,18]

7.8 The briefing concluded with a discussion on capturing both the practical limitations and the relevance of developments being considered and how to address these issues in the SAB's report to the Fourth Review Conference.

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

(a) The SAB acknowledged the efforts required to scan across broad fields of S&T and draw connections and potential applications in the implementation of the Convention. The Board highlighted the value of the Secretariat's outputs in collecting and summarising a wealth of scientific subject matter and expressed appreciation to all Secretariat staff and their interns involved in these initiatives.

(b) The question of how well S&T is being monitored was raised. There is so much scientific literature generated that it would be impossible to capture it all. The best approach is to monitor several search streams and use networks of technical experts to share insights. This requires interaction with the broader scientific community (through professional and social networks and conference attendance). In this regard, the SAB encouraged its members to share publications of relevance that they come across with the Secretariat and to join and promote the Secretariat's science communication initiatives.[19]

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17 A. Schmidt, D. Steinritza, H. Thiermann; Development of the sulfur mustard resistant keratinocyte cell line HaCaT/SM; *Toxicology Letters* 244 (2016) 44–48.

18 M. Wolf, M. Siegert, S. Rothmiller, N. Scheithauer, R. Strobelt, D. Steinritza, F. Worek, H. Thiermann, A. Schmidt; Characterization of Sulfur Mustard Resistant Keratinocyte Cell Line HaCaT/SM; *Toxicology Letters* 244 (2016) 49–55.

19 See www.opcw.org/special-sections/science-technology/science-technology-monitor/

8. AGENDA ITEM EIGHT – Scientific and technological elements of verification technologies, emerging technologies, and new equipment

Subitem 8(a): Science and technology relevant to contingency operations

8.1 Mr Lennie Phillips, a Team Leader of the OPCW Fact-Finding Mission,[20,21,22] described the methods and approaches to the collection of information and explained how such information is most effectively analysed.

8.2 Mr Nihad Alihodzic and Mr Moez Hani from the Secretariat's Declaration Assessment Team (DAT) discussed technical aspects of their 15 missions to the Syrian Arab Republic from 2014 to 2016.

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

(a) While the mandates of the OPCW Fact-Finding Mission in Syria (FFM) and the DAT were different, similar areas in which their activities might benefit from access to alternative tools and technologies were identified. These include advanced methods for organising, analysing, and archiving large unstructured data sets; remote means of sample collection (such as the types of unmanned systems used in environmental and ecological research, where GPS[23] and visual tracking may have the potential to ensure chain of custody); and point-of-care diagnostics and on-site analysis.

(b) Innovation and improvisation in these missions are important as dangerous security situations and resource limited conditions can hinder and/or delay the team's ability to conduct a mission.

(c) In response to lessons learned from OPCW contingency operations, the Secretariat has established a Capacity-Building and Contingency-Planning Cell within the Inspectorate.

Subitem 8(b): OPCW Biomedical Proficiency Test

8.4 Dr Murty Mamidanna of the OPCW Laboratory briefed the SAB on the First OPCW Biomedical Proficiency Test (BioPT). Dr Mamidanna explained that the Convention permits collection of samples for investigations of alleged use (IAUs), which include toxic chemicals, munitions and devices, remnants of munitions and devices, environmental samples (air, soil, vegetation, water, snow, etc.) and biomedical samples from human or animal sources (blood, excreta, tissue, etc.). Under the Convention, the Director-General shall certify the laboratories designated to perform different types of analysis.

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20 Summary Report of the Work of the OPCW Fact-Finding Mission in Syria Covering the Period from 3 to 31 May 2014 (S/1191/2014, dated 16 June 2014).

21 Second Report of the OPCW Fact-Finding Mission in Syria, Key Findings (S/1212/2014, dated 10 September 2014).

22 Third Report of the OPCW Fact-Finding Mission in Syria (S/1230/2014, dated 18 December 2014).

23 GPS = global positioning system.

8.5 The OPCW proficiency tests are the procedure that the Secretariat has put in place to allow the Director-General to carry out this certification. Laboratories of Member States are invited to participate in these proficiency tests for analysis of environmental or biomedical samples. The process of designation of laboratories for analysis of biomedical samples through proficiency testing is different from the system followed for designation of laboratories for analysis of environmental samples.[24]

8.6 The aim of the BioPTs is to establish the technical competence of participating laboratories that are seeking designation for biomedical sample analysis. BioPTs are conducted once per calendar year and the laboratories must demonstrate that they have maintained their capability by successful reporting in each BioPT. The BioPTs are limited to certified non-infectious human urine and plasma matrices spiked with organophosphorus nerve agents, nitrogen mustards, or sulfur mustards, and associated biomarkers.

Subitem 8(c): Analysis of chlorine exposure

8.7 Dr Peter Siegenthaler (guest speaker, Spiez Laboratory) briefed the SAB on methodologies that the Spiez Laboratory has been developing for detecting chlorine exposure in environmental samples.

8.8 Dr Crister Åstot (guest speaker, Swedish Defence Research Agency) presented the results of research that has identified biomarkers from the reaction of inhaled chlorine with biomolecules present in the lung. The markers are detected in bronchioalveolar lavage fluid of exposed mice up to 72 hours after exposure and the data indicate that the markers appear specific to chlorine. A manuscript of the work is in preparation for publication in the scientific literature.

8.9 In the subsequent discussion of the two presentations, the following points were raised:

(a) The SAB expressed its appreciation to Dr Siegenthaler and Dr Åstot for their presentations.

(b) The methods presented are important developments for detecting exposure to chlorine, allowing analysis of environmental and biomedical sample types. The SAB, the Secretariat, and the designated laboratories would benefit from keeping a watching brief on further developments in this field of analysis.

Subitem 8(d): Plants as indicators of chemical agent use

8.10 Dr Christopher Timperley briefed the SAB on the concept of plants as indicators of nerve agent use, describing published reports from the Defence Science and

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[24] Designation of Laboratories for the Analysis of Authentic Biomedical Samples and Guidelines for the Conduct of Biomedical Proficiency Tests (C-20/DEC.5, dated 2 December 2015).

Technology Laboratory (Dstl).[25,26,27] Verification of compliance and IAUs of chemical weapons require accurate detection of chemical warfare agents and their degradation products. Detection of chemical warfare agents such as organophosphorus nerve agents in the environment relies mainly upon analysis of soil. Vegetation also provides a potential sample for analysis. A method for the detection of the nerve agent VX and its hydrolysis products by gas chromatography and liquid chromatography-mass spectrometry of ethanol extracts of contaminated white mustard plants (*Sinapis alba*) was presented. Plants grown in loam, sand, or clay retained the compounds of interest. They acted as a time capsule for retaining the evidence of the prior presence of the nerve agent in soil (for longer than the evidence could be retrieved from the soil itself). The study indicated that vegetation might be sampled in any allegation of use of nerve agents, with a good chance of identification of molecular evidence after analysis of the plant extracts.

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

(a) Chemical, physical, and microbiological changes in vegetation upon exposure to toxic chemicals might be exploited for detection during investigations. This warrants further consideration, possibly with a comprehensive literature review.

(b) The application of emerging technologies for recognising chemical signatures has been demonstrated in agriculture; this may be relevant for verification purposes.

9. AGENDA ITEM NINE – Further scientific and technological advice relevant to the Chemical Weapons Convention

Subitem 9(a): Response to the Director-General's request to provide advice on long-term stability of samples collected in relation to the potential use of chemical weapons

9.1 The SAB Chairperson summarised the key findings and executive summary of the SAB's response to this request. This topic required analysis of scientific literature and the experience of the designated laboratories to provide evidence-based advice. The request can be found in Annex 2 of this report.

9.2 In response to the question "Given the current storage conditions in the OPCW Laboratory (…), how quickly and through what process could the [aforementioned] types of sample (…) degrade to a point where analysis of the samples would likely no longer return credible results?", the SAB provided the following advice:

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25 M.R. Gravett, F.B. Hopkins, M.J. Main, A.J. Self, C.M. Timperley, A.J. Webb, M.J. Baker. Detection of the organophosphorus nerve agent VX and its hydrolysis products in white mustard plants grown in contaminated soil. *Analytical Methods* 5 (2013) 50-53.

26 M.R. Gravett, F.B. Hopkins, A.J. Self, A.J. Webb, C.M. Timperley, M.J. Baker. Evidence of VX Nerve Agent Use from Contaminated White Mustard Plants. *Proceedings of the Royal Society A* 470:20140076 (http://dx.doi.org/10.1098/rspa.2014.0076).

27 M.J. Baker, M.R. Gravett, F.B. Hopkins, D.G.C. Rees, J.R. Riches, A.J. Self, A.J. Webb, C.M. Timperley; Plants as Nerve Agent Detectors; *OPCW Today*, 3(1) (August 2014) 27–36. Available at http://www.opcw.org/fileadmin/OPCW/OPCW_Today/OPCW_Today_-_Vol_3_No_1.pdf

(a) Any chemical stored for a sufficiently long time, no matter what the storage conditions, can degrade to one or more products. If the chemical degrades entirely and is no longer observable in the sample, scientists can often reconstruct the identity of the original chemical from analysis of its breakdown products. These products in a sense constitute a "memory" of the original chemical. The situation for chemical warfare agents and related chemicals, such as precursors, is no different: their concentration may reduce upon storage, although their breakdown products will increase in concentration. This change, allowing the identity of the disappearing chemical to be pieced together from the molecules constituting the breakdown products, makes chemical analysis a powerful tool for retrieving evidence of chemical weapons use. Samples may also contain by-products of their synthetic route and unreacted starting materials, which will further enhance their analytical value. (To visualise how molecular breakdown products can be used to reconstruct the identity of the original chemical warfare agent, the non-scientist may wish to think about reconstructing a broken object, such as a vase, from its fragments. Similarly, in chemical forensics, the identity of a chemical warfare agent or precursor can be reconstructed from the types of breakdown products observed through sample analysis by designated laboratories). It must be noted, however, that if the agent or precursor is initially present only at trace level, prolonged storage may result in adsorption of the original chemical and/or its degradation product(s) to the container walls, for example. In such cases re-analysis could result in a non-finding of the original chemical and/or its degradation product(s) due to their presence in extremely low concentration, at levels below the instrument detection levels.

(b) The storage conditions used by the OPCW Laboratory will inevitably and naturally lead to loss of intact original chemicals by degradation in most cases (this phenomenon occurs in every laboratory in the world). It is impossible to put a precise time on how long any chemical will take to degrade, as shelf-life or degradation rate depends on the chemical structure, matrix, the presence of stabilisers and storage conditions, as well as the initial concentration of the chemical. It is only possible to estimate, with considerable uncertainty, a likely storage time, and impossible to state accurately when the various sample types will degrade to a point where analysis would not identify the intact original chemical(s).

(c) However, it is possible to state that the intact original chemical(s) in the sample types stored in the OPCW Laboratory might degrade naturally in, at worst, weeks to months, and at best, months to several years. (In some cases, degradation is so slow that the intact agent is present for many decades.) The analysis of these samples will return credible analytical results, but with less specific information. The characteristic degradation compounds will still contain the molecular evidence for proving chemical warfare agent use, or in the case of other investigations, the presence of a Convention-related chemical.

(d) The main degradation of chemical warfare agents—and other Convention-related chemicals—in environmental samples occurs through reaction with water (hydrolysis) or oxygen in air (oxidation).

(e) To reduce the potential for degradation in the samples, as little time as possible should elapse from the time of collection of any sample to the time of analysis; lengthy delays of weeks to years may diminish the concentration of the intact original chemicals in the samples, but will not diminish their usefulness as evidence in IAUs or other Convention-related investigations.

(f) The following recommendations are made:

(i) **Recommendation 1**. Samples should be analysed as soon after collection as possible and the need for storage eliminated or, less favourably, the storage time minimised. Prompt analysis should be viewed as urgent, as the intact original chemicals will provide the strongest basis for confirming the use of chemicals prohibited by the Convention. This is because the sample stability, and potential impacts of any matrix or environmental factors on the stability of any Convention-relevant chemicals in the sample, will not be known prior to analysis.

(ii) **Recommendation 2**. Further work on the storage of samples just after sampling and during transport to the OPCW Laboratory, sample handling during splitting, handling, and storage of samples at the OPCW Laboratory, should be pursued.

9.3 In response to the question "What are the best-practice conditions for long-term storage of the types of sample (…)?", the SAB provided the following advice:

(a) The SAB has reviewed the scientific literature, and the answers to a SAB questionnaire returned by nine OPCW designated laboratories, on the best-practice conditions for the sample types described.

(b) Based on the findings, to optimise the conditions for reduced degradation of the Convention-relevant chemicals in the samples, the following recommendations are made:

(i) **Recommendation 3**. Commercial chemical samples should be stored in glass containers with Teflon-lined caps in the dark; those in:

a. Schedules 1A01, 1A02, 1A03, 1A06, 1B09, 1B10, 1B11 and 1B12 at -18° C under argon (to enable stability for 5-10 years);

b. Schedules 1A04 and 1A05 at room temperature (for stability > 10 years); and

c. Schedule 1A08 (ricin) as a precipitate in 6 M ammonium sulfate at 4° C (for stability > 10 years).

(ii) **Recommendation 4**. Extracts of chemicals should be made in dichloromethane and stored in glass containers at 4° C with Teflon-lined caps in the dark, to ensure stability of the intact original chemical for up to one year. Swabs or wipes should be analysed within one month of

collection or otherwise disposed of due to likely storage instability; wherever possible they should be extracted as soon as possible into dichloromethane and the extracts stored instead.

(iii) **Recommendation 5**. Highly heterogeneous unprocessed samples—such as soil, metal fragments, paint chips, or fragments of highly absorbent material—containing relatively high levels or trace levels of the chemicals of interest, should be stored in sealed glass or high-density polyethylene containers at -18° C, to guarantee the stability of the samples for up to six months.

(iv) **Recommendation 6**. Biomedical samples—for example, urine or plasma—should be stored in polypropylene or polyethylene **terephthalate** containers in a freezer at -80° C (except for whole blood, which should be refrigerated at 4° C) to ensure the integrity of the samples for as long as possible (up to several years).

(v) **Recommendation 7**. Larger volumes of chemicals/samples should be split into subsamples and the subsamples used for repeated analytical **manipulations**. This will reduce the number of warming-cooling cycles the samples have to encounter. This is important, especially for materials stored in a freezer or deep freeze (-80° C). It will also help to minimise degradation of the chemical(s) in the unused portions of samples.

(vi) **Recommendation 8**. Samples of neat scheduled chemicals required for **long**-term banking within the OPCW Laboratory should be flame-sealed in glass ampoules; the use of the flame-sealed ampoule technique appears to offer some storage and shipping advantages for which there is an evidence base.

9.4 In response to the question "Given the best-practice storage conditions (…), how quickly and through what process could the types of sample (…) degrade to a point where analysis of the samples would likely no longer return credible results?", the SAB provided the following advice:

(a) The previous comments in paragraph 9.2 on the uncertainties of prediction of shelf-lives of chemicals should be noted. Based on the review herein of processes by which Convention-relevant chemicals degrade, the SAB assesses that it is difficult, given the incomplete knowledge worldwide of the fate of chemical warfare agents and other Convention-relevant chemicals in different matrices, to specify precisely when analysis of a sample would likely no longer identify the intact original chemicals. The best-practice storage conditions provided in the answer to the previous question will extend the time the original chemical in the sample will persist. Although some loss of this chemical may occur even under these conditions, the analysis of the samples will return credible analytical results, but with less specific information. The characteristic degradation products and other chemical residues (such as synthesis by-products and unreacted starting materials) will still provide the

molecular evidence necessary for proving chemical warfare agent production, chemical weapons use, or other Convention-related compliance judgement.

(b) Further information on the provenance of the chemicals in a sample might be accessible by using chemical forensics. In this respect, the SAB recognises that attribution of chemical warfare agent use will become easier as the science of chemical forensics advances. These observations led the SAB to propose two additional recommendations relevant to addressing the Director-General's three questions:

(i) **Recommendation 9**. The Secretariat should monitor advances in sampling and analysis, and with the SAB, any new innovations relevant to chemical forensics.

(ii) **Recommendation 10**. A reference sample collection at the OPCW **Laboratory** should be kept to provide a range of chemical forensic options for current and future samples suspected of containing Convention-relevant chemicals.[28]

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

(a) The SAB expressed its appreciation to nine OPCW designated laboratories for their detailed responses to a questionnaire from the SAB requesting information of best-practice storage conditions.

(b) The SAB emphasised that if a chemical warfare agent or precursor is initially present in a sample only at "trace level", prolonged storage might result in adsorption of the chemical to the container walls or to degradation products that are present at levels below the instrumental detection limits. In such cases, reanalysis could result in a "false negative".

(c) The report of the SAB summarises the scientific literature on environmental and biomedical sample analysis and storage of chemicals relevant to the Convention. The report will be made available as an official document of the OPCW.

Subitem 9(b): OPCW Practical Guide for Medical Management of Chemical Warfare Casualties

9.6 Dr Shahriar Khateri (of the Secretariat's Assistance and Protection Branch) introduced the OPCW's recently published *Practical Guide for Medical Management of Chemical Warfare Casualties*.[29] The guidebook was developed by a team of medical experts from around the world who were invited by the Secretariat to

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[28] Retention of a sample reference collection would support two results areas of the MTP: "verification for continued confidence in compliance" and "capacity development to prevent and respond to the hostile use of toxic chemicals and to foster international cooperation" (EC-83/S/1 C-21/S/1).

[29] *Practical Guide for Medical Management of Chemical Warfare Casualties*, OPCW 2015. Available at www.opcw.org/fileadmin/OPCW/ICA/APB/Practical_Guide_for_Medical_Management_of_Chemical_Warfare_Casualties_-_web.pdf

contribute to the project in the context of the International Support Network for Victims of Chemical Weapons (C-16/DEC.13, dated 2 December 2011). The guidebook was launched during the Twentieth Session of the Conference in November/December 2015 and the updated version was published in April 2016. A copy of the updated version of the guidebook was distributed among the SAB members during this session.

9.7 In the subsequent discussion, the SAB noted the value of the publication and the OPCW's endeavour to ensure it remains up to date; it will be useful as educational material to support the newly established ABEO.

Subitem 9(c): Late effects of exposure to organophosphorus agents: diagnosis and management

9.8 Professor Mohammad Abdollahi outlined the late toxic effects of exposure to organophosphorus nerve agents. He described the symptoms, mechanisms of late toxicity, diagnosis, and possible management strategies. He emphasised that nerve agents can induce late toxic effects after a single high-dose acute exposure. The main late effects include:

(a) neurological and psychological complications;

(b) pulmonary and lung damage; and

(c) cardiovascular problems.

9.9 These complications are usually irreversible because of persistent structural and functional changes. Recovery can be achieved if the neurological lesions are in the peripheral nerve compartment, but those in the central nervous system are almost resistant to current management strategies. Examining blood acetylcholinesterase (AChE) and nerve conduction velocity can be helpful in diagnosis of the intermediate syndrome but not helpful for the study of chronic neuropathy.

9.10 Prolonged AChE inhibition, muscle necrosis, dysregulation of postsynaptic acetylcholine receptors, and oxidative stress are involved in the pathogenesis of delayed effects. Characteristics of the nerve agent such as high lipid-solubility, potential for accumulation in the human body, and duration of AChE inhibition are a factor in incidence and persistency of effects. There is no specific medical treatment for the late effects of nerve agents.

9.11 Some medications for the management of nerve agent-induced neuropathy (the most common late effect) depending on the severity of effects were described, together with current therapies used to treat these conditions. Advances in this field will arise from the development of drugs for treating neuropathies and the sharing of experiences and findings of medical doctors and scientists active in the field.

9.12 In the subsequent discussion, the SAB noted the importance of capturing and documenting the medical case histories of survivors of incidents involving nerve agents worldwide.

Subitem 9(d): TOXI-triage

9.13 Professor Paula Vanninen gave a short overview of the aims of the European Union-funded TOXI-triage project "Integrated and Adaptive Responses to Toxic Emergencies for Rapid Triage: Engineering the Roadmap from Casualty to Patient to Survivor". In this four-year project there are 18 partners and nine work packages. The project has seven specific objectives: accelerated delivery of situational awareness; command and control with secure, dynamic, and seamless communication; traceable point-of-care diagnostic tests with integrated casualty tracking; comprehensive field toolbox for chemical, biological, radiological, and nuclear (CBRN) threats for end users; protocol for the registration of biomarkers of injury from CBRN poisoning; establish a harmonised European framework for ethical and accountable civilian CBRN operations; establish a community of commerce; and deliver a commercial vision. Within this project, emerging technologies are also being explored; these include non-invasive breath analysis, remote piloted airborne systems, hyperspectral imaging, and aptamers. Results of the project will be available in 2019.

9.14 In the subsequent discussion, the SAB noted that knowledge gained from the TOXI-triage project could benefit the MTP (EC-83/S/1 C-21/S/1), specifically medium-term goal 5: "Augmented assistance and protection capabilities of the Organisation in support of its focus on the re-emergence of chemical weapons, both in terms of prevention and response".

Subitem 9(e): Science advice mechanisms: discussions regarding the Biological and Toxin Weapons Convention

9.15 Dr Robert Mikulak briefed the SAB on recent discussions concerning science advice mechanisms for the BTWC. Although the review of the BTWC takes into account any relevant scientific and technological developments, no procedure for doing so is specified. Initially, a few Member States provided their own analyses. Later, such analyses were supplemented by summaries prepared by the treaty Secretariat and groups of science academies and by discussions on agreed topics during annual one-week "meetings of experts". However, the lack of dedicated time and adequate expertise, as well as the lack of a means to sum up and assess the issues discussed, has led to a renewed effort to develop a better approach for adoption at the Eighth Review Conference in November 2016.

Subitem 9(f): The Hague Ethical Guidelines

9.16 Mr Cheng Tang spoke on the drafting process of The Hague Guidelines.[30] He mentioned that the Conference at its Nineteenth Session in December 2014 welcomed an initiative proposed by the Permanent Representation of Germany to draft a text of ethical guidelines for chemical professionals. The Conference also invited the Secretariat to inform the Council of its efforts for the advancement of the initiative and its objectives in close collaboration with relevant profession and chemical industry organisations. Two workshops on "Guidelines for the Practice of Chemistry

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30 See www.opcw.org/special-sections/science-technology/the-hague-ethical-guidelines/

under the Norms of the CWC"[31] were organised by the SAB with the support of the Secretariat on 11 March 2015, and on 17 and 18 September 2015 respectively. The text of The Hague Ethical Guidelines was discussed and finally agreed upon by chemistry practitioners from States Parties in all regions of the world at the second workshop in September 2015. The Conference acknowledged the establishment of "The Hague Ethical Guidelines" at its Twentieth Session in November/December 2015, encouraged States Parties, as well as the Secretariat and all relevant stakeholders, to promote awareness of these guidelines and their possible application, and asked the ABEO to contribute to this effort. The International Union of Pure and Applied Chemistry (IUPAC) has endorsed the guidelines.

9.17 The briefing was followed by a description of the text analysis of existing codes by Dr Jonathan Forman. A data set of 142 codes of ethics and codes of conduct (all in the English language) from nations in all regional groups, as well as international organisations, was analysed.[32] The collection includes contributions from scientific and engineering societies, academies of sciences, multinational industrial chemical companies, governmental agencies and institutions, and national and international organisations with relevance to chemistry. A hierarchical clustering analysis was performed using the QDA Miner Software Package (Provalis Research) which indicated that the only distinguishing characteristic of the documents was the type of organisations they were intended for; the codes use similar language and concepts independent of where they are produced and their intended purpose (e.g. ethics or conduct). The analysis had contributed to The Hague Ethical Guidelines workshops. The analysis shows the existence of many individual codes that are similar to one another. It was suggested that to engage stakeholders in discussions of codes and their uses, it may be best to give them guidelines and let them draft and discuss their own code in order for them to take ownership in its adoption.

9.18 Joseph Ballard (of the Secretariat's Office of Strategy and Policy) updated the SAB on the Secretariat's efforts to disseminate The Hague Ethical Guidelines. He explained that the experts involved in their drafting are the key to further dissemination. Furthermore, letters describing the guidelines had been sent to chemical industry organisations and National Authorities; there are additional plans to contact national chemical societies and chemistry focused journals.

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

(a) The SAB members are pleased that The Hague Ethical Guidelines are being discussed in other fora addressing responsibility in the practice of science.

(b) Some members of the SAB noted the challenges in developing codes of conduct and codes of ethics that are sufficiently broad and this is felt to be a potential weakness in the impact they have. However, many of the SAB members will work with relevant societies and associations to promote the development and implementation of such codes.

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31 CWC = Chemical Weapons Convention.

32 See www.opcw.org/fileadmin/OPCW/SAB/en/2015_Compilation_of_Chemistry_Codes.pdf

Subitem 9(g): Follow-up activities to Scientific Advisory Board recommendations on education and outreach, the Advisory Board on Education and Outreach, and OPCW education and outreach activities

9.20 Joseph Ballard briefed the SAB on activities to follow up on the SAB's recommendations on education and outreach, namely the establishment of the new ABEO and OPCW activities in that area. An overview was presented of the Organisation's changing context and the importance of education and outreach for the future implementation of the Convention.

9.21 The ABEO, which was established by the Conference at its Twentieth Session, is a direct consequence of the SAB's recommendations. Its first meeting would be held on 28 and 29 April 2016, and it would be mandated to provide both strategic and practical advice to the Secretariat and to States Parties on their education and outreach efforts. The ABEO would take S&T events into account in its work, and receive periodic reports on the work of the SAB. An overview was also presented of some of the OPCW's education and outreach tools and materials.

Subitem 9(h): OPCW engagement with the scientific community

9.22 Dr Jonathan Forman briefed the SAB on the Secretariat's science engagement activities since the previous SAB meeting. These included lectures and science projects for students, organising student projects with local universities, engaging with national and international scientific societies (especially the IUPAC, in which Dr Forman serves as an observer on the Committee for Chemistry Education), and an OPCW symposium planned to take place at the forthcoming IUPAC Chemistry Education Conference in Malaysia in August 2016.[33] Scientific engagement by the OPCW has been strengthened through collaboration with other international organisations, and by submitting publications to scientific and science diplomacy-related[34] fora (including in interactive fora such as ConfChem)[35] to maintain visibility within these communities. Engagement with scientists enables more effective monitoring of developments and trends in S&T and provides opportunities to promote the OPCW's education and outreach agenda. It was noted that the OPCW continues to expand the available Convention-relevant science materials through the OPCW public website. New initiatives from the OPCW's International Cooperation Branch on the subjects of green chemistry[36] and women in chemistry[37] were also noted.

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33 24th IUPAC International Conference on Chemistry Education (ICCE 2016). http://www.icce2016.org.my/

34 B. Maneshi, J.E. Forman, The Intersection of Science and Chemical Disarmament, *Science & Diplomacy*, 4(3) (September 2015). http://www.sciencediplomacy.org/perspective/2015/intersection-science-and-chemical-disarmament

35 2016 Spring ConfChem: Science, Disarmament, and Diplomacy in Chemical Education: The Example of the Organisation for the Prohibition of Chemical Weapons. http://confchem.ccce.divched.org/2016SpringConfChem

36 See www.opcw.org/news/article/opcw-convenes-inaugural-experts-group-meeting-on-green-chemistry/

37 Call for Nominations for a Symposium on Women in Chemistry and a Basic Analytical Course for Women Chemists, The Hague and Rijswijk, the Netherlands, 17 – 20 May 2016 (S/1350/2016, dated 8 February 2016). Available at www.opcw.org/fileadmin/OPCW/S_series/2016/en/s-1350-2016_e_.pdf

9.23 In the subsequent discussion, the SAB noted that the experiences of the Secretariat in science engagement (including student projects, informative infographic materials, and hands-on science with children) could be of interest to the newly formed ABEO.

Subitem 9(i): Outreach activities by Scientific Advisory Board members

9.24 SAB members described the outreach activities in which they were involved. These included holding university lectures and seminars; 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; 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 sampling and analysis in environmental issues, such as those associated with legacy chemical weapons; 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; and engaging with colleagues and students informally as opportunities present themselves.

10. AGENDA ITEM TEN – Scheduled chemicals and advice on the Annex on Chemicals: isotopically labelled scheduled chemicals and stereoisomers of scheduled chemicals

Response to the Director-General's request to provide advice on isotopically labelled scheduled chemicals and stereoisomers of scheduled chemicals

10.1 Professor David González presented a summary of the report prepared by the correspondence group, comprising Dr Christopher Timperley, Professor Roberto Martínez-Álvarez, and himself as a response to the Director-General's request to the SAB to provide advice on isotopically labelled scheduled chemicals and stereoisomers of scheduled compounds.

10.2 The presentation outlined the request and described examples of scheduled compounds for which isotopically labelled analogues or stereoisomers are known. Since Chemical Abstracts Service (CAS) numbers assigned to each isomer or isotopically labelled analogue are unique, it was concluded that the CAS number of the parent compound by itself is not sufficient to identify an isotopically labelled variant or individual stereoisomer of a chemical listed on the schedules.

10.3 From the report, the following recommendations are made:

(a) **Recommendation 1**. The SAB recommends that the molecular parent structure of a chemical should determine whether it is covered by a schedule entry. This is because:

(i) it is inappropriate to rely solely upon CAS numbers to define chemicals **covered** by the schedules. Although relevant as aids to declaration and verification, CAS numbers should not be used as the means to identify a

chemical, or to determine whether a chemical is included in, or excluded from, a schedule;

(ii) thus, if a chemical is included within a schedule, then all possible isotopically-labelled forms and stereoisomers of that chemical should be included, irrespective of whether or not they have been assigned a CAS number or have CAS numbers different to those shown in the Annex on Chemicals. The isotopically labelled compound or stereoisomer related to the parent chemical specified in the schedule should be interpreted as belonging to the same schedule; and

(iii) this advice is consistent with previous SAB views on this topic (RC-2/DG.1, dated 28 February 2008 and Corr.1, dated 5 March 2008).[38]

(b) **Recommendation 2**. Inclusion of appropriate analytical data in the OPCW Central Analytical Database (OCAD) for isotopically labelled relatives of scheduled compounds, where available, is recommended.

10.4 This advice should help ensure in the future a consistent approach by States Parties to the declaration of isotopically labelled chemicals or stereoisomers of chemicals in the schedules. The report has been made available as an official document of the OPCW.[39]

11. AGENDA ITEM ELEVEN – Central nervous system acting chemicals

11.1 Technical discussions by the SAB on the potential use of toxic chemicals for law enforcement purposes, prior to the Third Review Conference, were exhaustive.[40] Noting that a joint paper by 23 States Parties on the aerosolisation of central nervous system acting chemicals for law enforcement purposes had been submitted to the Conference at its Twentieth Session C-20/NAT.2/Rev.2, dated 3 December 2015),[41] the SAB thought it appropriate to receive a briefing on this previous work.

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38 RC-2/DG.1, dated 28 February 2008. Available at www.opcw.org/fileadmin/OPCW/CSP/RC-2/en/RC-2_DG.1-EN.pdf

39 Response to the Director-General's Request to the Scientific Advisory Board to Provide Further Advice on Scheduled Chemicals (SAB-23/WP.1, dated 28 April 2016). Available at www.opcw.org/fileadmin/OPCW/SAB/en/sab-23-wp01_e_.pdf

40 Report of the Scientific Advisory Board on Developments in Science and Technology for the Third Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons (RC-3/DG.1, dated 29 October 2012). Available at www.opcw.org/fileadmin/OPCW/CSP/RC-3/en/rc3dg01_e_.pdf

41 Aerosolisation of Central Nervous System-Acting Chemicals for Law Enforcement Purposes (C-20/NAT.2/Rev.2, dated 3 December 2015). Available at www.opcw.org/fileadmin/OPCW/CSP/C-20/national_statemements/c20nat02r2_e_.pdf

Subitem 11(a): Review of previous Scientific Advisory Board advice on central nervous system acting chemicals

11.2 Dr Robert Mathews (guest speaker, APCML), who was a member of the SAB from 2005 until 2011, was invited to provide a presentation reviewing the previous consideration of incapacitating chemical agents by the SAB. Commencing in April 2010 at the Fifteenth Session of the SAB, the SAB considered the history of the development of incapacitating chemical agents since the 1950s, including the fact that no chemical has been discovered or developed that satisfies the requirements of being able to produce almost instantaneous incapacitating effects which will last for some hours with no health risks to the exposed individuals.

11.3 The history of the negotiation of the provisions of the Convention relevant to incapacitating chemical agents was also considered by the SAB, with the recognition by the SAB of the complexities presented by incapacitating chemical agents and their treatment under the Convention. At its Sixteenth Session (April 2011), the SAB further considered some of the problems of incapacitating chemical agents, particularly in regard to their safe use for law enforcement purposes, including hostage situations. The SAB recognised that chemicals such as fentanyl, which are considered to be safe when used under controlled medical conditions, can have a very low safety margin when delivered as an aerosol, based on factors including uneven dissemination, variability in human response, and a need for rapid onset of action. It was pointed out that some fentanyl analogues have lethality comparable to the organophosphorus nerve agent VX.

11.4 Issues associated with advances in S&T relevant to incapacitating chemical agents were further discussed at subsequent SAB meetings and at the Eighteenth Session of the SAB (April 2012). The SAB came to the view that despite recent advances, the currently available S&T does not have the capabilities required to enable the use of ICAs for law enforcement purposes in a safe manner.

11.5 The SAB at its Nineteenth Session (September 2012) considered that the discussion of the potential use of toxic chemicals for law enforcement had been extensive, but that the SAB may continue its discussion when additional technical information becomes available. The SAB recommended that the Secretariat commence preparations for verification activities that could be required during an IAU, including sample collection and the use of analytical data.

11.6 Dr Mathews also discussed the nomenclature, and explained why he considered that the term “central nervous system acting chemical” is more accurate than the term “incapacitating chemical agent”. He then briefly outlined the joint paper by 23 States Parties that had been submitted to the Conference at its Twentieth Session (C-20/NAT.2/Rev.2). This joint paper recommended that all States Parties provide their national position on the use of central nervous system acting chemicals for law enforcement purposes, and express their interest for further discussion by States Parties within the OPCW framework on the use of central nervous system acting chemicals for law enforcement, with the object of developing concrete recommendations as to how the OPCW should address central nervous system acting chemicals in a way that would assist in preventing the re-emergence of chemical weapons.

Subitem 11(b): Testing of recommended operation procedures for the detection of central nervous system acting agents

11.7 Professor Paula Vanninen gave an overview of the work done by Tatu Köli at the Finnish Institute for Verification of the Chemical Weapons Convention (VERIFIN) on testing methods for wipe samples published in the "Recommended Operating Procedures for Analysis in the Verification of Chemical Disarmament", volume 2011 (so-called Finnish Blue Book) for central nervous system acting chemicals. Three wipe sample materials were tested (namely cotton wipe, filter paper, cotton swabs). Some central nervous system acting chemicals were chosen to test the applicability of existing recommended operating procedures (ROPs). Two independent methods were able to be used for screening and identification of these chemicals. Identification was based on two spectrometric methods according to the OPCW identification criteria. Mass spectra were produced for the selected candidate chemicals and are to be submitted to the Validation Group for the updating of the OCAD. The results showed that the ROPs worked, with good recoveries for target molecules.

11.8 In the subsequent discussion of the two presentations, the following points were raised:

(a) The SAB expressed its appreciation to Dr Mathews for his presentation and noted the previous SAB discussions and views on central nervous system acting chemicals.

(b) Numerous comments highlighted that the general topic of central nervous system-acting chemicals remains of interest. A report of a workshop held in Spiez in 2011 contains additional background information.[42]

(c) The Secretariat should continue to monitor the open literature and alert the SAB to any significant technical developments.

(d) In reference to the SAB recommendations made to the Third Review Conference on developing analytical methods and procedures for central nervous system acting chemicals, as well as collecting analytical reference data for the analysis of such chemicals,[43] the SAB encourages collaboration between laboratories in OPCW Member States, with a view to supplying spectra and other data on central nervous system acting chemicals to the aforementioned Validation Group for evaluation.

(e) The SAB stands ready to respond to any technical questions on central nervous system acting chemicals that might be posed by the Director-General.

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42 Technical workshop on incapacitating chemical agents, Spiez, Switzerland, 8 and 9 September 2011. Available at http://www.labor-spiez.ch/de/dok/hi/pdf/web_e_ICA_Konferenzbericht.pdf

43 See footnote 40.

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

Preparation of the Scientific Advisory Board's recommendations to the Fourth Review Conference

12.1 The SAB discussed its future work. Given the need to assess developments in S&T and make recommendations to the Director–General and the States Parties prior to the Fourth Review Conference, two SAB sessions need to be held in 2017. With the Fourth Review Conference to be held in late 2018, the SAB tentatively scheduled its next four sessions as follows:

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

(b) Twenty-Fifth Session: April 2017;

(c) Twenty-Sixth Session: October 2017; and

(d) Twenty-Seventh Session: April 2018.

12.2 Working toward the SAB's report on developments in S&T for the Fourth Review Conference, two workshops will be held in 2016, namely:

(a) VERIFIN will host a workshop on chemical forensics in Helsinki from 20 to 22 June 2016.

(b) The French General Secretariat for Defence and National Security (SGDSN) will host a workshop on chemical warfare agents, toxicity, emergency response and medical countermeasures with OPCW support. This will be held in Paris on 26 and 27 September 2016.

12.3 Trends in industrial chemical production and emerging technologies relevant to the Convention were identified as topics that could be useful to discuss in dedicated workshops in 2017; several options are being explored for co-organisation. The SAB's report on developments in S&T is to be issued six to nine months prior to the Fourth Review Conference, so that:

(a) States Parties will be able to take the scientific advice into account when formulating national positions;

(b) States Parties will be able to discuss S&T developments in preparation for the review conference; and

(c) the Secretariat will be able to take S&T advice into account when making substantive proposals to the review conference.

13. AGENDA ITEM THIRTEEN – Any other business

In the margins of this session, the SAB Chairperson and Vice-Chairperson continued to engage with the States Parties, and on 21 April they presented an overview of the activities of the SAB to representatives of the following States Parties: Algeria, Angola, Australia, Belgium, Brazil, Chile, China, Cuba, Denmark, El Salvador,

Finland, France, Germany, Ghana, Hungary, India, Iran (Islamic Republic of), Iraq, Ireland, Japan, Latvia, Lebanon, Malaysia, Mexico, the Netherlands, Norway, Saudi Arabia, Slovenia, Spain, Sweden, Switzerland, and the United States of America.

14. AGENDA ITEM FOURTEEN – Adoption of the report

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

15. AGENDA ITEM FIFTEEN – Closure of the session

The Chairperson closed the session at 16:55 on 22 April 2016.

Annexes:

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

Annex 2: (English only) Director-General's Request to the Scientific Advisory Board to provide Advice on Long-Term Storage and Stability of Samples Collected in Relation to Potential Use of Chemical Weapons

Annex 1

LIST OF PARTICIPANTS IN THE TWENTY-THIRD SESSION OF THE SCIENTIFIC ADVISORY BOARD[44]

	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.	Alonso, Isel Pascual	University of Havana, Cuba
4.	Martínez-Álvarez, Roberto	Complutense University, Madrid, Spain
5.	Baulig, Augustin	Secrétariat général de la défense et de la sécurité nationale, Paris, France
6.	Borrett, Veronica	BAI Scientific and Honorary Fellow University of Melbourne, Australia
7.	Curty, Christophe	Spiez Laboratory, Switzerland
8.	González Berrutti, David	Department of Chemistry, University of the Republic of Uruguay, Montevideo, Uruguay
9.	Kovarik, Zrinka	Institute for Medical Research and Occupational Health, Zagreb, Croatia
10.	Mikulak, Robert	United States Department of State
11.	Mourão, Nicia Maria Fusaro	Brazilian Chemical Industry, São Paulo, Brazil
12.	Ponnadurai, Ramasami	University of Mauritius
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[45]	Office for the Disposal of Japanese Abandoned Chemical Weapons, Ministry of National Defence, China
17.	Timperley, Christopher[46]	Defence Science and Technology Laboratory (Dstl), Porton Down, United Kingdom of Great Britain and Northern Ireland

44 Flerida Cariño and Syed K. Raza were not able to attend.

45 Vice-Chairperson of the SAB.

46 Chairperson of the SAB.

	Participant	Institution
18.	Trifirò, Ferruccio	Department of Industrial Chemistry, University of Bologna, Italy
19.	van Straten, Francois Mauritz	South African Nuclear Energy Corporation SOC Ltd, Pretoria, South Africa
20.	Vanninen, Paula	VERIFIN, Department of Chemistry, Faculty of Science, University of Helsinki, Finland
21.	Zaitsev, Volodymyr	Taras Shevchenko National University of Kyiv, Ukraine
22.	Waqar, Farhat	Pakistan Atomic Energy Commission
23.	Zina, Mongia Saïd	Faculty of Sciences of Tunis, Tunisia
24.	Åstot, Crister (guest speaker)	Swedish Defence Research Agency (FOI)
25.	Mathews, Robert (guest speaker)	Asia Pacific Centre for Military Law (APCML) at the University of Melbourne Law School
26.	Millet, Piers (guest speaker)	Biosecure Ltd.
27.	Siegenthaler, Peter (guest speaker)	Spiez Laboratory

Annex 2

DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE ADVICE ON LONG-TERM STORAGE AND STABILITY OF SAMPLES COLLECTED IN RELATION TO POTENTIAL USE OF CHEMICAL WEAPONS

1. In order to be fully prepared to analyse any chemical potentially present in a wide range of types of samples in support of various operational missions, the OPCW must be able to store samples over several years and analyse those samples with high accuracy at any point in time.

2. In the context of the OPCW's investigations and fact-finding missions the Secretariat has since 2013 received samples in relation to potential use of chemical weapons. These samples are stored at the OPCW Laboratory at room temperature or refrigerated at 4^{o} C.

3. Sample types (whether current or future)—containing chemicals of interest, such as various nerve and blister agents as well as their immediate precursors and degradation products—may include in particular:

   (a) relatively pure samples;

   (b) liquid (including extracts) and solid samples containing either relatively high levels or trace levels of the chemicals of interest;

   (c) highly heterogeneous unprocessed samples—such as soil, metal fragments, paint chips, fragments of highly absorbent material, or wipes—containing either relatively high levels or trace levels of the chemicals of interest; and

   (d) biomedical samples: blood, plasma, urine, tissue.

4. The Director-General requests the SAB to address the following questions:

   (a) Given the current storage conditions in the OPCW Laboratory (set out in paragraph 2), how quickly and through what process could the types of sample mentioned in paragraph 3 degrade to a point where analysis of the samples would likely no longer return credible results?

   (b) What are the best-practice conditions for long-term storage of the types of sample mentioned in paragraph 3?

   (c) Given the best-practice storage conditions set out in the SAB's answer to question 4(b) above, how quickly and through what process could the types of sample mentioned in paragraph 3 degrade to a point where analysis of the samples would likely no longer return credible results?

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