

**NOTE BY THE DIRECTOR-GENERAL****RESPONSE TO THE REPORT OF THE THIRTY-SEVENTH SESSION
OF THE SCIENTIFIC ADVISORY BOARD**

1. This Note presents the Director-General's comments on the report of the Thirty-Seventh Session of the Scientific Advisory Board (SAB) (SAB-37/1, dated 1 September 2023) and its ongoing work.
2. The role of science and technology in the ongoing efforts of the OPCW cannot be understated. Science underpins the Chemical Weapons Convention (hereinafter "the Convention") and forms the basis for the future direction of the Organisation. The OPCW will be able to leverage the latest technological approaches from the Centre for Chemistry and Technology (ChemTech Centre), allowing it to be best prepared moving forward. The SAB provides advice and recommendations that support the work of the Organisation, ensuring that it can keep pace with developments in science and technology, and ultimately assisting States Parties in the implementation of the Convention.
3. The Director-General appreciates the work of the Board since its last session, which culminated in the preparation of its comprehensive "Report of the Scientific Advisory Board on Developments in Science and Technology to the Fifth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention" (RC-5/DG/1, dated 22 February 2023). He also acknowledges the achievements of the SAB's Temporary Working Group (TWG) on the Analysis of Biotoxins, which concluded its mandate during the intersessional period, and notes that the TWG's final report¹ was adopted by the Board at its Thirty-Seventh Session. Now, with the Fifth Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention behind us, the SAB is embarking on another cycle of scientific and technological monitoring. Science and technology continue to advance at a rapid pace and the SAB will continue to play a critical role in preparing the Organisation to properly consider and, where possible, implement these advances in the context of its work.

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4. The SAB met for its Thirty-Seventh Session from 28 August to 1 September 2023 at the OPCW Headquarters in The Hague, the Netherlands. The session was chaired by Mr Günter Povoden, with Dr Andrea Leisewitz serving as Vice-Chairperson. The report of the session was issued as SAB-37/1.

¹ SAB/REP/1/23 (dated April 2023), attached as Annex 2 to SAB-37/1.



5. After carefully reading and reviewing the report of the Thirty-Seventh Session of the SAB, the Director-General is pleased to submit the following comments to the Executive Council.

RECOMMENDATIONS TO THE DIRECTOR-GENERAL (CONTAINED IN THE EXECUTIVE SUMMARY OF SAB-37/1)

6. The Director-General acknowledges the recommendations made by the SAB in the report of its Thirty-Seventh Session. He has carefully considered them.
7. Taking into account the SAB's recommendation regarding three different topics that would benefit from an in-depth review, the Director-General has decided to establish a new TWG on chemical forensics. He recognises that the ability to ascertain additional information about a given sample related to alleged use of a chemical weapon has become increasingly relevant and that this information can be derived from a sample's "chemical fingerprint". The chemical fingerprint is a unique chemical signature which can reveal information regarding the particular route used to make a toxic chemical and the source of the raw materials used. It may also be used to match samples of toxic chemicals that have been made in the same way or at the same time as a toxic chemical in another sample. The types of methods and analyses used to understand the chemical fingerprint are captured in the term "chemical forensics". The Director-General will determine the terms of reference and, with the assistance of the Chairperson of the SAB, the composition of the TWG in due course.
8. In regard to the TWG on the Analysis of Biotoxins, the Director-General agrees that the Secretariat should implement, where feasible, the recommendations made in the final report (SAB/REP/1/23). He notes that Secretariat staff are already moving forward with understanding how best to strengthen the Organisation's relationship with the Secretary-General's Mechanism for Investigation of Alleged Use of Chemical and Biological Weapons in regard to biotoxins. Likewise, the Secretariat has already conducted seven biotoxin analysis exercises with the aim of establishing a new proficiency test for the two scheduled biotoxins, ricin and saxitoxin, in the future.
9. The Director-General acknowledges the four themes suggested by the SAB for topical workshops. While all four themes are worthy of consideration, the Director-General is especially interested in the topic on hazard mitigation of chemical warfare agents, to establish current best practice in the area of medical countermeasures, detection, protection, and decontamination of new and emerging threat chemicals. The four new entries added to Schedule 1.A of the Annex on Chemicals to the Convention (hereinafter "the Annex on Chemicals"), in addition to other chemicals of increasing concern, like central nervous system-acting chemicals, require the Secretariat to have access to additional information related to their properties, appropriate personal protective equipment and medical countermeasures, and data associated with their unambiguous detection and identification. The Director-General asks the SAB, in conjunction with Secretariat staff, to hold a workshop on this topic. In addition, he calls on States Parties to be forthcoming with technical information that they may have on these compounds that will assist the Secretariat in conducting its work safely and efficiently.

THE NEWLY SCHEDULED CHEMICALS (PARAGRAPHS 15.1 TO 15.8 OF SAB-37/1)

10. States Parties adopted two decisions at the Twenty-Fourth Session of the Conference of the States Parties to add four new entries to Schedule 1.A of the Annex on Chemicals (C-24/DEC.4 and C-24/DEC.5, both dated 27 November 2019). This represents the first time that chemicals have been added to the Annex on Chemicals since the Convention entered into force, and demonstrates States Parties' willingness to update the Convention to ensure its continued relevance.
11. These newly scheduled chemicals comprise a single phosphonate nerve agent, a family of phosphonate nerve agents, a family of phosphate nerve agents, and a family of carbamate nerve agents. Full knowledge and understanding of the chemical and physical properties of these compounds is paramount to the Secretariat being able to safely inspect facilities handling them, investigating incidents of their alleged use, and providing assistance and protection to States Parties.
12. Dr Keunhong Jeong's research at the Korean Military Academy is helpful in starting to fill knowledge gaps related to the newly scheduled chemicals. Machine learning approaches to predict hazard and toxicity properties of these compounds is a useful first step in starting to understand how they may differ from traditional nerve agents. The Director-General asks the SAB to continue to understand how machine learning and generative artificial intelligence (AI) may be used to predict the properties of toxic chemicals.

NEW TECHNOLOGIES, APPROACHES, AND INNOVATIONS OF RELEVANCE TO THE OPCW (PARAGRAPHS 8.1 TO 8.8, PARAGRAPHS 20.1 TO 20.5, AND PARAGRAPHS 21.1 TO 21.6 OF SAB-37/1)

13. One of the most important tasks of the SAB is to stay abreast of new developments in science and technology. The research presented by Dr Michael Shevlin, Prof Hiroaki Suga, and Dr Adam Jakus is a reminder of the exciting progress taking place across scientific disciplines. The Director-General read with interest the summaries of their research activities presented to the SAB.
14. Oftentimes it is beneficial to have more data available, whether this be in relation to scientific experiments or investigations of alleged use. Additional data can often build confidence in derived results and the ensuing conclusions. In investigation settings, it may sometimes be easy to collect many samples, but the resulting chemical analysis often needs to be triaged as it is time- and resource-heavy. In research, both the experimentation and subsequent analysis may require extensive efforts. Research at MSD into both high-throughput experimentation (HTE) and high-throughput analysis (HTA) looks to be a promising approach to addressing the aforementioned bottlenecks in generating useful data. Particularly in chemical forensics research, where many samples need to be generated and analysed in order to build confidence in the results, HTE and HTA, combined with machine learning and deep learning, may prove instrumental in pushing the field forward.
15. Synthetic biology is bringing about a renaissance in medical treatment, allowing for therapeutics to be developed more rapidly and efficiently, as well as opening the door to personalised medicine. The research presented on artificial peptides at the University of Tokyo is revolutionising the discovery of novel therapeutics.

16. Additive manufacturing continues to mature. Where before only limited types of plastics could be extruded through hot nozzles to create rough three-dimensional objects of limited size, one can now use various types of technologies to print from diverse materials intricate objects on a wide variety of scales. The methods in bioprinting being developed by Dimension Inx will help bring forward custom medical solutions in treating tissue injuries and diseases.
17. The Secretariat provides assistance and protection to States Parties under Article X of the Convention. Medical countermeasures are an important aspect of assistance and protection; should an incident occur, then it is paramount that States Parties understand the correct antidotes and treatments available to counteract the effects of the toxic chemical involved. It is important that the Secretariat continue to monitor advancements in the field of medical countermeasures against chemical warfare agents.
18. The Director-General recognises the potential of the research of Prof Suga and Dr Jakus on the development of medical countermeasures and treatments to chemical warfare agent exposure. Prof Suga's work may be useful in designing new drugs to counteract the effects of toxic chemicals, while the work of Dr Jakus may help in tissue reconstruction following exposure to blister agents. Additionally, the ability to bioprint cells and/or tissue may hasten the development of a range of medical countermeasures that no longer would require animal testing to understand their efficacy.

NEW MEDICAL COUNTERMEASURES AGAINST PERCUTANEOUS INTOXICATION BY LOW-VOLATILITY (PERSISTENT) ORGANOPHOSPHORUS NERVE AGENTS (PARAGRAPHS 14.1 TO 14.7 OF SAB-37/1)

19. For low-volatility nerve agents, catch-up therapy appears to be an advance on the well-known, accepted treatments, such as atropine or midazolam, administered in cases of nerve agent poisoning. Catch-up therapy makes use of a scavenger chemical, in the form of a topical lotion, to neutralise skin-absorbed nerve agent before it reaches the bloodstream. It can be applied to the skin following exposure and does not preclude the use of traditional, still important antidotes.
20. The research on catch-up therapy presented by Dr Nissan Ashkenazi is an eloquent approach that will provide even more effective countermeasures against exposure to certain nerve agents. The Director-General hopes that research into medical countermeasures for chemical warfare agents will continue to be a priority for States Parties, especially considering the paucity of information publicly available on the four entries added in 2019 to Schedule 1.A of the Annex on Chemicals.

BIOMARKERS OF EXPOSURE TO TOXIC CHEMICALS (PARAGRAPHS 11.1 TO 11.5, PARAGRAPHS 13.1 TO 13.3, PARAGRAPHS 17.1 TO 17.10, PARAGRAPHS 18.1 TO 18.4, PARAGRAPHS 19.1 TO 19.5, AND PARAGRAPHS 23.1 TO 23.7 OF SAB-37/1)

21. Any incident of alleged use of a chemical weapon can present investigative challenges. Notably, proving that a chemical weapon was used at all can be difficult when there is no immediate opportunity to access the scene. Not all chemicals are persistent and one cannot find traces of the original chemical in samples if the chemical is no longer there. A relevant example is chlorine, which has been used as a chemical weapon in recent times and is not persistent.

22. Many chemicals, though, may leave markers behind in the form of reaction products with chemicals in living organisms or materials that were present during the exposure. Markers of exposure to toxic chemicals in human blood or urine are known to exist and can be particularly useful when proving somebody has been the victim of a chemical attack. However, markers of exposure may be present elsewhere on or in the human body as well. The work being conducted by Spiez Laboratory, among others, on identifying unambiguous markers of chlorine exposure in human hair is interesting.
23. Similarly, organisms other than humans may provide proof of a chemical attack in the absence of the intact toxic chemical used. The OPCW Plant Biomarker Challenge, funded by the European Union, is an innovative approach to finding out whether plants may act as sentinels to toxic chemical exposure via, inter alia, change in colour or morphology, or via adducts to proteins present in their tissue.
24. Five of the six teams participating in the Plant Biomarker Challenge presented their results during the session. These teams comprise the University of Buenos Aires in Argentina, the La Trobe Institute of Sustainable Agriculture and Food in Australia, the Netherlands Organisation for Applied Scientific Research (TNO) in the Netherlands, Usmanu Danfodiyo University in Nigeria, and the University of Belgrade in Serbia. The Director-General read the SAB's summary of each of the team's research and appreciates the efforts they made to identify creative approaches to use plants as sensors of exposure to toxic chemicals.
25. The Director-General asks the SAB to continue to pay close attention to this area of research. Any methods of unambiguous detection of chemical warfare agents that can be relied upon days, weeks, or even months after the exposure occurred could enhance the work of the Organisation. In particular, methods that provide information related to unambiguous exposure to chlorine gas are of specific interest.

**TEMPORARY WORKING GROUP ON THE ANALYSIS OF BIOTOXINS
(PARAGRAPHS 7.1 TO 7.4 OF SAB-37/1)**

26. Biotoxins are toxic chemicals that are produced by living organisms, and there have been cases of their weaponisation by non-State actors in recent years. Two biotoxins, ricin and saxitoxin, are in Schedule 1.A in the Annex on Chemicals. However, there are many more known biotoxins, and likely many unknown. The OPCW must stand ready to assist in the event of any alleged misuse of a toxic chemical. The Director-General therefore in early 2021 established a TWG of the SAB, upon the SAB's recommendation, to provide a review of the science and technology relevant to the analysis of biotoxins and considerations that need to be taken into account in investigations of their alleged use.
27. The final report of the TWG on the Analysis of Biotoxins was issued in April 2023 (SAB/REP/1/23) and adopted by the SAB during its Thirty-Seventh Session. The Director-General read the final report of the TWG in detail, and acknowledges the pertinent recommendations made by the Group. The Director-General thanks all the members of the TWG for their hard work on a complex topic. The final report of the Group, and the recommendations within, will be instrumental to the OPCW as it builds capability in the analysis of biotoxins.

UPDATES FROM THE IUPAC WORLD CHEMISTRY CONGRESS (PARAGRAPHS 9.1 TO 9.4 OF SAB-37/1)

28. The International Union for Pure and Applied Chemistry (IUPAC) held its biennial World Chemistry Congress in The Hague at the World Forum from 18 to 25 August 2023. The OPCW contributed to the conference, sending a number of its technical staff to participate in the scientific lectures and discussions, providing a booth in the exhibition hall where interested conferees could talk to OPCW staff to learn more about the Organisation, its work, and career opportunities, and hosting tours of the OPCW Headquarters and the ChemTech Centre.
29. The Director-General recognises the strong partnership between the two organisations, demonstrated by IUPAC's inclusion of the OPCW in the run-up to the conference and reciprocated by the OPCW's in-depth participation during the conference. The Director-General also notes the participation of a number of SAB members, who moderated and spoke in several focus sessions during the conference. He looks forward to a continued collaboration and to identifying additional areas where the OPCW and IUPAC can work together.

PRESENTATIONS BY MEMBERS OF THE SAB (PARAGRAPHS 22.1 TO 22.6 AND PARAGRAPHS 24.1 AND 24.2 OF SAB-37/1)

30. The SAB is comprised of experts in different disciplines, and they should regularly share their expertise and experience with the Board. The Director-General appreciates the presentations given by Prof Syeda Sultana Razia on hazardous chemical substitution, and by Prof Mostafa Ghanei on the recent allegations of chemical poisoning of Iranian schoolchildren.
31. There are advantages in trying, where possible, to replace toxic chemicals in industrial processes with less toxic ones. However, this is not a straightforward endeavour as industrial processes are often optimised for their efficiency and utility, with the chemical hazards being just one consideration; simply substituting one chemical for another is not often possible. Efforts should nevertheless still be made to decrease the need and use of toxic chemicals. Computer-aided tools, like generative AI, will assist researchers in identifying opportunities to substitute hazardous chemicals from chemical processes. The Director-General would like the Board to continue to follow this area of research to stay apprised of the latest developments in reducing the need for certain toxic chemicals.

UPDATES FROM THE OPCW TECHNICAL SECRETARIAT AND THE ADVISORY BOARD ON EDUCATION AND OUTREACH (PARAGRAPHS 6.1 AND 6.2, PARAGRAPHS 10.1 TO 10.3, PARAGRAPHS 12.1 AND 12.2, PARAGRAPHS 25.1 TO 25.4, PARAGRAPHS 26.1 TO 26.5, PARAGRAPHS 27.1 AND 27.2, AND PARAGRAPHS 28.1 TO 28.5 OF SAB-37/1)

32. The SAB's provision of advice depends not only on the ability to hear from experts in various scientific disciplines of relevance to the Convention and work of the Organisation, but also on the opportunity to hear from Secretariat staff on their technical work. Of particular importance is work related to the ChemTech Centre. The Director-General recognises the utility of the Board receiving regular briefings from technical staff who work in and/or with the Centre—to include the Laboratory and

the Inspectorate—and in non-routine missions. Secretariat staff can benefit from the SAB’s consideration of their technical work and can, in turn, provide the Board with updates that will enable them to better advise the Director-General. Furthermore, updates from the Advisory Board on Education and Outreach are beneficial to identify synergies between the two Boards, which both play a role in scientific education, and ensure that the SAB remains apprised of developments which may enhance its ability to provide effective scientific advice.

CLOSING REMARKS

33. The Director-General acknowledges the SAB Chairperson and Vice-Chairperson for their strong leadership of the Board. He notes the re-election of Mr Günter Povoden as Chairperson of the Board, and the election of Dr Imee Su Martinez as Vice-Chairperson, for 2024. He thanks Dr Andrea Leisewitz for her service as Vice-Chairperson over the last three years. The Director-General also thanks the five members of the Board who are completing their tenure by the end of 2023, namely: Prof Khaldoun Bachari of Algeria, Prof Syeda Sultana Razia of Bangladesh, Prof Vladimir Dimitrov of Bulgaria, Dr Yasuo Seto of Japan, and Dr Maciej Śliwakowski of Poland. Their dedication over the last six years has ensured that the SAB continues to produce high-quality scientific advice that has positively impacted the work of this Organisation.
34. Lastly, the Director-General expresses his thanks to all States Parties, organisations, and institutions that have financially assisted the work of the SAB.

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