

OPCW Scientific Advisory Board Briefing to States Parties

Friday 28 October 13:30 - 15:00

Ooms Room
(light lunch available from 13:00)

Christopher Timperley (SAB Chair) and Cheng Tang (SAB Vice-Chair)

"WORKING TOGETHER FOR A WORLD FREE OF CHEMICAL WEAPONS"





Developments since SAB-23





ORGANISATION FOR THE
PROHIBITION OF CHEMICAL WEAPONS

Working together for a world free of chemical weapons

SAB-23 The Hague April 2016





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2016



ORGANISATION FOR THE



OPCW

Eighty-Second Session
12 – 15 July 2016

Executive Council

EC-82/DG.13
7 June 2016
Original: ENGLISH

NOTE BY THE DIRECTOR-GENERAL IN THE CONTEXT OF THE CHEMICAL WEAPONS CONVENTION

1. This Note sets out the Director-General's views on the impact of developments in science and technology in the context of the Chemical Weapons Convention (hereinafter "the Convention") and includes comments on the report of the Twenty-Third Session of the Scientific Advisory Board (SAB) (SAB-23/1, dated 22 April 2016).
2. An understanding of developments in science and technology is crucial to the full and effective implementation of the Convention, as scientific and technological underpinnings are found throughout its articles. With reference to the current and highly visible work of the OPCW, scientific advice has been especially important in terms of the support of designated laboratories for contingency operations. In this time of change and transition in the mission of the OPCW, there is recognition that effectively preventing the re-emergence of chemical weapons will require ever greater levels of science policy maker partnerships.
3. A call for voluntary contributions to support the work of the SAB was issued in January this year (S/1344/2016, dated 29 January 2016). The Director-General encourages States Parties to carefully consider this Note.
4. The Director-General wishes to remind States Parties that three members of the SAB will complete their second term in 2016. States Parties wishing to submit nominations to the SAB must do so by 12 August 2016. Nominations can be submitted to the science policy adviser in accordance with S/1343/2016 (dated 28 January 2016).

RESPONSE TO THE REPORT OF THE TWENTY-THIRD SESSION OF THE SCIENTIFIC ADVISORY BOARD

5. The SAB met in The Hague, the Netherlands, for its Twenty-Third Session on 18 to 22 April 2016. The session was chaired by Dr Christopher T. (hereinafter "Mr Cheng Tang") as the Vice-Chairperson. The report of the session was issued as SAB-23/1.
6. In his opening remarks, the Director-General thanked the members of the SAB for their efforts in science and technology and for their engagement with and briefings to States Parties both inside and outside the OPCW. These engagements have brought greater visibility to the SAB and its work across the disarmament com

Much support expressed from Director-General and in statements from States Parties

(S/1343/2016(E) distributed 07/06/2016



OPCW

Scientific Advisory Board

Twenty - Third Session
18 – 22 April 2016

SAB-23/WP.1
28 April 2016
ENGLISH only

**RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE
SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE
ON SCHEDULED CHEMICALS**

1. RECOMMENDATIONS

1.1 The Scientific Advisory Board (SAB) has considered isotopically labelled scheduled chemicals and stereoisomers of scheduled compounds relating to the Convention according to the Director-General's requests (see Appendixes 1 and 2).

1.2 **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:

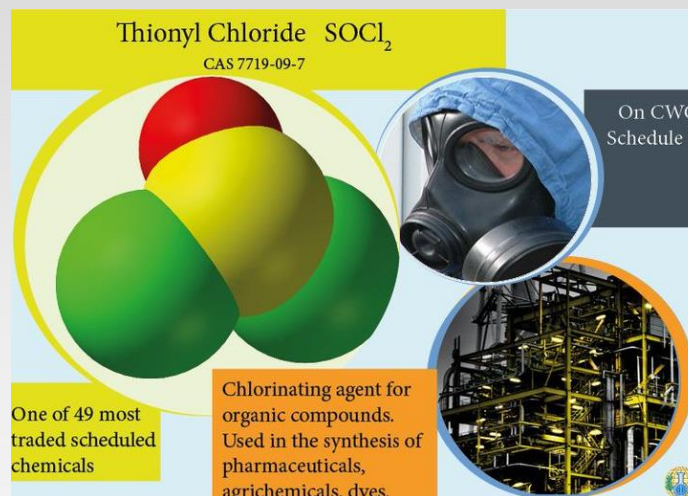
- (a) it is inappropriate to rely solely upon Chemical Abstracts Service (CAS) numbers to define chemicals covered by the schedules. Although relevant as aids to declaration and verification, CAS numbers should not be used as the means to identify a chemical, or to determine whether a chemical is included in, or excluded from, a schedule;
- (b) 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 to the Convention. 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
- (c) this advice is consistent with previous SAB views on this topic.¹

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

2. OBJECTIVE

2.1 At the Twenty-Second Session of the SAB in June 2015 [1]², the Technical Secretariat introduced a request from the Director-General (Appendixes 1 and 2) to make technical recommendations on how chemicals relevant to Schedules 1, 2 and 3 should be considered in relation to the Convention if they contain isotopic labels or can exist in distinguishable stereoisomeric forms; taking into account the SAB's previous views on CAS registry numbers [2].

Scheduled chemicals





Engagement on advice from SAB-23

SCIENCE FOR DIPLOMATS

**ISOTOPIC LABELS, STEREOISOMERS,
& SCHEDULED CHEMICALS**

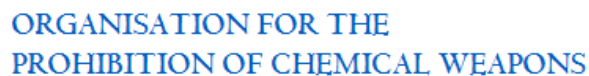
**WHY DOES THIS MATTER?
A REVIEW OF THE SAB'S ADVICE**

**WEDNESDAY 13 JULY 2016
13:30-15:00
OOMS ROOM
LIGHT LUNCH PROVIDED AT 13:00**

Isomers

- Enantiomers**: Mirror images of molecules.
- Diastereomers**: Non-mirror image stereoisomers.
- Conformers**: Different spatial arrangements of the same molecule due to rotation around single bonds.
- Structural**: Different connectivity of atoms.

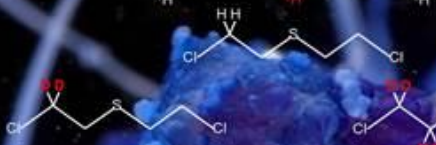
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Engagement on advice from SAB-23

**ISOTOPIC LABELS, STEREOISOMERS
& SCHEDULED CHEMICALS**

WHY DOES THIS MATT A REVIEW OF THE SAB'S

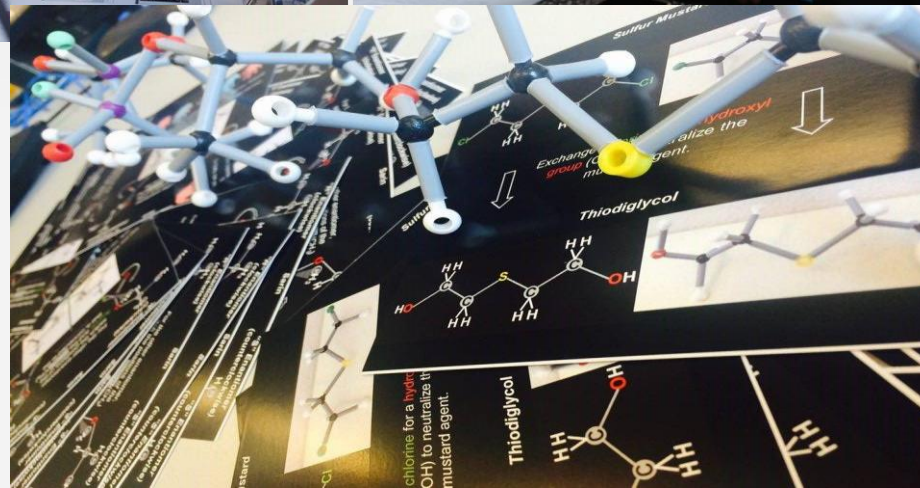
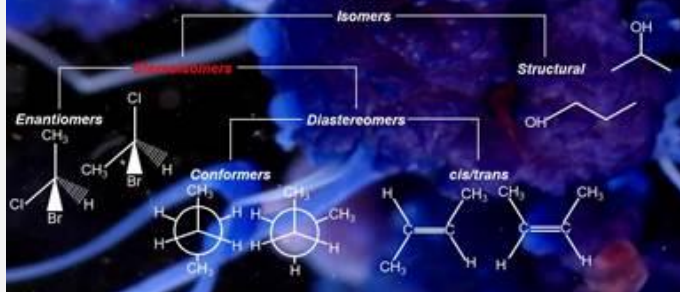


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Scientific Advisory Board

Twenty-Third Session
18 – 22 April 2016

SAB-23/WP.2
25 May 2016
ENGLISH only

RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON CHEMICAL WEAPONS SAMPLE STABILITY AND STORAGE

1. EXECUTIVE SUMMARY

1.1 The Scientific Advisory Board (SAB) has considered the long-term storage and stability of samples collected in the context of the OPCW's investigations, including fact-finding missions and the Declaration Assessment Team, according to the Director-General's questions of 2 November 2015 (see Annex 1).

1.2 In the context of the OPCW's investigations, the Technical Secretariat has since 2013 received numerous samples, which are stored in the OPCW Laboratory at room temperature or refrigerated at 4 °C.

1.3 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 for example:

- Relatively pure samples;
- Liquid (including extracts) and solid samples containing either relatively high levels or trace levels of the chemicals of interest;
- 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
- Biomedical samples: blood, plasma, urine, tissue.

1.4 The Director-General requested the SAB to address three overarching questions:

- Given the current storage conditions in the OPCW Laboratory, how quickly and through what process could the aforementioned types of samples degrade to a point where analysis of the samples would likely no longer return credible results?
- What are the best-practice conditions for long-term storage of the aforementioned types of samples?

Sample storage

Scheduled Chemicals under the Chemical Weapons Convention (CWC)

Schedule 1

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

- It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;
- It poses otherwise a high risk to the object and purpose of this Convention by virtue of its high potential for use in activities prohibited under this Convention because one or more of the following conditions are met:
 - It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparable properties;
 - It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
 - It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in multisteps or elsewhere;
 - It has little or no use for purposes not prohibited under this Convention.

Schedule 2

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

- It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;
- It may be used as a precursor in one of the chemical reactions at the final stage of formation of a chemical listed in Schedule 1 or Schedule 2, part A;
- It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;
- It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3

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

- It has been produced, stockpiled or used as a chemical weapon;
- It poses otherwise a risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;
- It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part A;
- It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals

Schedule 2 Part B, Precursors

Schedule 3 Part A, Toxic Chemicals

Schedule 1 Part B, Precursors

Schedule 2 Part A, Toxic Chemicals

Schedule 3 Part B, Precursors

Relationship between Schedules, Illustrated with author consent.

Scheduled chemicals are both scientifically and economically important as illustrated by the number of yearly publications that refer to them.



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Science for Diplomats at EC-83

Chemical Weapons Sample Stability and Storage

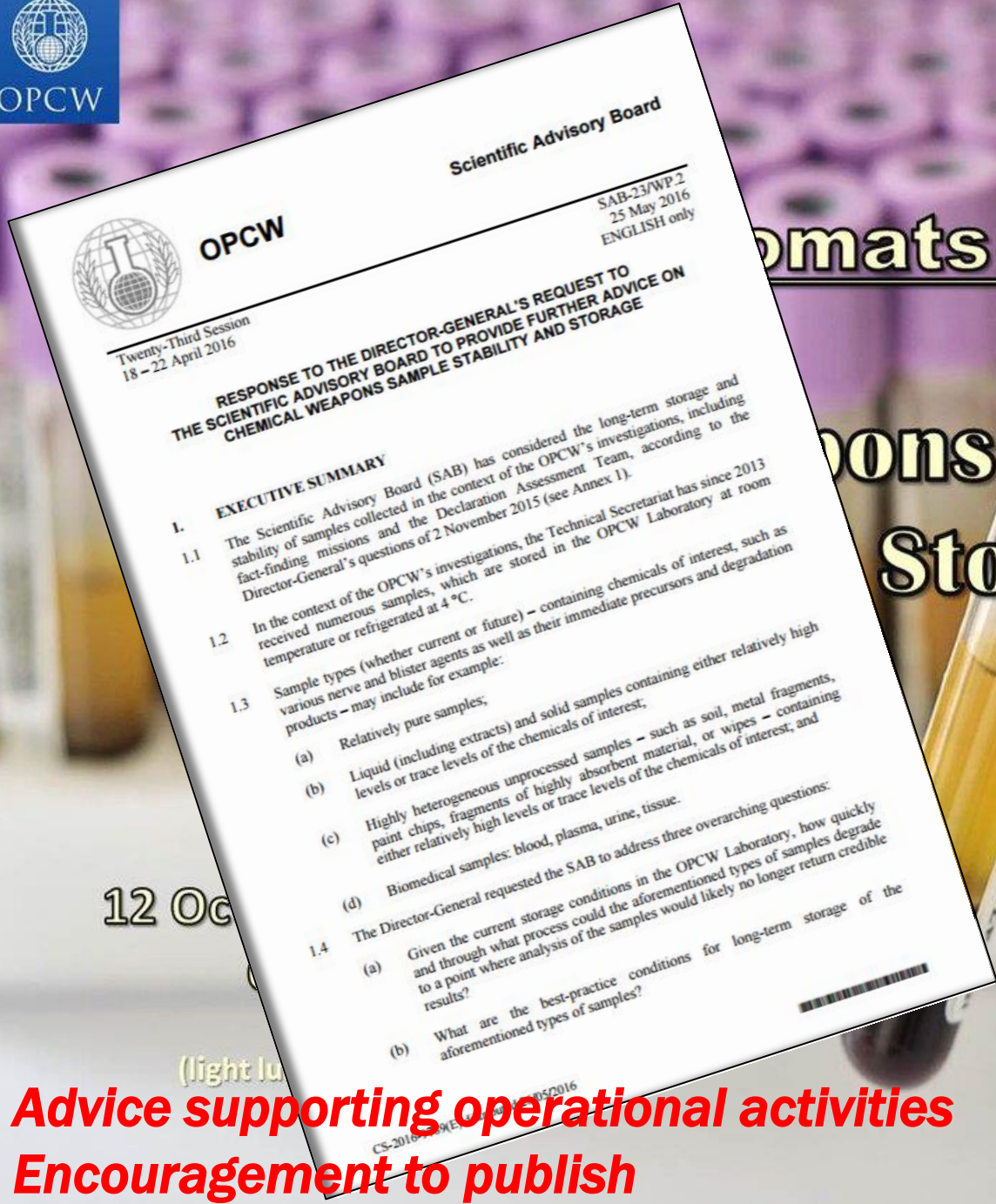
12 October 13:30 – 14:45

Ooms Room

(light lunch available at 13:00)



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OPCW

Twenty-Third Session
18 – 22 April 2016

Scientific Advisory Board

SAB-23/WP.2
25 May 2016
ENGLISH only

**RESPONSE TO THE DIRECTOR-GENERAL'S REQUEST TO
THE SCIENTIFIC ADVISORY BOARD TO PROVIDE FURTHER ADVICE ON
CHEMICAL WEAPONS SAMPLE STABILITY AND STORAGE**

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 - (d) Biomedical samples: blood, plasma, urine, tissue.
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 - (b) What are the best-practice conditions for long-term storage of the aforementioned types of samples?

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Storage**

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**Advice supporting operational activities
Encouragement to publish**





CWC/OPCW mentions from SAB members in scientific publications



DivCHED CCCE: Committee on Computers in Chemical Education

Home

TO JOIN

Contact Site Moderator
Dr. Robert E. Belford
(rebelford@ualr.edu)

2016 Spring ConfChem: Science, Disarmament, and Diplomacy in Chemical Education: The Example of the Organisation for the Prohibition of Chemical Weapons

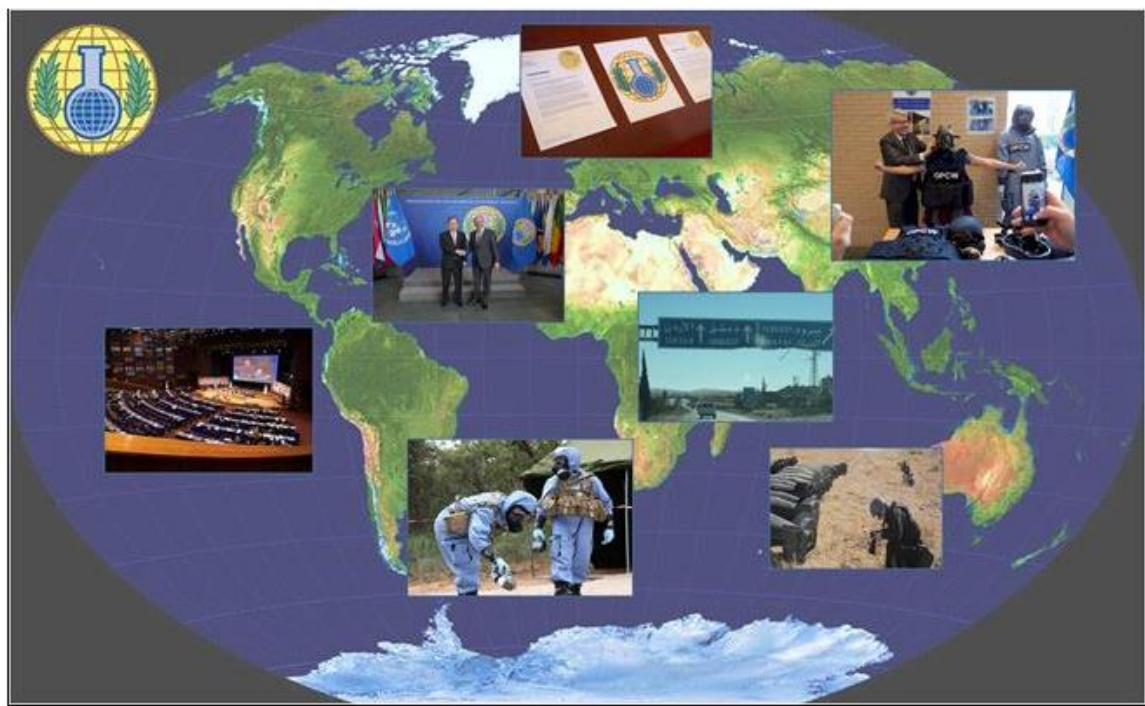
- May 2-6:** Education, outreach and the OPCW: growing partnerships for a global ban
- May 9-13** Education and Engagement: Key Elements to Achieve a World Free of Chemical Weapons
- May 16-20** Mainstreaming Multiple Uses of Chemicals in Chemistry Teacher Education Programs of Africa
- May 23-27** The project Irresistible: Introducing Responsible Research and Innovation into the Secondary School Classroom
- May 30-June 3:** Citizen Science and International Collaboration through Environmental Monitoring with Simple Chemical Sensors
- June 6-10:** Painful chemistry! From barbeque smoke to riot control
- June 13-17:** Sampling and Analysis of Organophosphorus Nerve Agents: Analytical Chemistry in International Chemical Disarmament



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CWC/OPCW mentions from SAB members in scientific publications



Education, Outreach and the OPCW: Growing Partnerships for a Global Ban

Joseph Ballard and Jonathan E. Forman

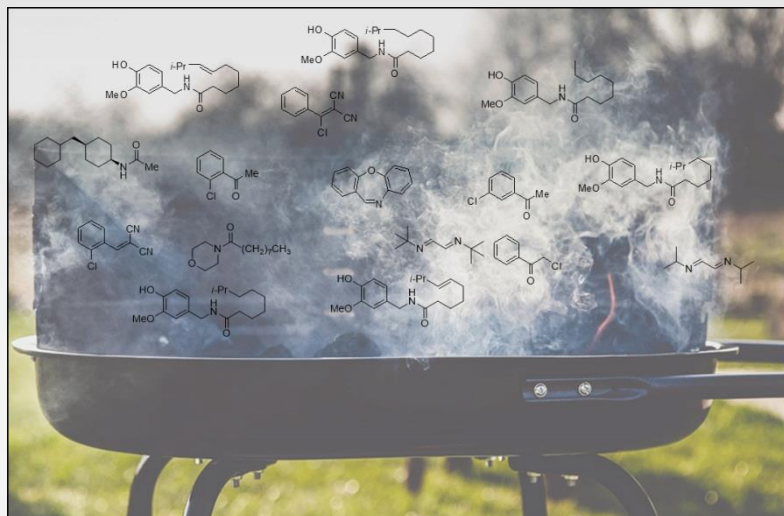


I U P A C

INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY



CWC/OPCW mentions from SAB members in scientific publications



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J. Am. Soc. Mass Spectrom. (2016)
DOI: 10.1007/s13361-016-1430-0

RESEARCH ARTICLE

GC-MS Study of Mono- and Bis(haloethyl)phosphonates Related to Schedule 2.B.04 of the Chemical Weapons Convention: The Discovery of a New Intramolecular Halogen Transfer

Nerea Picazas-Márquez,¹ María Sierra,¹ Clara Nova,¹ Juan Manuel Moreno,² Nuria Aboitiz,¹ Gema de Rivas,² Miguel A. Sierra,³ Roberto Martínez-Álvarez,³ Esther Gómez-Caballero²

¹Ingeniería de Sistemas para la Defensa de España (ISDEFE), Beatriz de Bobadilla 3, E-28040, Madrid, Spain

²Laboratorio de Verificación de Amas Químicas (LAVEMA), Área de Defensa Química, Subdirección General de Sistemas Terrestres, INTA, Campus La Maza, San Martín de la Vega, E-28330, Madrid, Spain

³Departamento de Química Orgánica, Facultad de Ciencias Químicas, Universidad Complutense, E-28040, Madrid, Spain



Abstract. A new class of compounds, mono- and bis-haloethylphosphonates (HAPs and bisHAPs, respectively), listed in Schedule 2.B.04 of the Chemical Weapons Convention (CWC), has been synthesized and studied by GC-MS with two aims. First, to improve the identification of this type of chemicals by the Organization for the Prohibition of Chemical Weapons (OPCW). Second, to study the synergistic effect of halogen and silicon atoms in molecules undergoing mass spectrometry. Fragmentation patterns of trimethylsilyl derivatives of HAPs were found to depend on the nature of the halogen atom; this was in agreement with DFT-calculations. The data suggest that a novel intramolecular halogen transfer takes place during the fragmentation process.

Keywords: Iodine transfer, Haloethylphosphonates, Chemical weapons convention

Received: 10 February 2016/Revised: 19 May 2016/Accepted: 24 May 2016



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Workshop on chemical forensics





OPCW

Scientific Advisory Board

Twenty-Fourth Session
25 – 28 October 2016

SAB-24/WP.1
14 July 2016
ENGLISH only

REPORT OF THE SCIENTIFIC ADVISORY BOARD'S WORKSHOP
ON CHEMICAL FORENSICS

1. EXECUTIVE SUMMARY

- 1.1 The OPCW Scientific Advisory Board (SAB) in cooperation with VERIFIN held a workshop,¹ “Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation”, from 20 to 22 June 2016 in Helsinki, Finland. The workshop is one of a series intended to inform the report of the SAB on developments in science and technology to the Fourth Review Conference² of the Chemical Weapons Convention to be held in 2018. Interest in chemical forensics, and its relevance to the work of the OPCW, has been described through Recommendation 17 of the OPCW SAB's Temporary Working group on Verification.³
- 1.2 Forensic science is defined as the study of traces (remnants of presence and/or activity).^{4, 5} These are silent witnesses that need to be detected, seen, and understood to make reasonable inferences about criminal phenomena, investigation or demonstration for intelligence, investigation and court purposes.
- 1.3 Chemical forensics aims to obtain information from chemical remnants that is relevant to investigative, legal and intelligence questions. Just as fingerprints and DNA can provide unique signatures that can be used to identify individuals, chemical samples can provide distinctive signatures (for example through their impurities

¹ Funding for the workshop was provided in part through project III (Science and Technology: Assessment of Developments in Science and Technology) of EU Council Decision (CFSP) 2015/259 dated 17 February 2015. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.043.01.0014.01.ENG

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

³ 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

⁴ Forensic science on trial. Proceedings of the Plenary presentations from the 20th ANZFSS International Symposium on the forensic sciences, Sydney 2010; *Australian Journal of Forensic Sciences*, 2011, 43:2-3, 89-103. <http://www.tandfonline.com/loc/tajf20/43/2-3>

⁵ C. Roux, F. Crispino, O. Ribaux; *Current Issues in Criminal Justice*, 2012, 24(1), 7-24. <http://www.austlii.edu.au/au/journals/CJCrimJust/2012/16.pdf>



Raid-M-100



Sabre 4000



APD 2000



ChemPro100



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Workshop on medical countermeasures





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Scientific Advisory Board

Twenty-Fourth Session
25 – 28 October 2016

SAB-24/WP.2
14 October 2016
ENGLISH only

REPORT OF THE SCIENTIFIC ADVISORY BOARD'S WORKSHOP ON CHEMICAL WARFARE AGENT TOXICITY, EMERGENCY RESPONSE AND MEDICAL COUNTERMEASURES

1. EXECUTIVE SUMMARY

- 1.1 The Organisation for the Prohibition of Chemical Weapons (OPCW) Scientific Advisory Board (SAB) in cooperation with the Secrétariat Général de la Défense et de la Sécurité Nationale (SGDSN) held a workshop on "Chemical Warfare Agents: Toxicity, Emergency Response and Medical Countermeasures" from 26 to 27 September 2016 in Paris, France.¹ The workshop was the second in a series intended to inform the report of the SAB on developments in science and technology to the Fourth Review Conference² of the Chemical Weapons Convention, which is to be held in 2018.
- 1.2 Effective emergency response and medical treatment form a frontline defence against the use of chemical agents. The more effective detection and alarm systems, protective equipment, decontamination equipment, medical antidotes and treatments become; the less effective are chemical weapons. Staying abreast of developments in science and technology related to the toxicology of chemical warfare agents (CWAs), clinical detection of exposure and medical response (both short- and long-term) is of vital importance. This importance is underscored by current events in the Syrian Arab Republic³ and growing concerns over the potential for the use of chemicals by terrorists. In this regard, understanding the molecular biological mechanisms and the chemistry⁴ through which chemical agents exert their toxic effects is critical for the development of more effective medical countermeasures and for the long-term treatment of survivors of exposure.
- 1.3 This workshop brought together experts from relevant scientific fields and stakeholders in chemical security to discuss and review current knowledge and

¹ Funding for the workshop was provided through the generous support of the SGDSN and also project III (Science and Technology: Assessment of Developments in Science and Technology) of EU Council Decision (CFSP) 2015/259 dated 17 February 2015.
http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJL_2015.043.01.0014.01.ENG

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

³ Third report of the Organisation for the Prohibition of Chemical Weapons-United Nations Joint Investigative Mechanism; (United Nations, S/2016/738, dated 24 August 2016). Available at: http://www.un.org/ga/search/view_doc.asp?symbol=S/2016/738

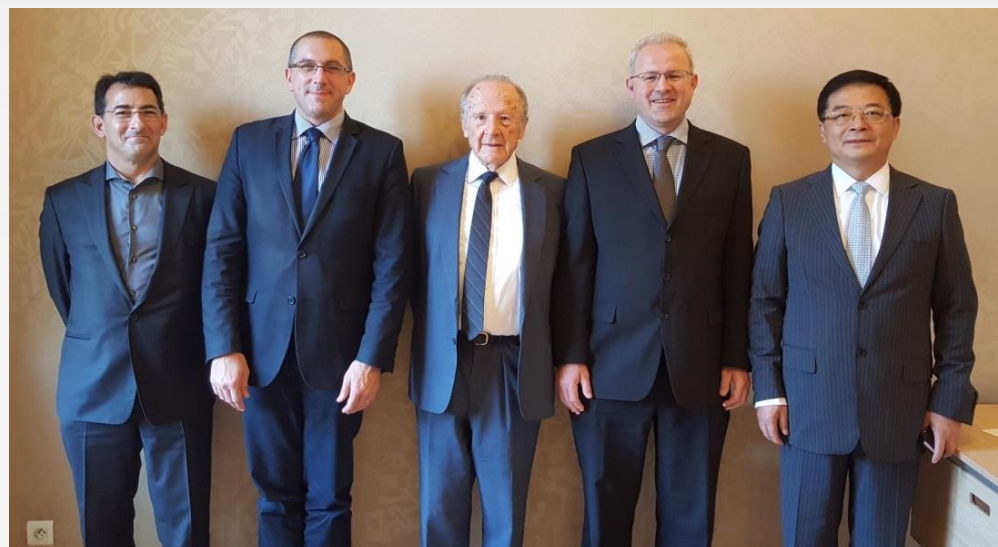
⁴ D. Ajami, J. Rebel, Jr.; Chemical approaches for detection and destruction of nerve agents; *Org. Biomol. Chem.*, 2013, 11, 3936-3942.



International workshop on chemical warfare agents: toxicity, emergency response and medical countermeasures

Maison de la chimie – Paris
September 26-27, 2016

*Co-organized by the General Secretariat for Defense and National Security
and the Organization for Prohibition of Chemical Weapons*





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SAB-24 The Hague April 2016





Updates from OPCW

- Status of SAB recommendations
- Activities of the Technical Secretariat on “Produced by Synthesis”
- Briefing from the Advisory Board on Education and Outreach
- Contingency operations
- Science and technology capacity in the Inspectorate
- Rapid Response Assistance Mission (RRAM)
- Unscheduled chemicals in the OPCW Central Agent Database



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SAB-24 : Developments in science & technology





Mahdi Balali-Mood
Mohammad Abdollahi *Editors*

Basic and Clinical Toxicology of Mustard Compounds

Springer

Late effects of exposure to sulfur mustard

Presentation by Prof. Mohammad Abdollahi



Delayed toxicity treatment

Skin:

Systemic antihistamine
Local emollients
Frequent baths
Sunscreen lotion and cream

• **Respiratory system:**

Beclomethasone inhaler
Bronchodilator (salbutamol + ipratropium)

Supportive care

focuses on the prevention of
infection and reduction of
pain.

• **Eye:**

- Artificial tears
- Therapeutic contact lenses
- Local/systemic corticosteroid
- Immunosuppressant (e.g. azathioprine)
- Corneal argon laser
- Keratoplasty



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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Bevölkerungsschutz BABS
LABOR SPIEZ

2nd Spiez CONVERGENCE

Workshop in Spiez, Switzerland

6 – 8 Sept. 2016



Dr Christophe Curty
SPIEZ LABORATORY





- In 2014 under the title **Spiez CONVERGENCE**, the Swiss Government started a workshop series focusing on advances in chemical and biological sciences.
- The series is dedicated to informing participants about significant scientific developments and to serve as forum for expert discussions.
- The objective of this workshop series is to identify developments in chemistry and biology which may at some point have implications for the Biological Weapons Convention (BWC) and the Chemical Weapons Convention (CWC).



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together For a World Free of Chemical Weapons

Recommendations From The OPCW Scientific Advisory Board's Report on Convergence of Chemistry & Biology

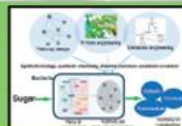
Recommendation 1

The SAB, or a suitable TWG, and the TS should continue to monitor advances in production facilities and technologies, and related trends such as outsourcing and modularisation of equipment. Assessments should be made on a periodic basis to determine their relevance to verification under the CWC. Regular engagement with subject matter experts, e.g. from the biotechnology industry, will be required.



Recommendation 2

The SAB should monitor developments in biological and biologically-mediated chemical production processes, such as metabolic engineering, synthetic biology and associated enabling technologies. Regular engagement with subject matter experts will be required.



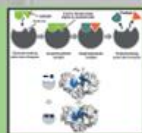
Recommendation 3

The SAB should continue to monitor the range of chemicals being studied and produced using biological or biologically-mediated processes.



Recommendation 4

The SAB, or a suitable TWG, should review advances in rational enzyme design prior to the next review conference.



Recommendation 5

The SAB, or a suitable TWG, should review the feasibility of using metabolic engineering or synthetic biology to obtain toxins prior to the next review conference.



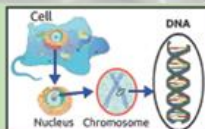
Recommendation 6

The TS should increase and maintain in-house knowledge of bioregulators, and possible applications of new developments in drug delivery.



Recommendation 7

The SAB, or a suitable TWG, should review the synthesis of replicating organisms prior to the next review conference.



Recommendation 8

The SAB, or a suitable TWG, should review progress in the use of enzymes for decontamination prior to the next review conference.



Recommendation 9

The OPCW should monitor advances in protective equipment and possible applications for OPCW personnel as they become commercially available.



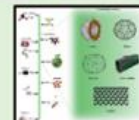
Recommendation 10

The OPCW should consider possible applications of diagnostic devices to on-site activities as they become commercially available.



Recommendation 11

The SAB should monitor advances in nanotechnology prior to the next review conference. Regular engagement with subject matter experts will be required.



Recommendation 12

The SAB and TS should examine ways to increase and maintain in-house, high level knowledge of a broader range of scientific disciplines.



Recommendation 13

A venue like the TWG on convergence of chemistry and biology should continue to exist, possibly as a temporary working group or a standing arrangement under the SAB.



Recommendation 14

National Authorities could be encouraged to engage more actively on convergence issues, including interacting with relevant biological and chemical scientific communities and hosting relevant events. A standing item on science and technology at National Authority Days might provide an opportunity to promote and report back on such an activity. Adopting convergence as a major theme for a future National Authority Day would help draw attention to this issue.



Recommendations 15 & 16

The SAB and TS should continue to work across areas of overlap between the CWC and the BWC. The Director-General might ask States to consider knowledge of the biological sciences when considering nominating experts to the SAB.



The TS, supported by the SAB, should continue to participate in such meetings and continue to address convergence.

Recommendation 17

The Director-General might consider meeting with the Chair of the BWC and heads of relevant international scientific bodies to explore issues around convergence.



Recommendation 18

Taking into consideration the convergence of chemistry and biology as it relates to the synthesis of chemicals, the TWG was of the view that any process designed for the formation of a chemical substance should be covered by the term "produced by synthesis".



Recommendation 19

The TS should review the technical feasibility of converting a bio-based chemical processing facility to produce chemicals of concern to the CWC.





The topics discussed by experts were :

- **Synthesis, modification, large molecules**
- **Additive manufacturing, 3D printing**
- **Genome editing**
- **Big data**
- **DNA origami**
- **Science and policy**

Spiez Convergence 2016

- *report in November 2016*

Spiez Convergence 2018

- *early September 2018*

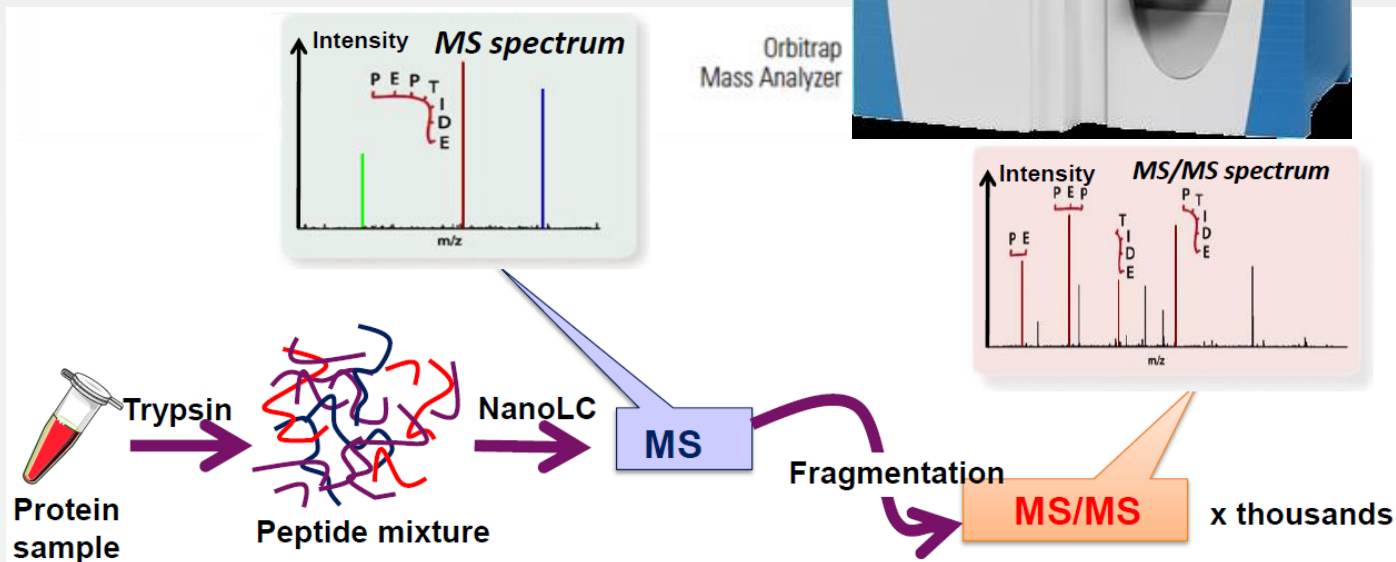




Dr J. Armengaud

Biomarker-based diagnostics

Rapid method for identifying specific proteins (e.g. ricin) within a complex mixture of proteins by mass spectrometry





These analytical methods can be applied to :



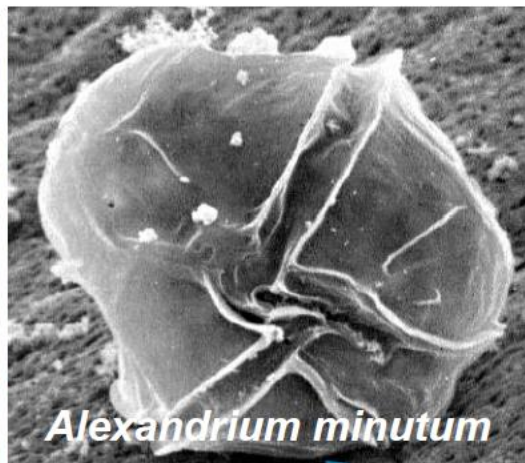
CBRN-relevant toxins & pathogens



Ricinus communis

Ricin

LD50: 3 µg/kg



Alexandrium minutum



Poison dart frogs



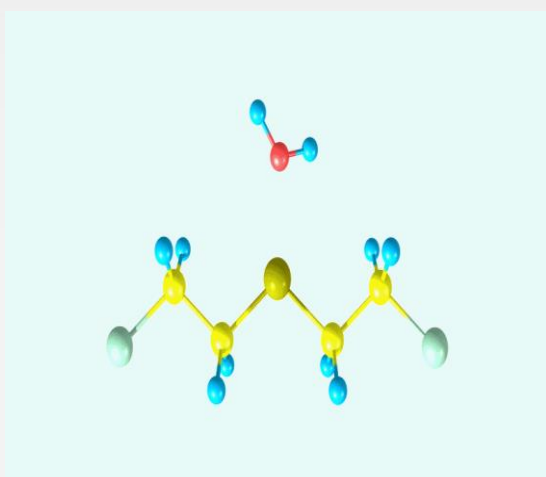
Lipophilic alkaloids



Computational chemistry as a tool to study chemical warfare agents

Computers can be used to calculate chemical processes

- rates of degradation of CWC Scheduled chemicals in the presence of water (i.e. environmental breakdown pathways, a knowledge of which assists lab analysis)
- the ways in which toxic chemicals interact with biological targets in the body (assisting knowledge of mechanisms of toxicity and insights in how to design improved medical countermeasure drugs/treatments)
- breakdown pathways of chemicals during analysis by mass spectrometry or other analytical techniques



Water (top) approaching
sulfur mustard (bottom)



Computational chemistry and a Nobel Prize



The Nobel Prize in Chemistry 2013

Martin Karplus, Michael Levitt, Arieh Warshel

The Nobel Prize in Chemistry 2013



© Harvard University
Martin Karplus



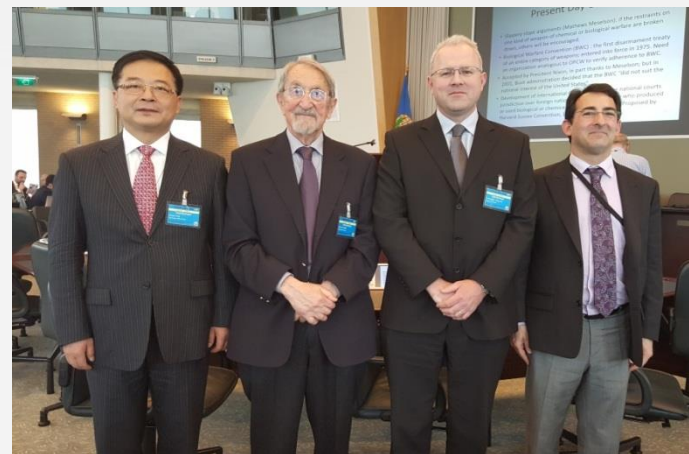
Photo: © S. Fisch
Michael Levitt



Photo: Wikimedia
Commons
Arieh Warshel

The computer – your Virgil in the world of atoms

Chemists used to create models of molecules using plastic balls and sticks. Today, the modelling is carried out in computers. In the 1970s, Martin Karplus, Michael Levitt and Arieh Warshel laid the foundation for the powerful programs that are used to understand and predict chemical processes. Computer models mirroring real life have become crucial for most advances made in chemistry today.





ORGANISATION FOR THE
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Working together for a world free of chemical weapons

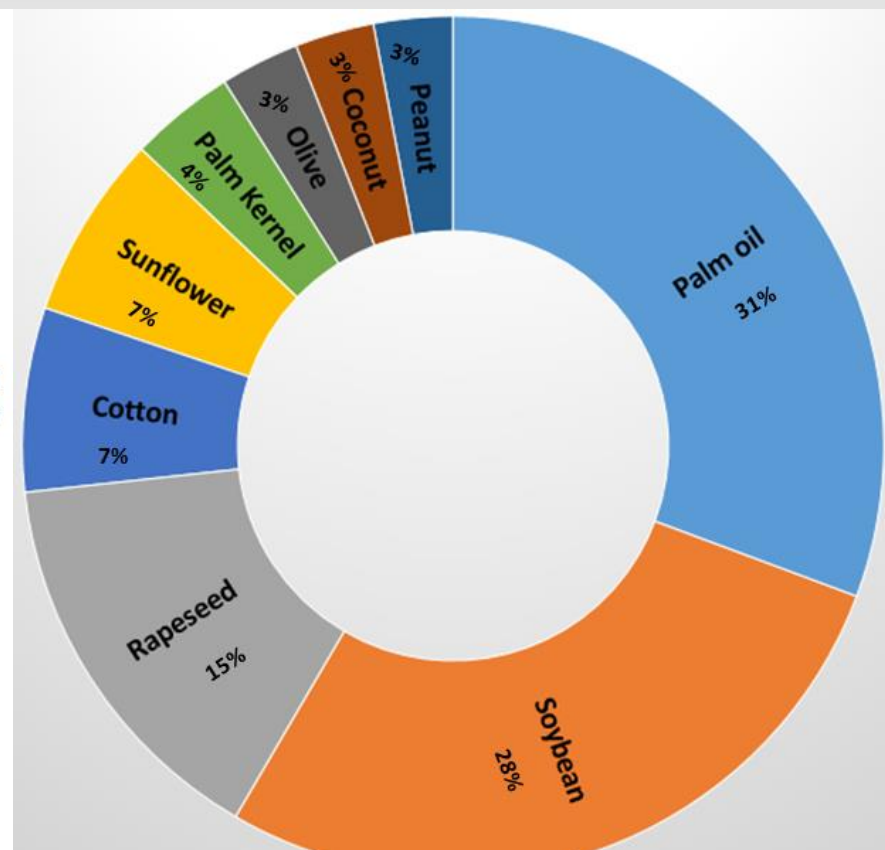
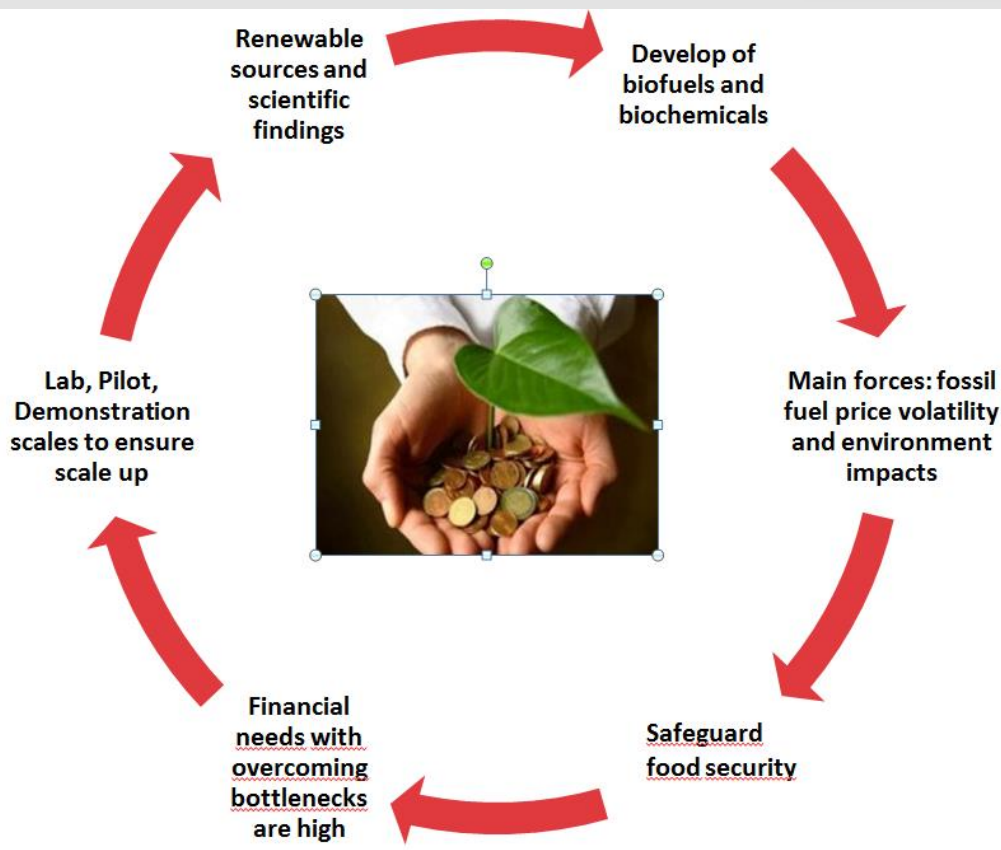
SAB-24 : Industrial developments





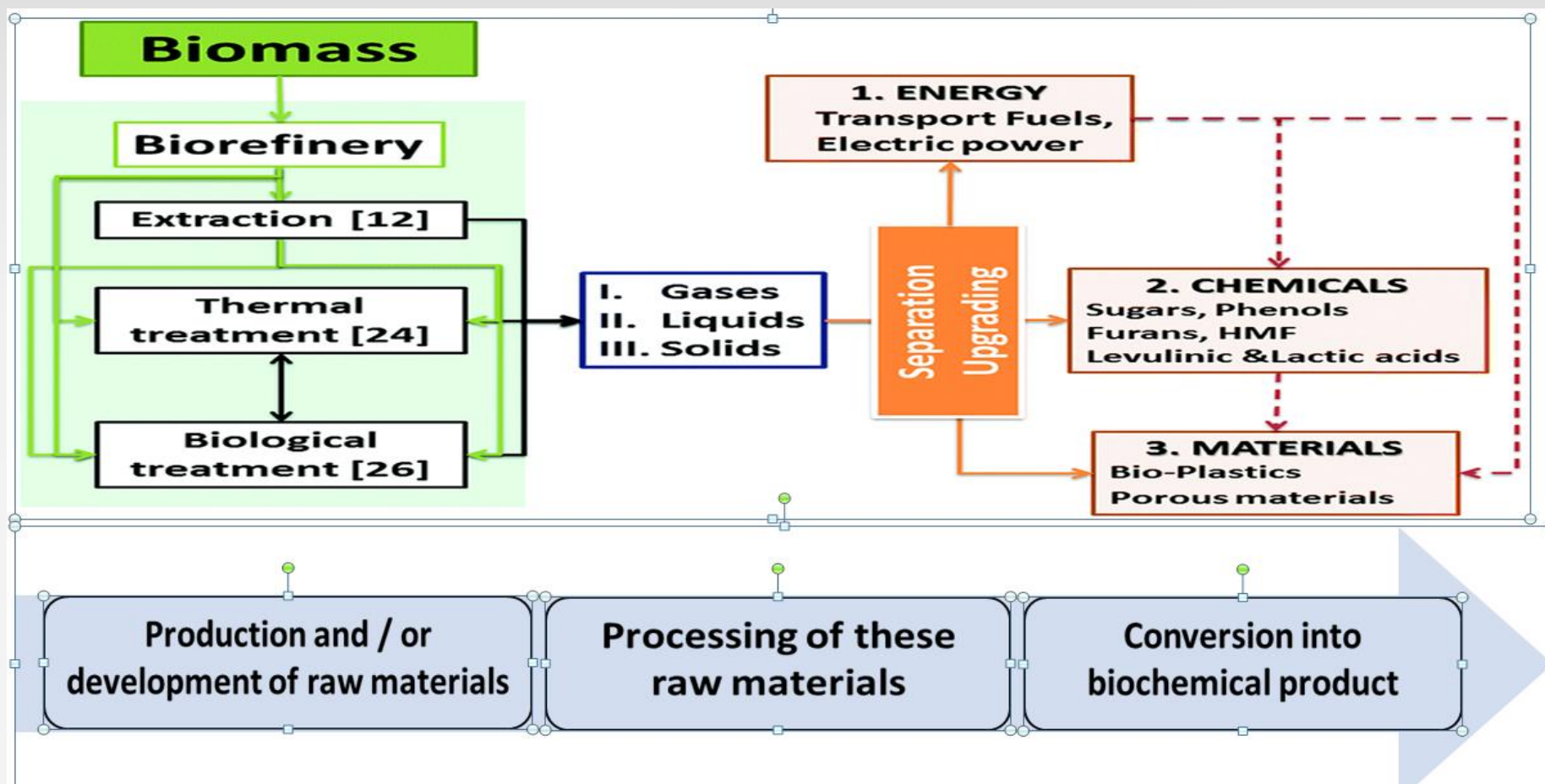
Nícia Mourão
Brazilian Chemical
Industry Association

Industrial chemistry : biomass





Industrial chemistry : biomass

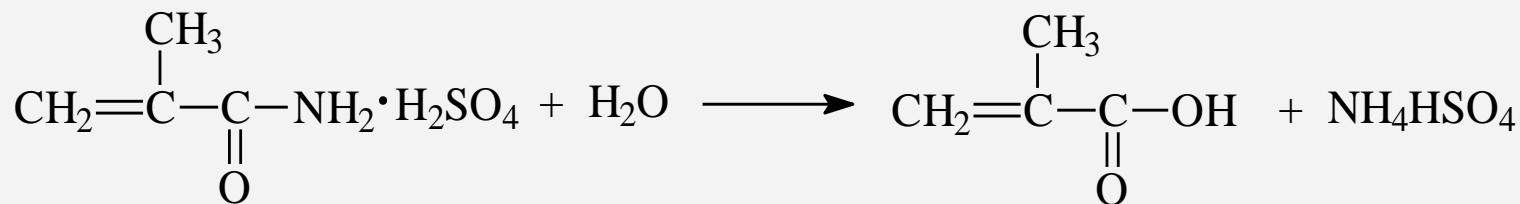
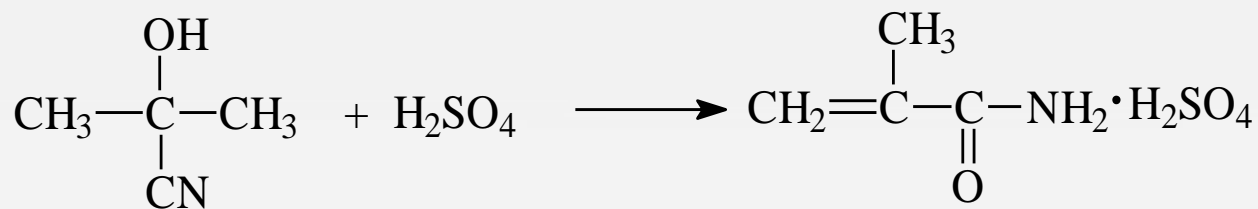
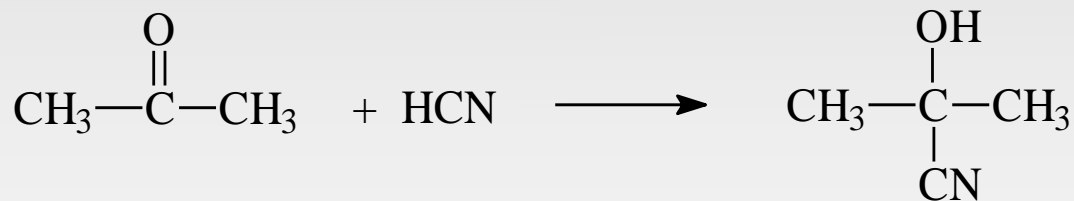




Prof. F.
Trefiro

Industrial chemistry : safer reagents

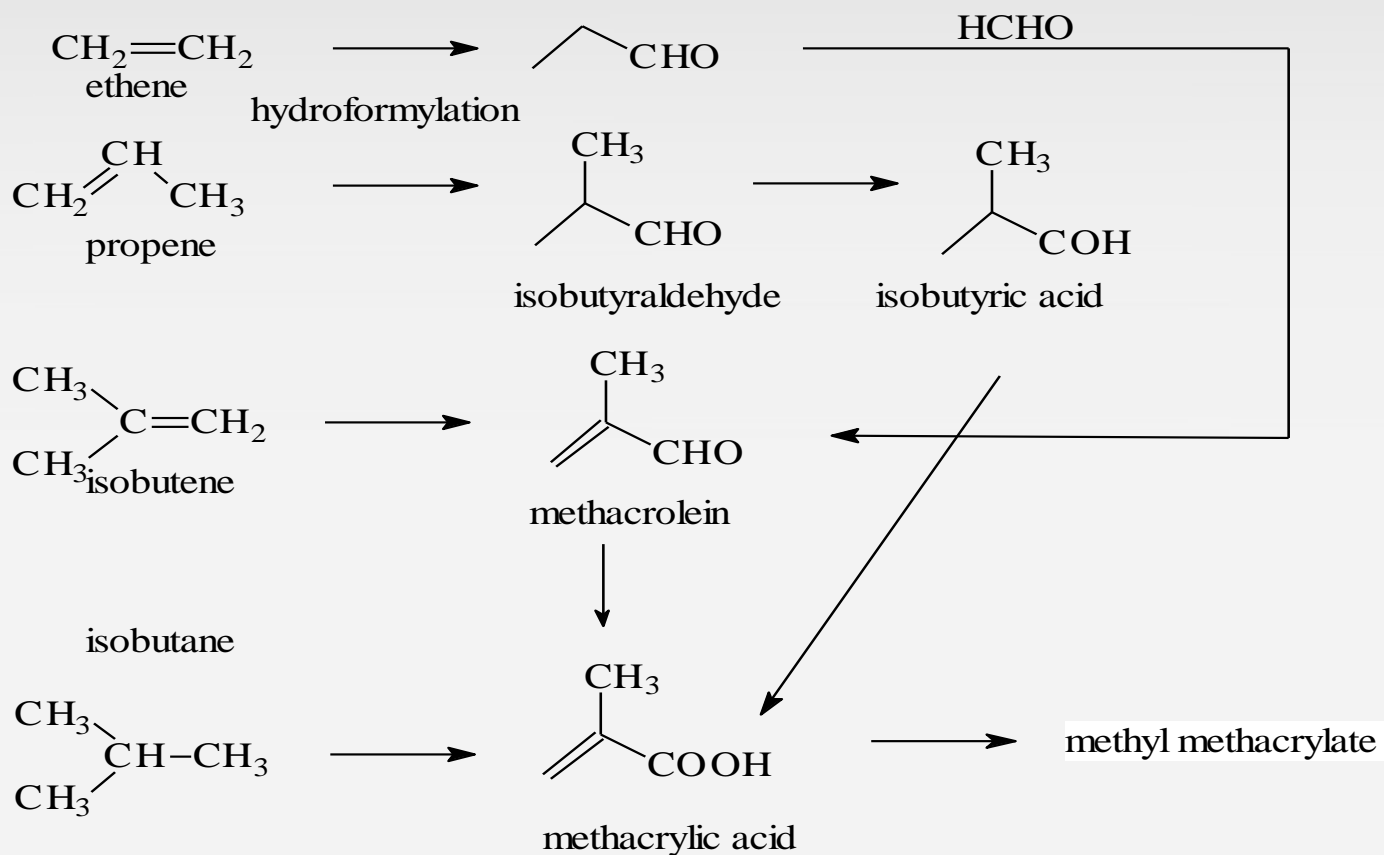
A production route for methacrylic acid uses highly toxic hydrogen cyanide :





Industrial chemistry : safer reagents

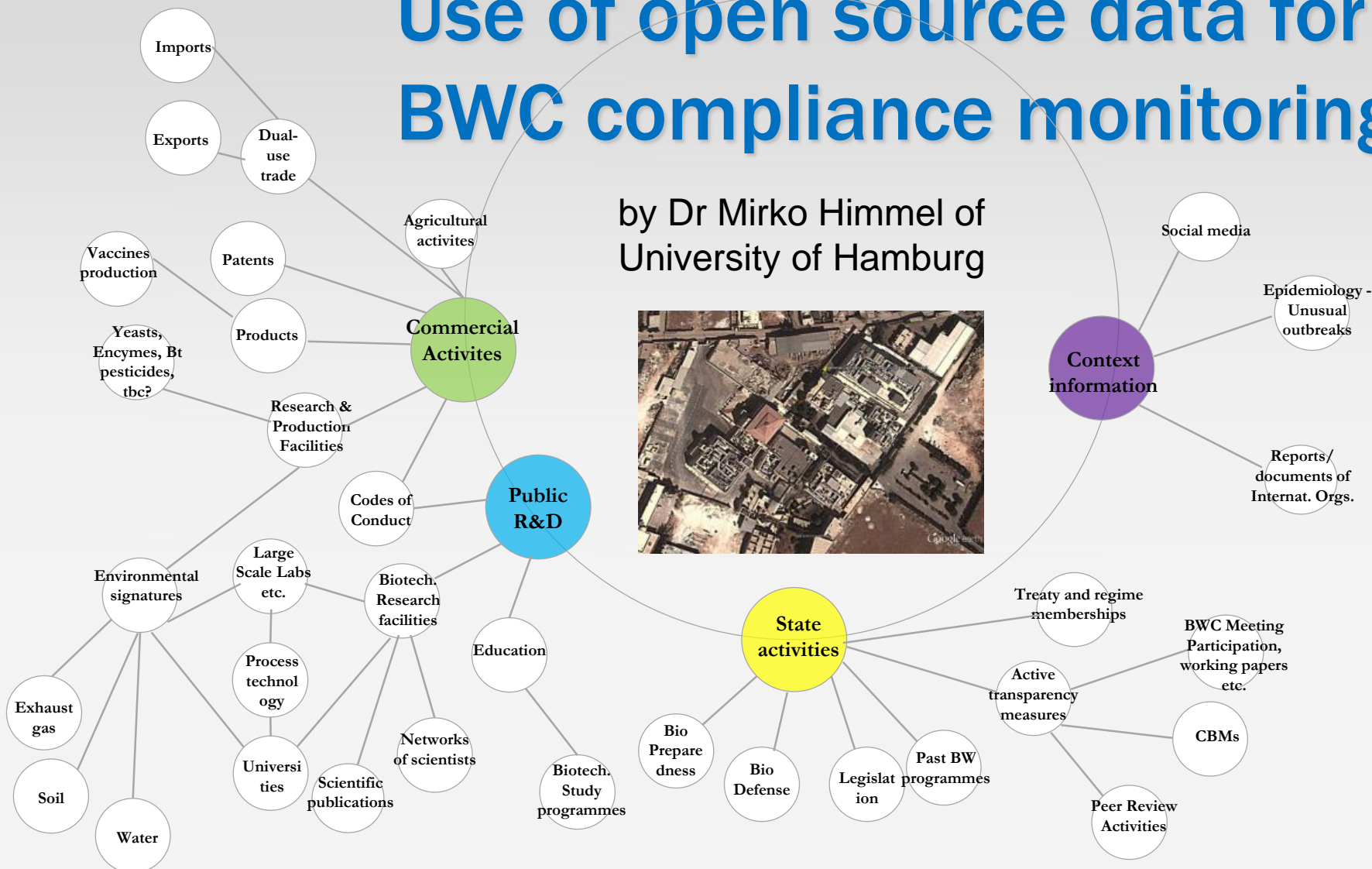
Alternative production routes for methacrylic acid avoid hydrogen cyanide :





Use of open source data for BWC compliance monitoring

by Dr Mirko Himmel of
University of Hamburg





SAB-24 : Legacy chemical weapons





Identification of Abandoned Chemical Weapons Discovered in China

Cheng TANG

Technical Aspects of Old and Abandoned Chemical Weapons Destruction Projects

Koji Takeuchi

National Institute of Advanced Industrial Science and Technology (AIST)
Japan



Abandoned Chemical Weapons in China

Misc. ACW components

Booster Tube



Burster Tube



Drum Can for Yellow agents



Shells

400 mm

200 mm

75 mm shell



90 mm Mortar shell



105 mm shell



150 mm shell



Gas Pots

200mm

Small Red Gas Pot



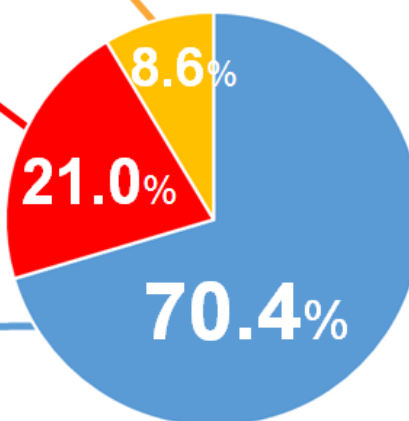
Medium Red Gas Pot



Large Red Gas Pot



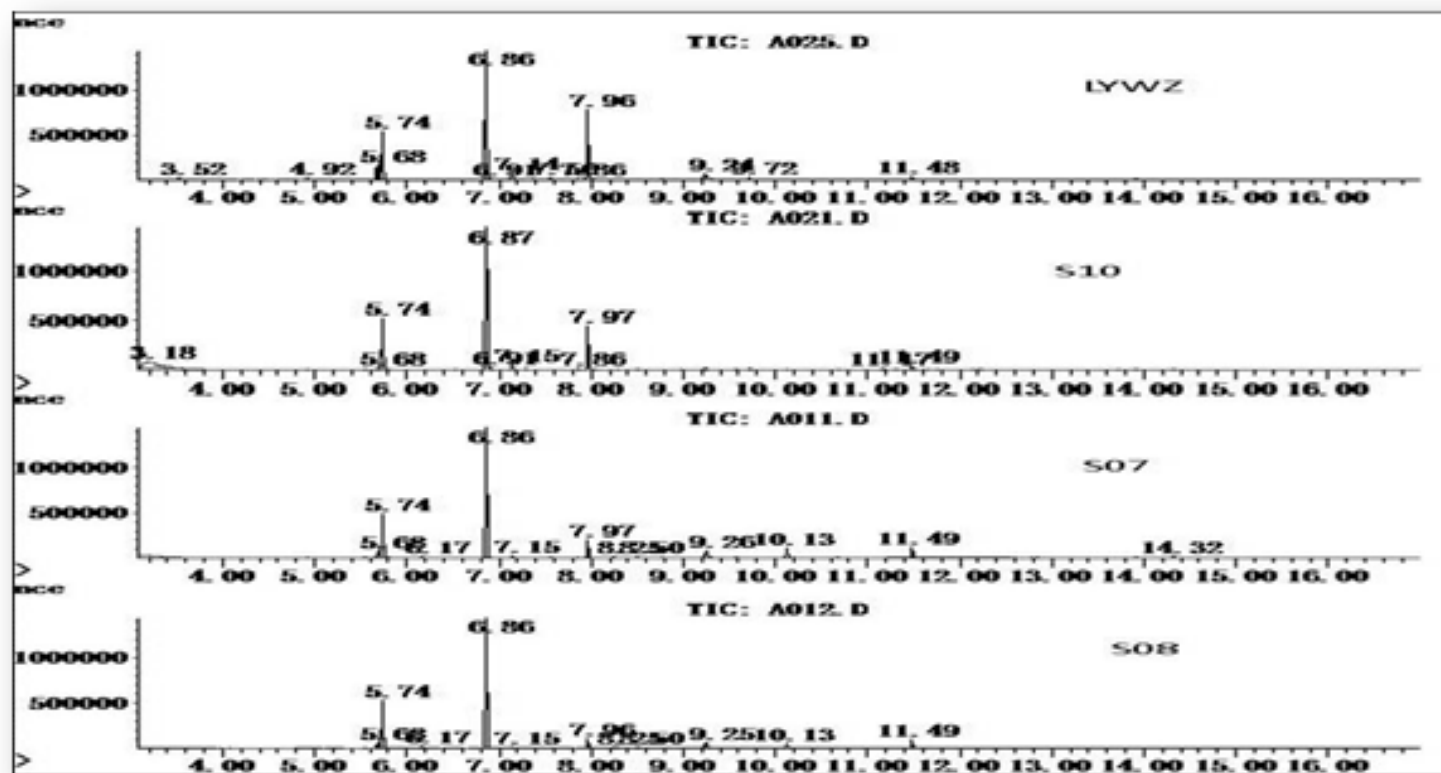
Agent type	Military Designator	Toxic Chemical
Blister agent	Yellow	Mustard, Lewisite
Vomiting agent	Red	DC, DA
Lachrymatory agent	Green	Chloroaceto-phenon
Pulmonary agent	Blue	Phosgene
Smoke agent	White	trichloroarsine





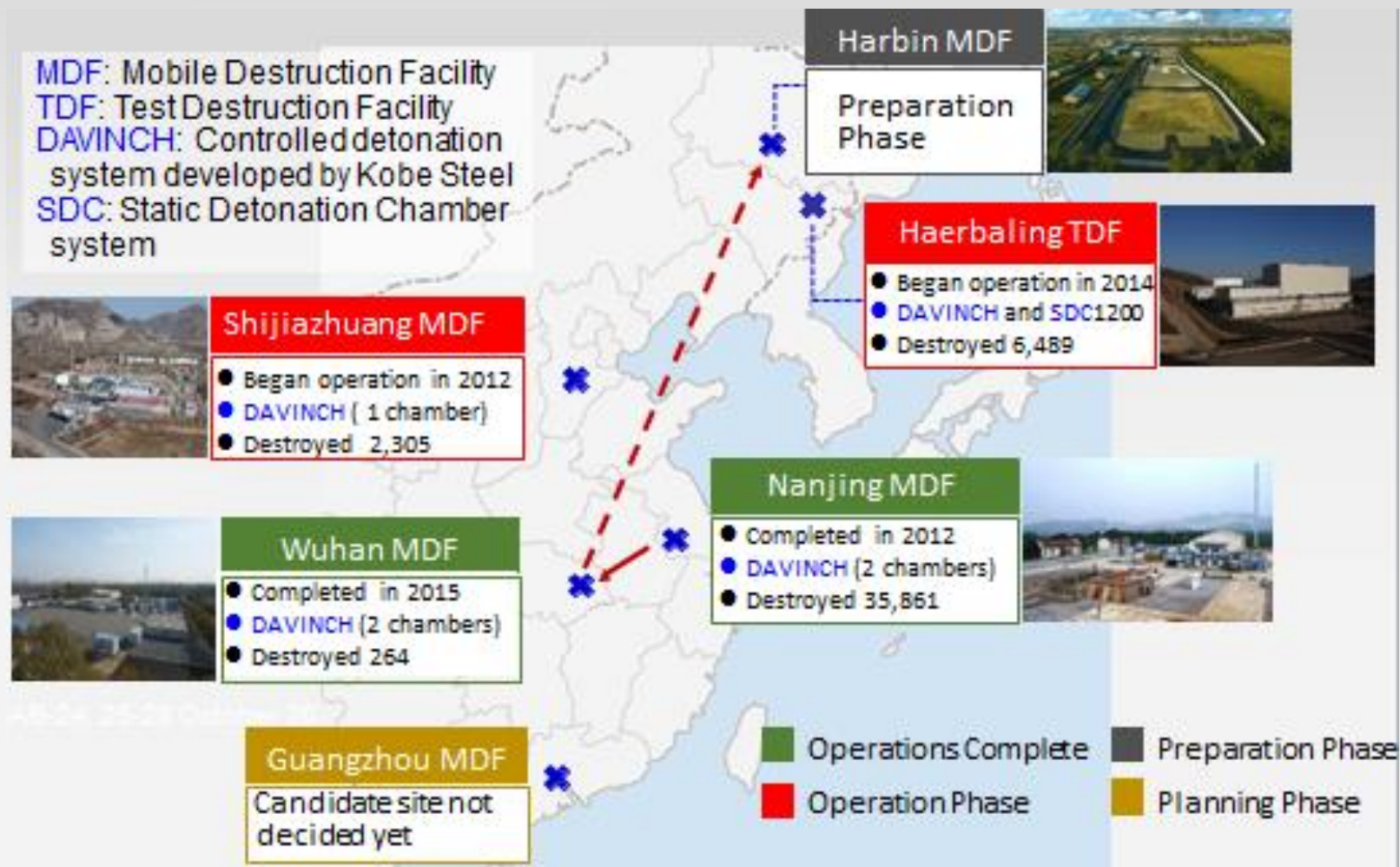
Abandoned Chemical Weapons in China

★ Consistent with samples taken from confirmed different JACW150 mm yellow agent projectile





Abandoned CW Destruction in China





Abandoned CW Destruction in Japan



Lake Kussharo (2000)

- 26 of 50kg-Yellow bombs (Lewisite/Mustard)
 - Disassembly + Neutralization + Detonation

Samukawa (2003)

- 806 CWM filled bottles
 - Neutralization
- Approx. 8,000m³ of contaminated soil
 - Heat treatment

Kanda (2004-)

- 2,968 Sea-dumped OCWs
 - Destruction by DAVINCH



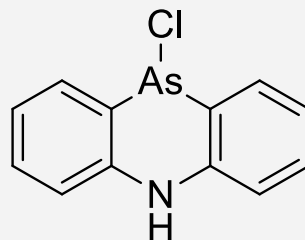
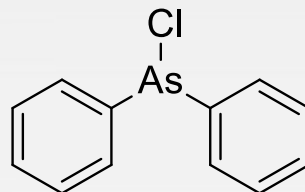
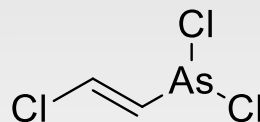
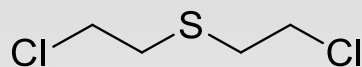
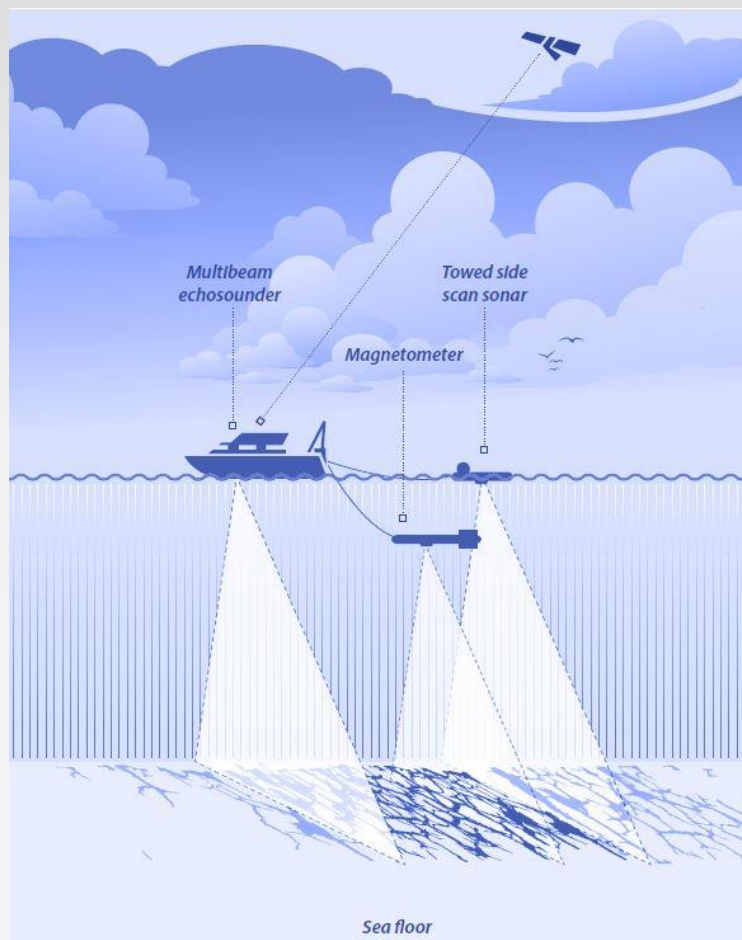
Sea Dumped Chemical Weapons in the Baltic Sea

Presentation by Prof. Vanninen, VERIFIN, Finland





Sea Dumped Chemical Weapons in the Baltic Sea



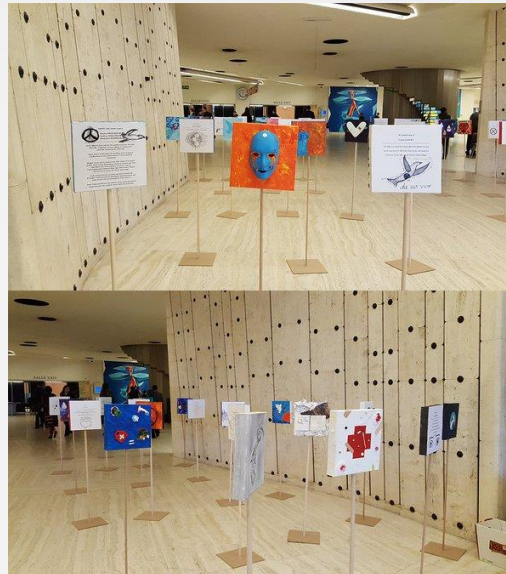
VERIFIN and a consortium are engaged in monitoring sediments from the Baltic Sea, and marine life (e.g. cod and mussels) for :

- Intact CW agents
- Metabolites

Analytical techniques are the same as those used by OPCW Designated Labs for environmental samples



SAB-24 : Science advice mechanisms





ORGANISATION FOR THE
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Interaction with UN SAB



United Nations Secretary-General's
Scientific Advisory Board

24-25 May 2016 | Trieste, Italy

5TH MEETING

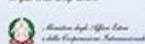
hosted by:



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In partnership with:



Members of the Scientific Advisory Board and observers at Board's 5th meeting in Trieste, Italy, May 2016, at The Abdus Salam International Centre for Theoretical Physics



The Future of SCIENTIFIC ADVICE TO THE UNITED NATIONS

A Summary Report to the Secretary-General
of the United Nations from the
SCIENTIFIC ADVISORY BOARD

September 2016

**‘I wish to acknowledge the contributions of
observers from the UN and other international
observers that have enriched the work of the Board’**

RECOMMENDATIONS

- 1.** The Board is ready to take on a more visible and active engagement with the scientific community.
- 2.** A focal point for the Board within the office of the Secretary-General should be established. This would foster better communication with the Secretary-General as well as a range of UN agencies.
- 3.** The Board recommends a well-resourced secretariat, exclusively working for the Board.
- 4.** Members believe the Board has gradually developed a strong sense of collegiality that has heightened its effectiveness and recommend staggered terms of service – providing both refreshment and continuity.

Irina Bokova,
Chairperson of the Scientific Advisory Board

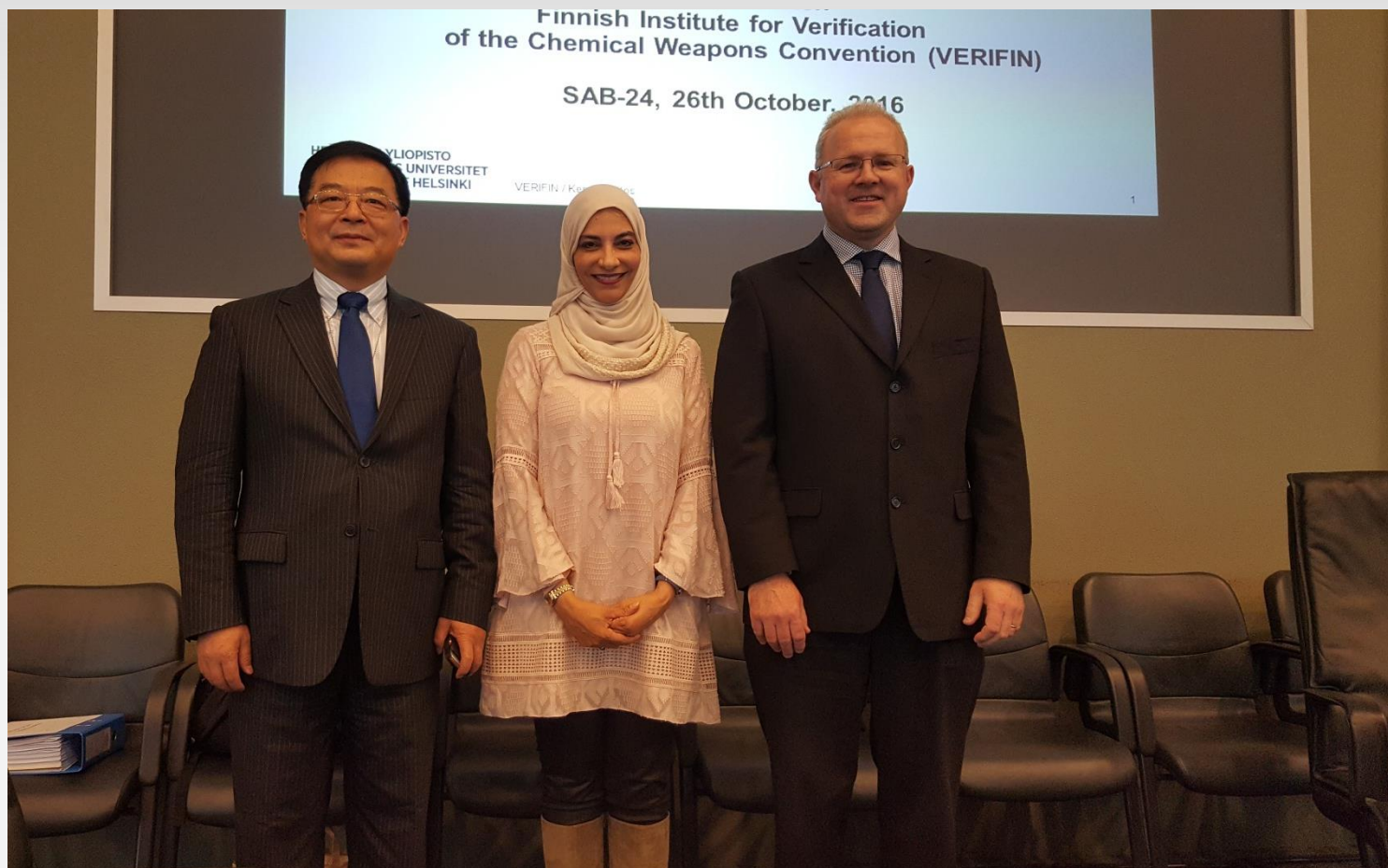




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Dr Hayat Sindi of the UN SAB at OPCW





Lessons learned from the OPCW SAB for an effective science advisory mechanism

- **Questions are clearly phrased and strictly related to S&T**
- **Technical considerations are not politicized**
- **All relevant information (from all sources) is considered**
- **Feedback from advice recipients is crucial**
 - Director-General response to SAB reports
- **Science communication with stakeholders is important**
 - Briefings to States Parties
 - Science for Diplomats
- **Sufficient supporting staff is available**
 - Secretary to SAB in organisationally appropriate position
- **Sufficient funding is available**



Briefing by Secretary to ICC SAB

- **OTP Scientific Advisory Board**

- Academia Ibero-americana de Criminalística y Estudios Forenses
- Australian & New Zealand Forensic Science Society
- European Council of Legal Medicine
- Ibero-american Network of Forensic Medicine and Forensic Science Institutions
- International Association of Forensic Sciences
- EUROPOL / European Cybercrime Centre
- International Academy of Legal Medicine
- International Forensic Strategy Alliance
- INTERPOL International Forensic Science Managers Symposium
- Indo-Pacific Association of Law, Medicine and Science
- New Mediterranean Academy of Forensic Sciences
- Arab Union of Forensics and Toxicology
- Southern Africa Regional Forensic Science Network
- United Nations Institute for Training and Research UNITAR/UNOSAT
- World Association for Medical Law

- **Scientific SOPs**

- Exhumations
- Autopsies
- Clinical examinations
- Crime scene examinations
- Forensic evidence collection
- Forensic operations in contaminated environments
- Online evidence collection
- Handling of medical information





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SAB visit Netherlands Forensic Institute





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Working together for a world free of chemical weapons

SAB interaction with



CURRENT TREATY STATUS

MEMBER STATES	183
TOTAL RATIFICATIONS	166
ANNEX 2 RATIFICATIONS	36
LATEST STATE SIGNATORY	Niue
LATEST RATIFYING STATE	Myanmar

INTERNATIONAL MONITORING SYSTEM STATUS


CERTIFIED STATIONS	283
INSTALLED	19
UNDER CONSTRUCTION	17
PLANNED	18



UN SECURITY COUNCIL ADOPTS HISTORICAL RESOLUTION ON CTBT

On the eve of the 20th anniversary of the opening for signature of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the United Nations Security Council met in New York on 23 September 2016 for a historical debate on, and endorsement of, the Treaty. A resolution on the subject (2310/2016), co-sponsored by 42 countries, passed with 14 positive votes; one country, Egypt, abstained.

United Nations

Security Council

S/RES/2310 (2016)

Distr.: General
23 September 2016

Resolution 2310 (2016)

**Adopted by the Security Council at its 7776th meeting, on
23 September 2016**

The Security Council,

Recalling its resolution 1887 (2009), and reaffirming its firm commitment to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in all its aspects,

Reaffirming the Statement of its President adopted at the Council's meeting at the level of Heads of State and Government on 31 January 1992 (S/23500), including the need for all Member States to fulfil their obligations in relation to arms control and disarmament and to prevent proliferation in all its aspects of all weapons of mass destruction,

Underlining that the NPT remains the cornerstone of the nuclear non-proliferation regime and the essential foundation for the pursuit of nuclear disarmament and for the peaceful uses of nuclear energy,





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OPCW SAB Chair on CTBT SnT 2017

Scientific Programme Committee





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Organising committee for SnT 2017








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Interaction with BTWC

Science Advice at the OPCW
An 8th Review Conference of the BWC Side Event



Wednesday
10 November 2016
13:00-15:00



OPCW

Science Advice at the OPCW

A Side-Event of the 8th Review Conference of the BWC

Thursday 10 November, 13:00-15:00, Room XXV

**Science Advice and Policy-Maker Engagement in
Support of the Chemical Weapons Convention**

Dr Jonathan Forman, OPCW Science Policy Adviser
and Secretary to the Scientific Advisory Board

The OPCW Scientific Advisory Board

Dr Christopher Timperley, OPCW Scientific Advisory Board Chair

The Role of Designated Laboratories

Professor Paula Vanninen, OPCW Scientific Advisory Board

**Science Advice on Medical Countermeasure
Aspects Against Chemical Warfare Agents**

Dr Zrinka Kovarik, OPCW Scientific Advisory Board

The Hague Ethical Guidelines:

**Applying the norms of the practice of chemistry
to support the Chemical Weapons Convention**

Mr Cheng Tang, OPCW Scientific Advisory Board Vice-Chair



SAB involvement at various events





ORGANISATION FOR THE
PROHIBITION OF CHEMICAL WEAPONS

Working together for a world free of chemical weapons

International Day for the Foundation of the Organisation for the Prohibition of Chemical Weapons

Chemical Safety and Security in a
Technologically Evolving World



2 - 4 May
2016

#opcwday

www.opcwday.org

OPCW Day



Dr Lassina Zerbo,
Executive Secretary,
Comprehensive
Nuclear-Test-Ban Treaty
Organization (CTBTO)

#OPCWDay
www.opcwday.org



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OPCW Day included SAB members



3 May 2016 -
Track 3: Technology Foresight

Panel: Technology into the Future

Christopher Timperley
Scientific Advisory Board, OPCW

Simon Bootsma
CEO, Common Invent

Norbert Hübner
European Space Agency

[#OPCWDay](#)
www.opcwday.org



3 May 2016 -
Track 3: Technology Foresight

Panel: Emerging Technology: A World of Possibility

Cheng Tang
Vice-Chair, Scientific Advisory Board, OPCW

Herman Lampalzer
Biological Weapons Convention Implementation Support Unit

Dimitry Finker
International Atomic Energy Agency

[#OPCWDay](#)
www.opcwday.org

Panel: Opportunities and Threats

2 May 2016 - Track 1: Chemical Safety and Security



Robert Mikulak
Former Ambassador of the USA to the OPCW

Catherine Smallwood
WHO

María Teresa Infante Caffi
Ambassador of Chile to the OPCW

Irakli Beridze
UNICRI



[#OPCWDay](#)
www.opcwday.org

Panel: Industry Outlook

3 May 2016 - Track 1: Chemical Safety and Security



Prashant Yajnik
Indian Chemical Council

Neil Harvey
Chemical Industries Associations

Milan Seman
Senior Industry Officer, OPCW

Nicia Mourão
Brazilian Chemical Industry Association



[#OPCWDay](#)
www.opcwday.org

SAB-24, 25-28 October 2016



Scientific events involving OPCW SAB

Dr Carlos
Fraga (PNNL)



253rd American Chemical Society
National Meeting & Exposition

Advanced Materials, Technologies, Systems & Processes

APRIL 2-6, 2017 | SAN FRANCISCO, CA



46th World Chemistry Congress
40ª Reunião Anual da Sociedade Brasileira de Química
July 9 to 14, 2017 - São Paulo - Brazil

IUPAC 49th General Assembly
July 7 to 13, 2017 - São Paulo - Brazil

Sustainability & Diversity through Chemistry

IUPAC
INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

Sb
Sociedade
Brasileira
de Química



**17th Asian Chemical Congress &
19th General Assembly of FACS**

23-28 July 2017 Melbourne Australia

Chemistry addressing sustainable development and other challenges of the 2020s



Future work of the OPCW SAB

- National Authority Days 24-25 November 2017
- CSP SAB briefing 1 December 2017
- SAB-25 27-31 March 2017
- SAB workshops Emerging Technologies (with IUPAC)
Trends in Industrial Chemical Production
(dates TBA)
- SAB-26 16-20 October 2017
- SAB-27 April 2018 (S&T report to 4th Review
Conference finalised)
- RC-4 December 2018



Composition of OPCW SAB

- Departing members at end of 2016
 - Dr Abdullah Saeed Al-Amri (of Saudia Arabia)
 - Dr Nicia Maria Fusaro Mourao (of Brazil)
 - Professor Slawomir Neffe (of Poland)
 - Professor Paula Vanninen (of Finland)
- New members starting in 2017
 - Dr Pal Aas (of Norway)
 - Dr Evandro de Souza Nogueira (of Brazil)
 - Dr Renate Becker-Arnold (of Germany)
 - Prof. Ahmed Elsadig Mohammed Saeed (of Sudan)



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Any questions?

The OPCW Scientific Advisory Board (SAB) in 2016

The SAB is responsible for providing scientific advice to the Director-General on topics with technical implications.

Topics in 2016

- Isotopically Labeled & Stereoisomers of Scheduled Chemicals
- Sample Stability & Storage
- Chemical Forensics
- Toxicity, Emergency Response & Medical Countermeasures of Chemical Warfare Agents

“To enable the Director-General, in the performance of his functions, to render specialized advice in areas of science and technology relevant to this Convention, to the Conference, the Executive Council or States Parties.”

-CWC Article VIII, Paragraph 21(h)



OPCW SAB with Director-General at their 23rd Session (April 2016)

Recent Reports

Verification



Medical Countermeasures



Education and Outreach



Convergence of Chemistry & Biology



Riot Control Agents



Learn more at
www.opcw.org/about-opcw/subsidiary-bodies/science-technology/scientific-advisory-board/



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/company/opcw



Nationalities
of the 25
SAB members
in 2016



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

SAB-24, 25-28 October 2016

Authors: Peter Melly, Thomas von der Fort, Hans Fischer, 2016.
Map: Modified from Map No. 475 Rev. 1, UNITED NATIONS. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the Organisation for the Prohibition of Chemical Weapons. The land boundary between the Republic of India and the Republic of South India has not yet been determined. The dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Kashmir and Pakistan has not yet been agreed upon by the parties. A dispute exists between the Government of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).