



OPCW Scientific Advisory Board Briefing to States Parties

Christopher M Timperley SAB Chair

Cheng Tang

SAB Vice-Chair

Thursday, 30 March 2017

Leper Room | 13.30-15.00

Light lunch available at 13.00

1 H Hydrogen 1.008																	2 He Helium 4.003						
3 Li Lithium 6.94	4 Be Beryllium 9.012																	5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305																	13 Al Aluminum 26.982	14 Si Silicon 28.085	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.69	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798						
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium [97]	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.904	54 Xe Xenon 131.293						
55 Cs Cesium	56 Ba Barium	*	71 Lu Lutetium	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon					



TODAY'S OPCW

Today, the Chemical Weapons Convention is the most successful international disarmament treaty eliminating an entire class of weapons of mass destruction. The commitment to the Convention by 192 nations — representing 98 per cent of the world's population — is meant for the benefit of people and the planet.

A large, three-dimensional silhouette of the letters 'OPCW' is positioned in the lower half of the frame. The letters are dark and stand out against a bright, sunburst-like light source on the left side of the image. The background is a clear, light blue sky.





Reports of the Scientific Advisory Board

SAB-23/1, dated 22 April 2016

SAB-24/1, dated 28 October 2016

SAB-23



SAB-24



EC-82



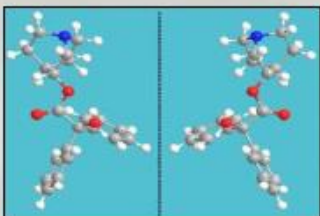
EC-84



Director-General's Response to Reports of the Scientific Advisory Board

EC-82/DG.13, dated 7 June 2016 (SAB-23)

EC-84/DG.9, dated 18 January 2017 (SAB-24)



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)



Response to the Director-General's Request to the Scientific Advisory Board to Provide Further Advice on Chemical Weapons Sample Stability and Storage

(SAB-23/WP.2, dated 25 May 2016)



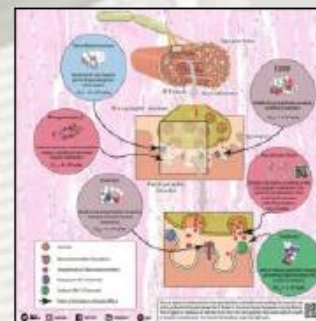
Report of the Scientific Advisory Board's Workshop on Chemical Forensics

(SAB-24/WP.1, dated 14 July 2016)



Report of the Scientific Advisory Board's workshop on Chemical Warfare Agent Toxicity, Emergency Response and Medical Countermeasures

(SAB-24/WP.2, dated 14 October 2016)



Briefing to the 21st Conference of the States Parties, December 2016:

Statement



Slides



To Learn more about the SAB





Reports of the Scientific Advisory Board

SAB-23/1
SAB-24/1

SAB-23

SAB-24



OPCW

Executive Council

Eighty-Fourth Session
7 – 10 March 2017

EC-84/DG.9
18 January 2017
Original: ENGLISH

NOTE BY THE DIRECTOR-GENERAL

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

1. This Note sets out the Director-General's comments on the report of the Twenty-Fourth Session of the Scientific Advisory Board (SAB) (SAB-24/1, dated 28 October 2016) and the ongoing work of the SAB.
2. An understanding of developments in science and technology is crucial to the full and effective implementation of the Chemical Weapons Convention (hereinafter "the Convention"), as scientific and technological underpinnings are found throughout its articles. The rapid pace of scientific advances, alongside increased diffusion and globalisation of scientific knowledge, demands scientific literacy and the ability to bring practical scientific advice to policymakers.
3. With the preparation of the SAB's recommendations to the Fourth Special Session of the States Parties to Review the Operation of the Chemical Weapons Convention (hereinafter "the Fourth Review Conference"), the activities of the SAB have seen a significant increase, as illustrated by the six substantive reports produced in 2016.¹ The Director-General encourages States Parties to carefully consider his call for voluntary contributions (S/1450/2017, dated 16 January 2017) to support the work of the SAB. In this regard, the Director-General wishes to thank the Government of New Zealand for its 2016 contribution.
4. The Director-General wishes to inform States Parties that seven members of the SAB will be leaving the Board in 2017 and a formal call for nominations has been issued (S/1452/2017, dated 18 January 2017). States Parties wishing to submit nominations to the SAB must do so by 28 July 2017.

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

5. The SAB met in The Hague, the Netherlands, for its Twenty-Fourth Session from 25 to 28 October 2016. The session was chaired by Dr Christopher Timperley, with Mr Cheng Tang as the Vice-Chairperson. The report of the session was issued as SAB-24/1.

¹ Reports of the SAB are available at: www.opcw.org/about-opcw/subsidiary-bodies/scientific-advisory-board/documents/reports/

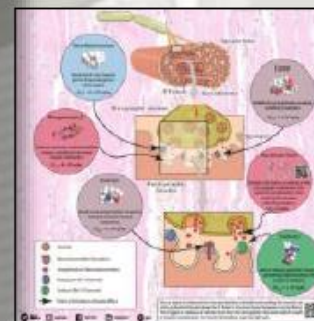
CS-2017-0148(E) distributed 18/01/2017



advisory
chemicals



Forensics



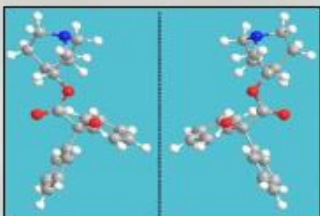
To Learn more about the SAB



EC-82



EC-84



Response
Board
(SAB-23/1)



Response to the Director-General's
Provide Further Advice
(SAB-23/WP.2, dated 25 October 2016)



Report
(SAB-24/1)



Report of the Scientific Advisory Board on
Agent Toxicity, Emergencies and
(SAB-24/WP.2, dated 14 October 2016)

Briefing to the 21st Conference



Statement

Slides



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>



Endorsed by



I U P A C

INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY



ACS CHED CCCE

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

<http://www.confchem.org> 2016SpringConfChem



DE GRUYTER

Conference paper

Robert E. Belford* and Jonathan E. Forman

Science, disarmament and diplomacy in chemical education: the example of the organisation for the prohibition of chemical weapons – The Spring 2016 Confchem

DOI 10.1515/pac-2016-1115

Abstract: In May and June of 2016 the Organisation for the Prohibition of Chemical Weapons (OPCW), IUPAC and the ACS CHED Committee on Computers in Chemical Education (CCCE) collaboratively ran an online conference hosted with the online ConfChem conference system on "Science, Disarmament and Diplomacy in Chemical Education."
This ConfChem Online Conference was designed to highlight the work of the OPCW and the important contribution of scientists and educators to achieving its goals, the science that underpins the Chemical Weapons Convention, and how scientific and technological advances will help to better implement the Convention in the future.

The OPCW is the implementing body for Chemical Weapons Convention, an international disarmament treaty banning chemical weapons. The organisation is now approaching the 20th anniversary of the entry into force of the Chemical Weapons Convention in 1997. Twenty years that have seen the destruction of more than 67 000 metric ton of the world's declared military stockpiles of chemical weapons and a Nobel Peace Prize in 2013. With 192 States Parties (the governments that have agreed to uphold the norms and obligations required by the treaty), the Chemical Weapons Convention is the most widely subscribed disarmament-focused diplomatic circles. This is in spite of the fact that the science of chemistry played a critical role in informing the negotiations that lead to the signing of the Chemical Weapons Convention, and underpinning the articles of implementation, requiring that organizations like the OPCW interact with the scientific communities – especially new stakeholders and engagement to raise awareness of its work and the contributions both from and to science in chemical disarmament.

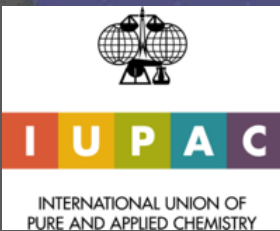
The objective of this internationally open access ConfChem online conference was to bring forth educational material that could usefully introduce chemistry educators and students to the nexus of science and multilateral diplomacy in chemical disarmament. To this end, we introduce the seven papers of the ConfChem and their authors. We hope you enjoy this collection of papers at the intersection of science and international disarmament policy. A collection that looks to stimulate interest in the role of scientists and educators, especially chemists in making the world a safer place.

Article note: A collection of invited papers based on presentations at the Open Access Online Conference "Science, Disarmament, and Diplomacy in Chemical Education: The Example of the Organisation for the Prohibition of Chemical Weapons", which was held from 2nd May till 20th June 2016.

*Corresponding author: Robert E. Belford, Conference Co-organizer, University of Arkansas at Little Rock, Little Rock, AR, USA, e-mail: rebelford@ualr.edu
Jonathan E. Forman: Conference Co-organizer, Organisation for the Prohibition of Chemical Weapons, The Hague, NL



Endorsed by



ACS CHED CCCE



Spiez Laboratory & OPCW Present Science for Diplomats at CSP-21

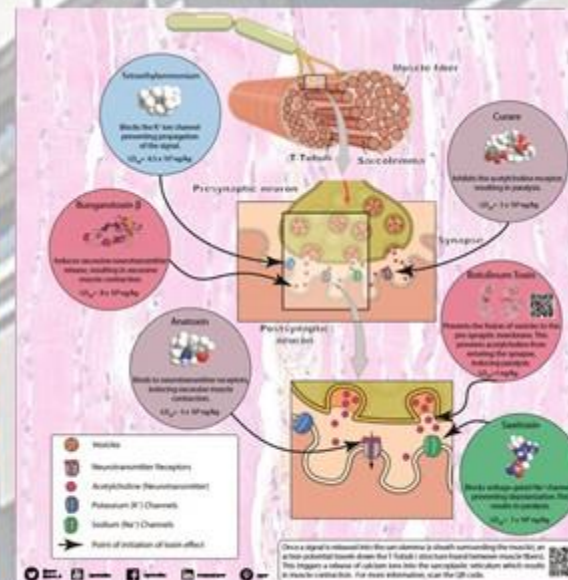


Wednesday 30 November 2016 Europe Room, World Forum 13:00 – 15:00

A Review of three workshops: Spiez CONVERGENCE 2, and the OPCW SAB's Chemical Forensics and Toxicity of Chemical Agents; with lunch



Background image courtesy of TNS Sofres
www.flickr.com/photos/324561666@100/





Spiez Laboratory & OPCW Present Science for Diplomats at CSP-21



A Review
SAB's C

OPCW
lunch





Science Advice at the OPCW

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



Thursday

10 November 2016

13:00-15:00

Room XXV



Science Advice at the OPCW

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



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



Science Advice at the OPCW
A Side-Event of the 8th Review Conference of the BWC
Thursday
10 November 2016
13:00-15:00
Room XXV

Room XXV



Four new SAB members



Overview of developments at OPCW

- **OPCW Chemical Demil. Branch provided a briefing on Libya's Category 2 chemicals - removal and destructions operations - and an update on Iraq**
- **OPCW Office of Strategy and Policy updated the SAB on the status of the work of the Open Ended Working Group on Future Priorities of the OPCW**



IUPAC

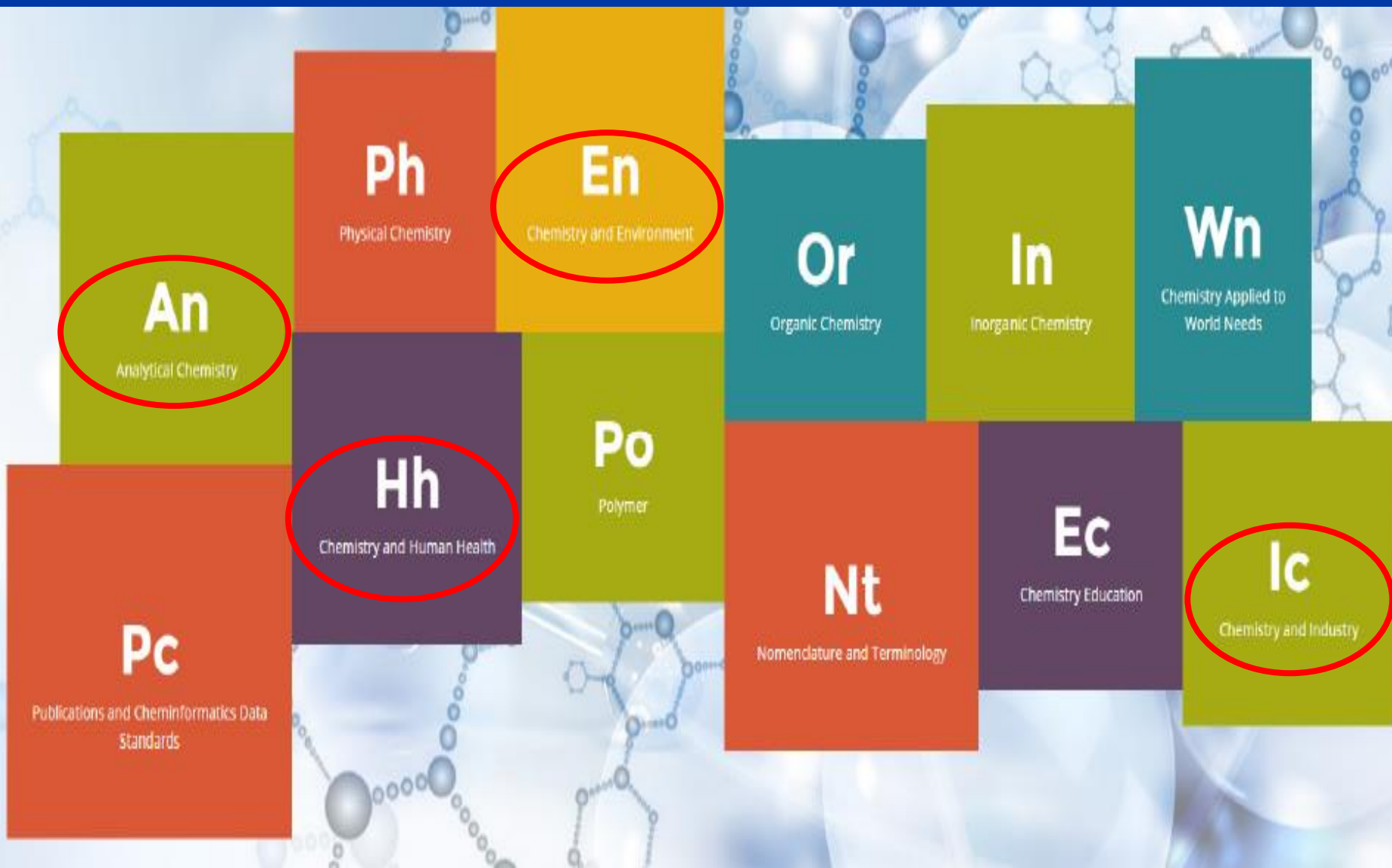
The International Union of Pure and Applied Chemistry is the global organization that provides objective scientific expertise and develops the essential tools for the application and communication of chemical knowledge for the benefit of humankind and the world.



IUPAC's role in chemistry community

- A focus on those aspects of chemistry where global consensus is essential for progress in research, commerce and policy.
- Respect for its objectivity and scientific excellence, providing access to the highest levels in the scientific, industrial, and policy communities to represent global chemistry.
- A worldwide base of volunteers with the best skills and background, recruited by transparent and well-understood processes.

IUPAC and SAB future collaboration



Nanotechnology



ELSEVIER

Contents lists available at ScienceDirect

Journal of Chromatography A

journal homepage: www.elsevier.com/locate/chroma

Analysis of chemical warfare agents in organic liquid samples with magnetic dispersive solid phase extraction and gas chromatography mass spectrometry for verification of the chemical weapons convention

Varoon Singh^a, Ajay Kumar Purohit^a, Sridhar Chinthakindi^a, Goud Raghavender D.^a, Vijay Tak^a, Deepak Pardasani^a, Anchal Roy Shrivastava^b, Devendra Kumar Dubey^{a,*}

^aVertox Laboratory, Defence Research and Development Establishment, Jhansi road, Gwalior 474002, India

^bElectron Microscopy Division, Defence Research and Development Establishment, Jhansi road, Gwalior 474002, India

J|A|C|S
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

pubs.acs.org/JACS

Ultratrace Detection of Toxic Chemicals: Triggered Disassembly of Supramolecular Nanotube Wrappers

Shinsuke Ishihara,^{†,‡} Joseph M. Azzarelli,[†] Markrete Krikorian,[†] and Timothy M. Swager^{*,†}

[†]Department of Chemistry, Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts 02139, United States

[‡]International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), Tsukuba, Ibaraki 305-0044, Japan

DOI: 10.1021/jacs.6b03869

J. Am. Chem. Soc. 2016, 138, 8221–8227

Supporting Information

Int Nano Lett (2016) 6:161–171
DOI 10.1007/s40089-016-0183-x



ORIGINAL ARTICLE

Decontamination of chemical warfare sulfur mustard agent simulant by ZnO nanoparticles

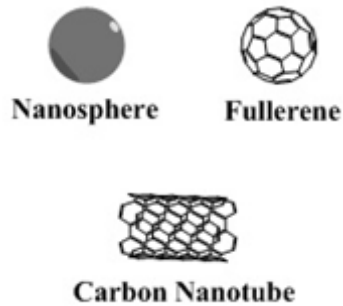
Meysam Sadeghi¹ · Sina Yekta² · Hamed Ghaedi³

Francois van Straten (SAB, South Africa) talked about nanotechnology from CWC perspective

Scientific advances since Third CWC Rev. Con. have resulted in advances in :

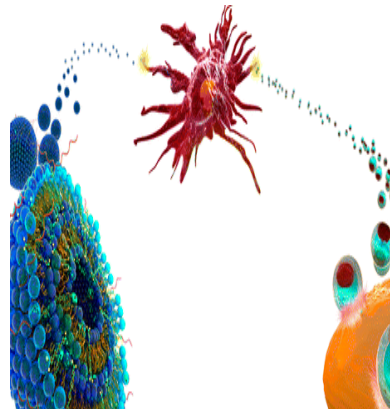
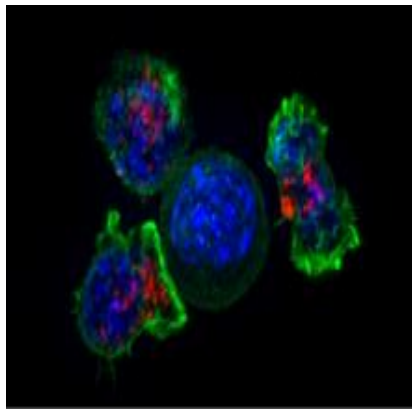
- Analysis of CW agents
- Detection of toxic chemicals
- Decontamination techniques

Nanotoxicology



- **Valentin Rubaylo (SAB, Russia) gave a presentation on nanomaterials and their potential toxic hazards**

- **Some limited studies describing the toxicity of nanomaterials in animals exist, but difficult to conclude from these that the materials would be toxic to humans by inhalation or skin contact**



Silica-based NPs



Metal-based NPs

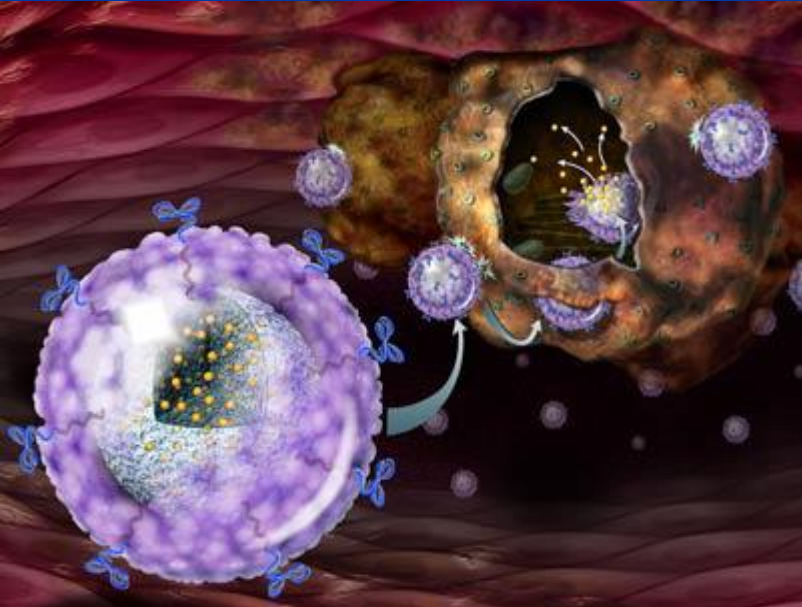
Metal oxide NPs



Liposomes



Nanomedicine



**Briefing by Prof. Andrew Wang
of University of North Carolina**

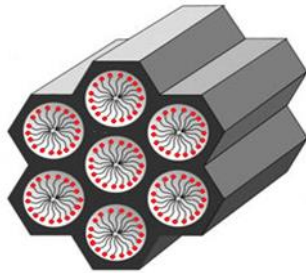
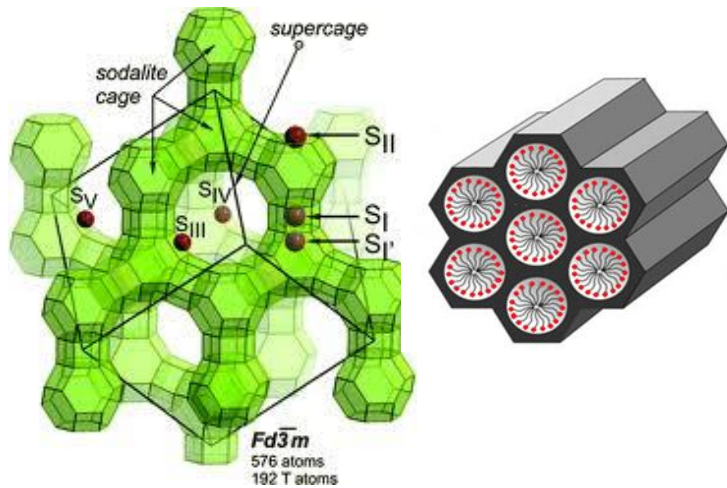
**Novel medicines based on
nanoparticles (less than or
equal to 100 nm in diameter)**

**Nano size can impart unique
properties and be used for the
delivery of therapeutic agents**

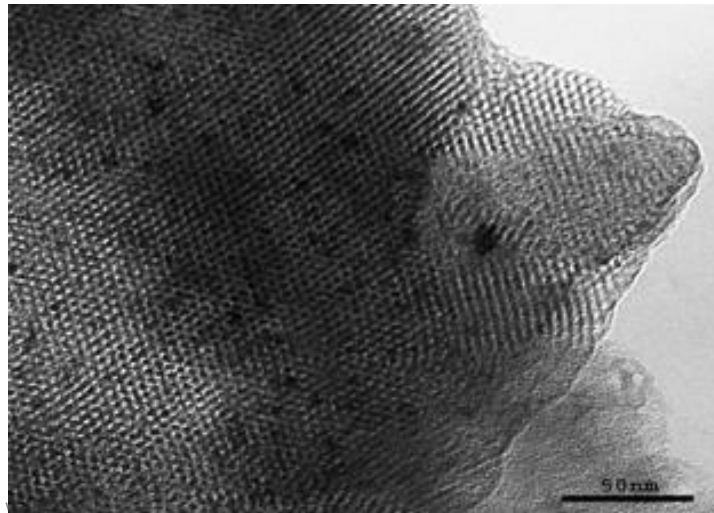
Research in this area continues



Nanocatalysis



- Briefing by Mongia Said Zina (SAB, Tunisia) gave a briefing on catalysis by nanomaterials for environmental protection
- Nanomaterials are increasingly used as catalysts for chemical production : their structure is ordered with large surface area
- Improved catalysts can result in greener chemical processes



Scientific and technological elements of verification technologies



Toxin analysis



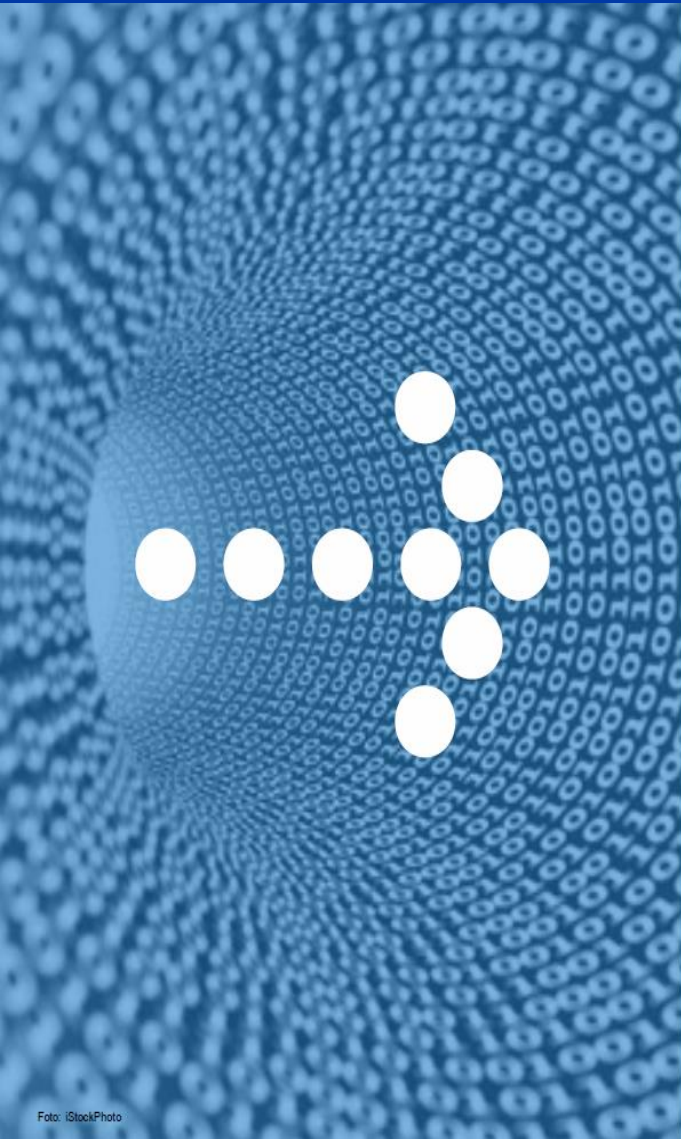
Dr. Brigitte Dorner (Robert Koch Institute, Germany) provided a presentation on detection and identification technologies for biological toxins

Analytical options for ricin :

- Immunological methods
- Spectrometric identification
- Functional methods

Best to use a combination of these analytical techniques

Chemical and biological forensics



Forensics and source attribution of chem-bio threat agent attacks

Jon Ahlinder

CBRN division, Swedish Defense Research Agency (FOI), Umeå, Sweden

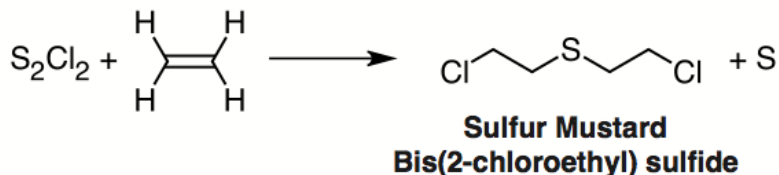
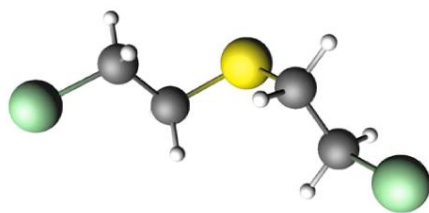
Project Underworld



Presentation by Prof. Eric Alm,
Massachusetts Institute of Technology



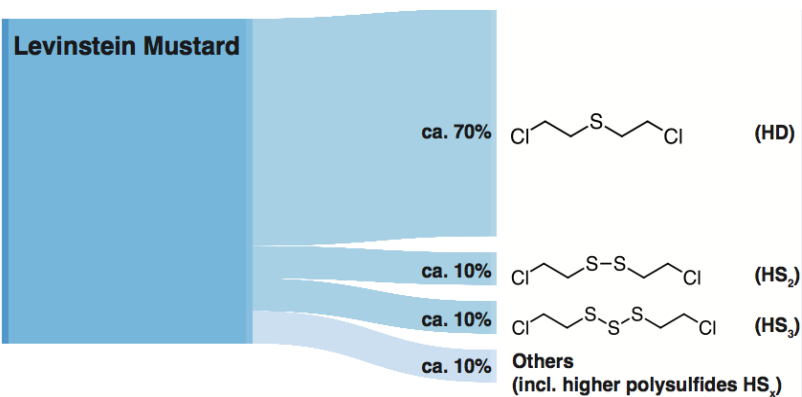
Levinstein sulfur mustard



Dr. Marc-Michael Blum (OPCW Laboratory) described how computational chemistry and analytical chemistry could be used to determine the route of production of sulfur mustard

Sulfur mustard made by the Levinstein route contains specific polysulfur impurities

Calculations help understand how these by-products form



Inspectorate training

General information
about the CWA, CWC,
and OPCW



Capability to work in a
toxic environment



Briefing from Mehran Rouzbahani



Speciality Training:

- Chemical Production Technologist
- Chemical Weapons-Munition Specialist
- Analytical Chemist
- Health and Safety Specialist



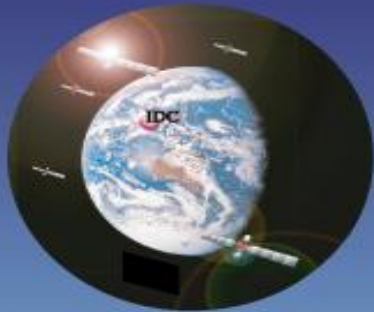
Contingency Operations

- SSAFE training;
- Contingency Operation Exercise
- Command and Control
- Interview Skills
- **Forensics**
- Communication

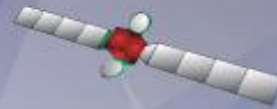
CTBTO

The CTBT Verification Regime

Presentation to SAB by
Patrick Grenard, CTBTO



5 Geostationary Satellites



GLOBAL COMMUNICATIONS
INFRASTRUCTURE

INTERNATIONAL
DATA CENTRE

National
Authorities

Radionuclide
(80, 1/2 Xe)

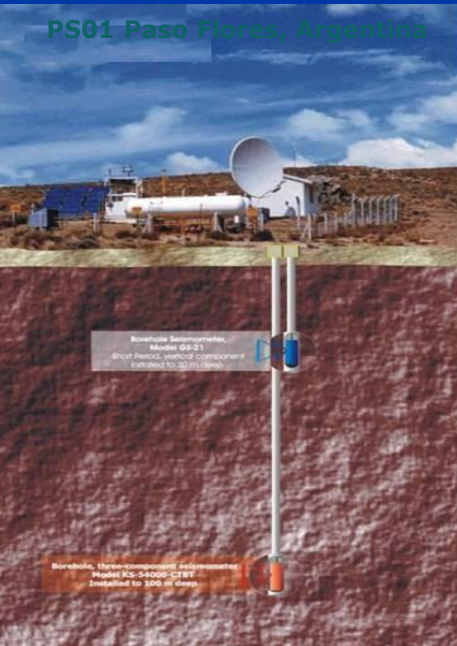
Infrasound
(60)

Seismic
(50 Pri + 120 Aux)

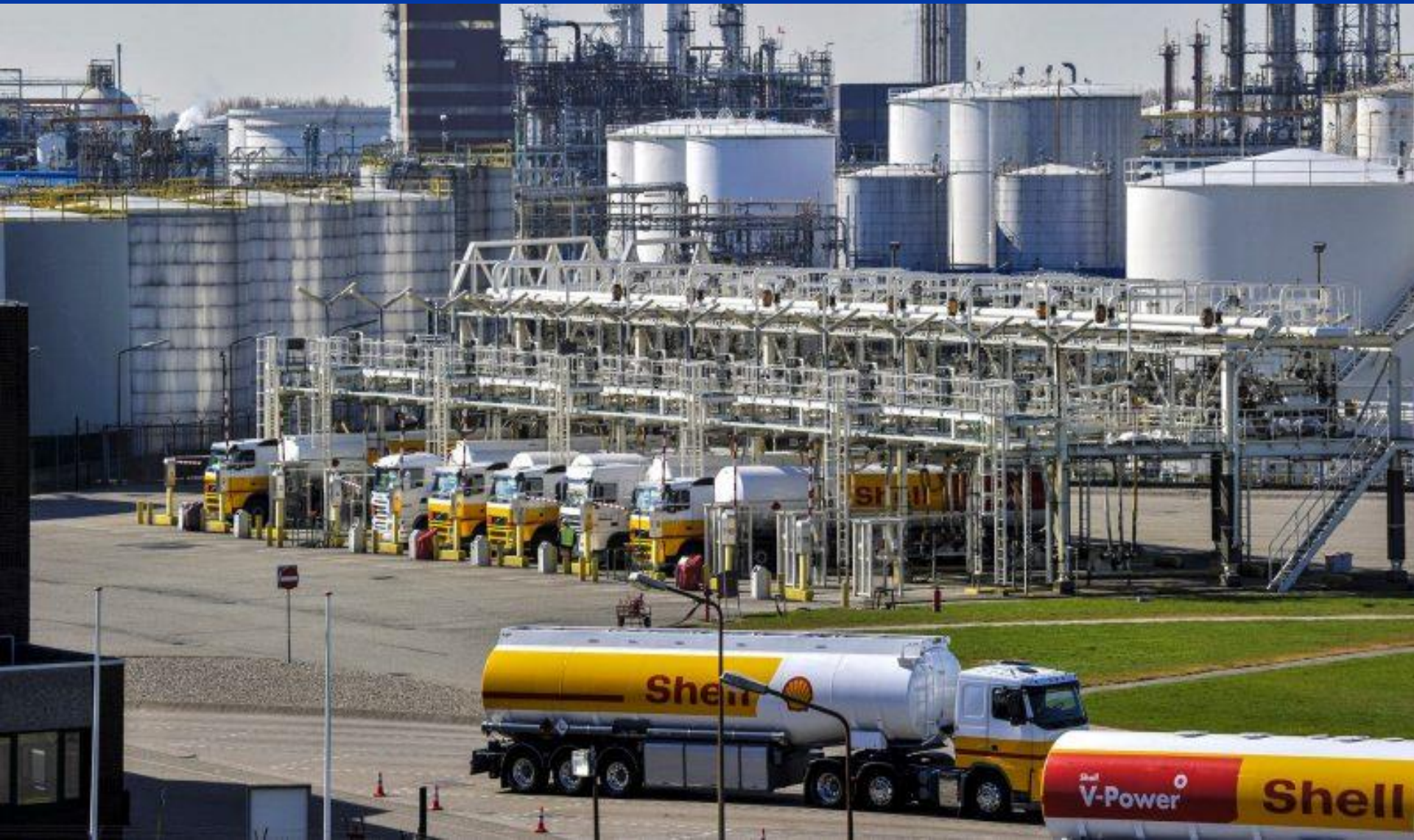
Hydroacoustic
(6 hydro, 5T)

INTERNATIONAL
MONITORING SYSTEM

CTBTO International Monitoring



Visit to Shell Pernis chemical plant



Medical countermeasures



OPCW

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://www.lex.europa.eu/legal-constants/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 Third report of the Organization 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. Rebek, 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*



Medical countermeasures

Mahdi Balali-Mood
Mohammad Abdollahi *Editors*

Basic and Clinical Toxicology of Mustard Compounds

 Springer

Presentation by Prof. Mohammad Abdollahi (SAB, Iran) on gene therapy for treating sulfur mustard poisoning

Delayed toxicity treatment

Skin:

Systemic antihistamine

Local emollients

Frequent baths

Sunscreen lotion and cream

• **Respiratory system:**

Beclomethasone inhaler

Brochodilator (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*



Advice on riot control agents



OPCW

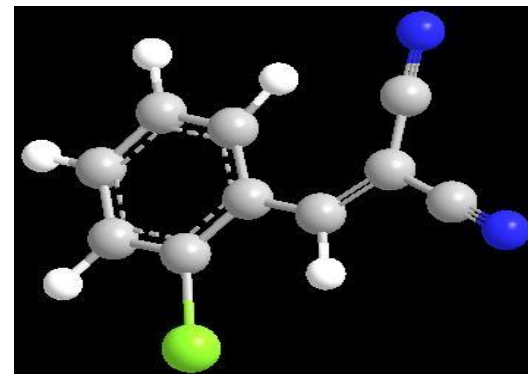
Technical Secretariat

Office of Strategy and Policy
S/1177/2014
1 May 2014
ENGLISH only

NOTE BY THE TECHNICAL SECRETARIAT

DECLARATION OF RIOT CONTROL AGENTS: ADVICE FROM THE SCIENTIFIC ADVISORY BOARD

1. In accordance with subparagraph 1(e) of Article III of the Chemical Weapons Convention (hereinafter “the Convention”), States Parties are required to declare riot control agents (RCAs), which are defined in paragraph 7 of Article II of the Convention.
2. At its Twentieth Session, the Scientific Advisory Board (SAB) was requested by the Director-General (Annex 4 of SAB-20/1, dated 14 June 2013) to provide technical advice on an initial list of RCAs that had been declared by States Parties, researched, or were commercially available.
3. The SAB has advised the Director-General that the following 17 chemicals correspond to an RCA as defined by paragraph 7 of Article II of the Convention:



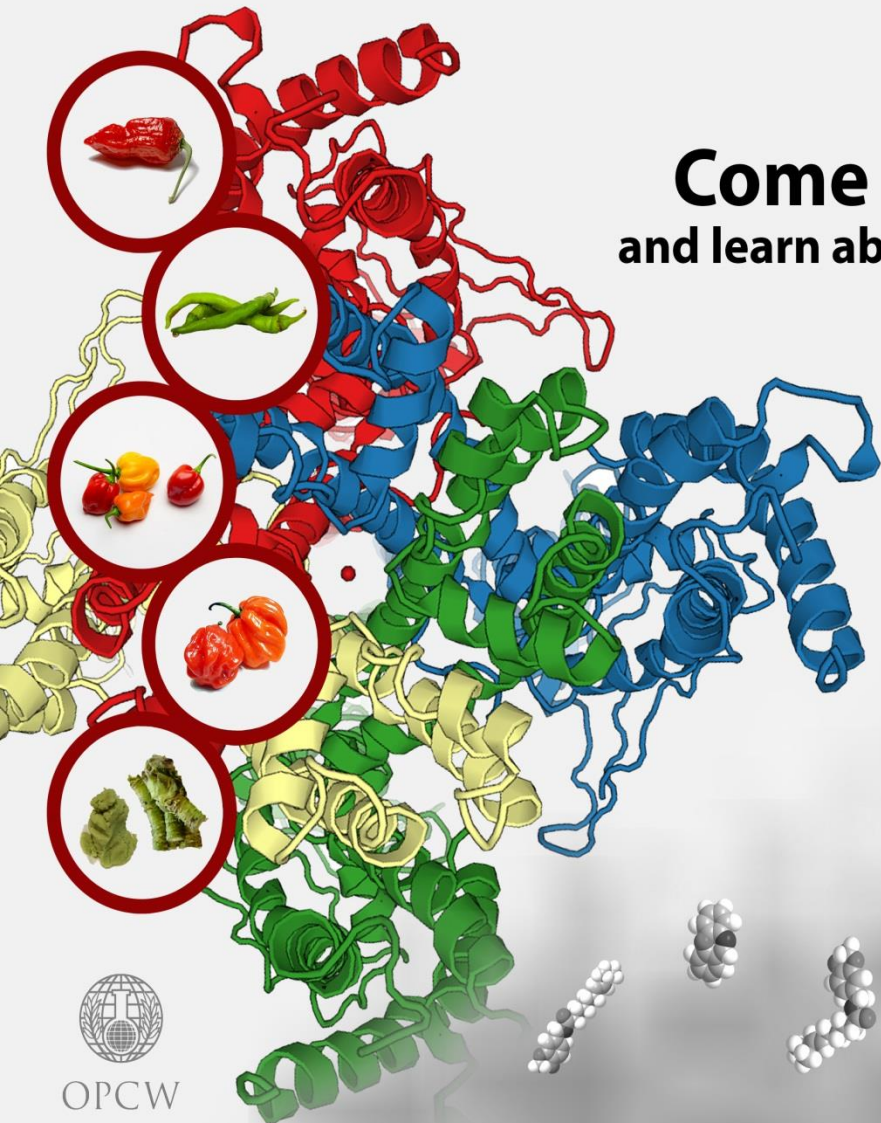
Science for Diplomats at EC-84

What Defines a Riot Control Agent?

Come activate your **TRP** receptors!
and learn about the biochemistry of **Riot Control Agents**

Wednesday, **8 March 2017**
Ooms Room | 13.30-14.45

Light lunch available at 13.00



OPCW



- Horseradish (contains 10% wasabi)
- Another horseradish ("wasabi-like")
- Mont Blanc mustard
- Sriracha chilli sauce
- Hot pepper sauce
- Hot chili pepper hot sauce
- Hot pepper sauce
- Sauces from China *
- Vanilla extract

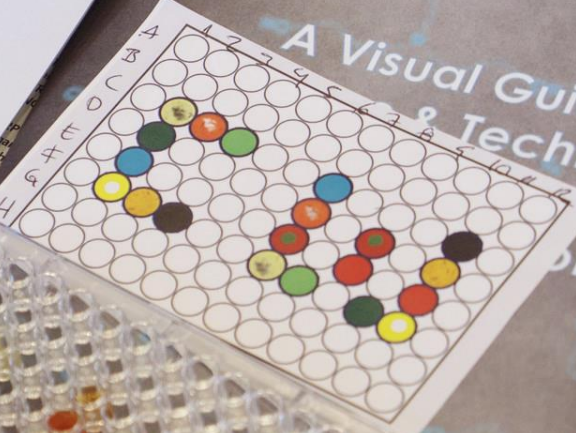
COUNTERMEASURES
 Water
 Vanilla ice cream



Allyl isothiocyanate
 responsible for wasabi's spicy attitude

Cheng Tang
 scale rating of potency and persistence of the
 data on the scorecards provided

Measure	After
1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10
10	10
11	10
12	10
13	10
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91	10
92	10
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97	10
98	10
99	10
100	10



A Visual Guide to & Technology Chemical on (CWC)



ORGANIZATION FOR THE PROHIBITION OF CHEMICAL WEAPONS
 Working together for a world free of chemical weapons

Opponents, however, worry that other
 related compounds could be used to
 synthesize these compounds and thereby
 found in their chemical processes.

Riot Control Agents

Fauzia Nurul Izzati, Jonathan E. Forman and Christopher M. Timperley

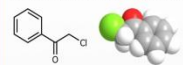
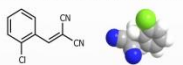
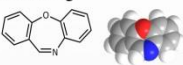

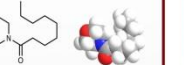
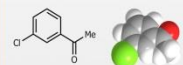
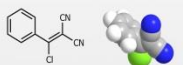
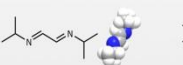


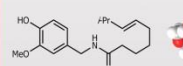


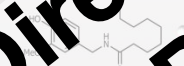

What is the definition of a Riot Control Agent (RCA)?

From paragraph 7, Article II of the Chemical Weapons Convention:

"Any chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure."

What are Riot Control Agents?

Chemicals that meet the criteria of an RCA include the following:

<p>2-Chloroacetophenone (CN)</p>  <p>Synonyms: Mace, CAP, KhAF CNB (10% CN, 45% benzene, 40% carbon tetrachloride), CNC (30% CN, 70% chloroform), and CNS (23% CN, 38.4% chloroform, 38.4% chloroform).</p> <p>Physical states: White solid with odour of apple blossom Melting Point 54-56 °C; Boiling Point 245 °C</p>	<p>2-Chlorobenzylidenemalonitrile (CS)</p>  <p>Synonyms: 2-Chlorobenzylidenemalonitrile, o-chlorobenzylidene malononitrile, K62 CS (pure), CS1 (95% CS, 5% silica aerogel), CS2 (CS and silica aerogel), CSX (1 g CS, 99 g tri-n-octyl phosphite). CS dissolved in methyl ethyl ketone is used in spray devices.</p> <p>Physical states: White solid with pungent peppery odour Melting Point 93-95 °C; Boiling Point 310-315 °C dec</p>	<p>Dibenzo[<i>b,f</i>]1,4-oxazepine (CR)</p>  <p>Synonym: CR</p> <p>Physical states: Yellow stable powder Melting Point 72 °C; Boiling Point 335 °C</p>	<p>2'-Chloroacetophenone</p>  <p>Synonym: o-chloroacetophenone</p> <p>Physical states: Colourless liquid Boiling Point 229 °C</p>	<p>4-Nonanoylmorpholine</p>  <p>Synonyms: MPA, MPK, petargonic acid morpholide</p> <p>Physical states: Liquid Boiling Point 310 °C</p>
<p>3'-Chloroacetophenone</p>  <p>Synonym: m-chloroacetophenone</p> <p>Physical states: Colourless liquid Boiling Point 228 °C</p>	<p>o-Chlorobenzylidenemalonitrile</p>  <p>Synonym: none</p> <p>Physical states: White solid Melting Point 68-70 °C; Boiling Point 126 °C/0.1 mmHg</p>	<p>N,N-Bis(isopropylethyl)enediimine</p>  <p>Synonym: Dimine</p> <p>Physical states: Volatile tan-coloured solid Melting Point 48-50 °C</p>	<p>N,N-Bis(tert-butylethyl)enediimine</p>  <p>Synonym: none</p> <p>Physical states: White solid Melting Point 39-43 °C</p>	<p>N-(1-cyclohexyl-2-cyclohexylethyl)methanamine</p>  <p>Synonym: none</p> <p>Physical states: White solid Melting Point 112 °C</p>
<p>8-Methyl-N-vanillyl-trans-6-nonenamide</p>  <p>Synonyms: C, capsaicin, Mollin, Zacin</p> <p>Physical states: White solid Melting Point 62-65 °C; Boiling Point 210-220 °C at 0.01 mmHg</p>	<p>8-Methyl-N-vanillynonamide</p>  <p>Synonyms: Dihydrocapsaicin, DHC</p> <p>Physical states: White solid Physical data unavailable</p>	<p>N-Vanillyl-9-methyldecanamide</p>  <p>Synonyms: N-(4-hydroxy-3-methoxyphenyl)-9-methyldecanamide, nonivamide, nonivamide, PAVA</p> <p>Physical states: White solid Melting Point 100 °C Physical data unavailable</p>	<p>N-Vanillyl-7-methyloctanamide</p>  <p>Synonym: nordihydrocapsaicin</p> <p>Physical states: Lipophilic colourless odourless crystalline or waxy solid</p>	<p>Oleoresin capsaicin (OC)</p>  <p>This is a mixture containing ≥ 8% capsaicins: capsaicin, dihydrocapsaicin, and nordihydrocapsaicin dissolved in an organic solvent.</p>

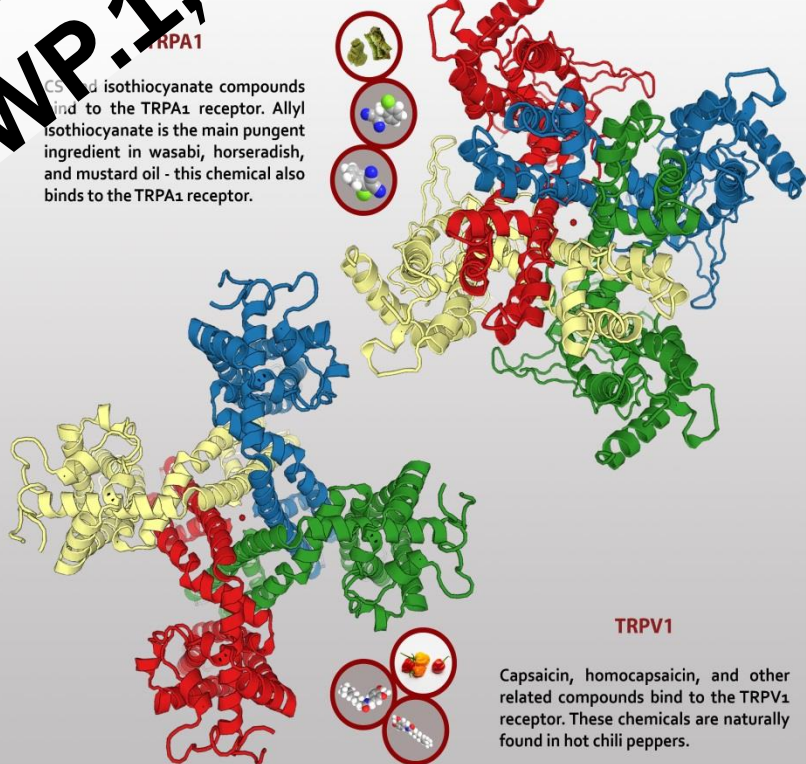
How do Riot Control Agents work?

RCA's produce irritation through binding to TRP (Transient Receptor Potential) receptors. This activates some of the same biochemical pathways that are triggered by eating horseradish or hot peppers.

What are TRP Receptors?

TRP receptors are a class of ion channel receptors primarily located on cell membranes of multicellular organisms. TRP receptors are classified into several families: TRPC (canonical or classical), TRPV (vanilloid), TRPM (melastatin), TRPA (ANKTM), TRPML (mucolipin), TRPP (polycystin), TRPML (mucolipin), and TRPN (NOMP).

TRP receptors serve as versatile sensors that allow individual cells and multicellular organisms to detect changes in their environment. This includes experiencing changes in temperature, pH, osmolarity, taste and other stimuli (including pain).



TRPA1

Allyl isothiocyanate and mustard oil - these chemical also binds to the TRPA1 receptor.

TRPV1

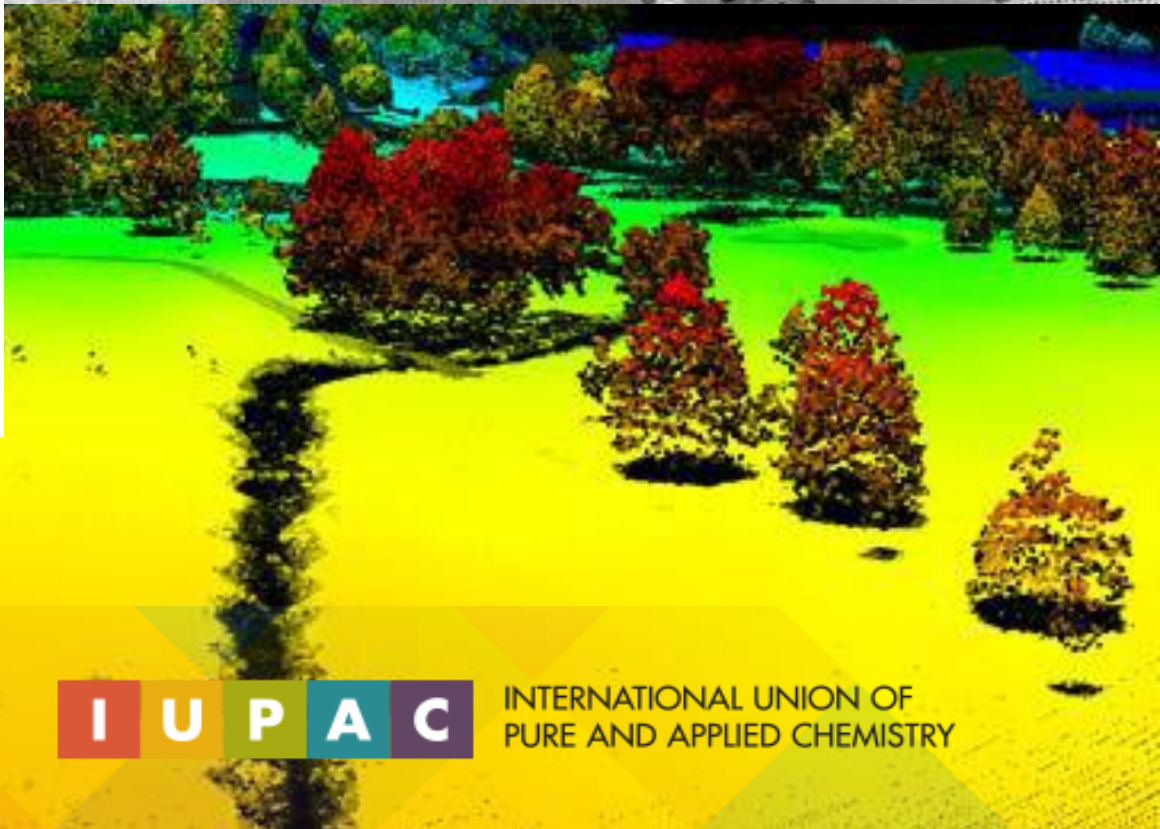
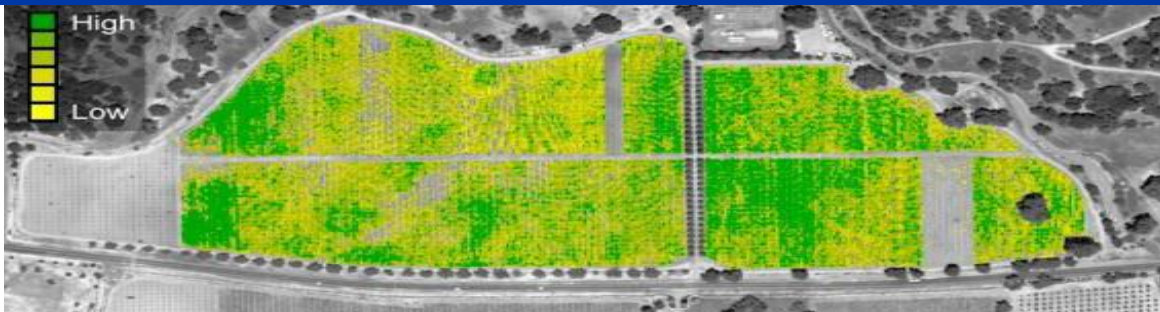
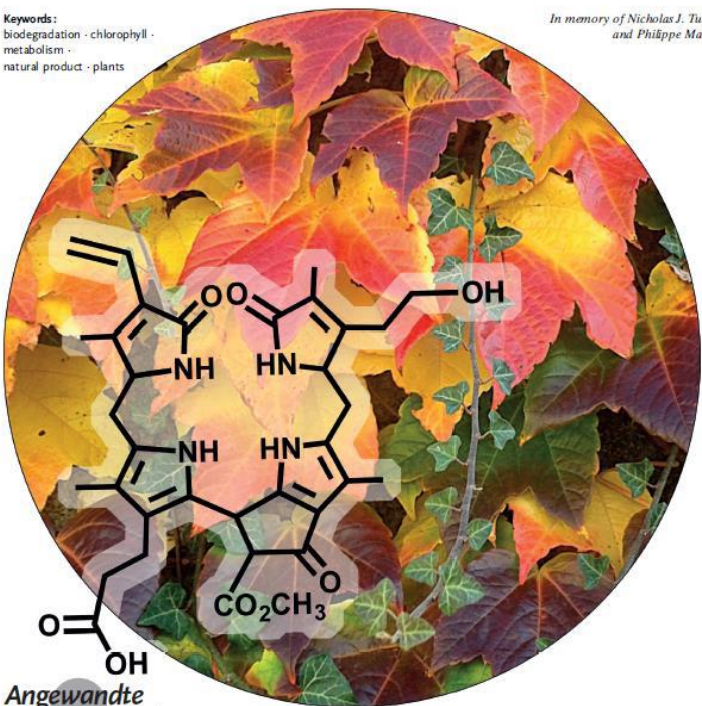
Capsaicin, homocapsaicin, and other related compounds bind to the TRPV1 receptor. These chemicals are naturally found in hot chili peppers.

Response to Director General's request on
 RCAs issued as SAB-25/WP.1, dated 27 March

Workshop on innovative technologies

Keywords:
biodegradation · chlorophyll ·
metabolism ·
natural product · plants

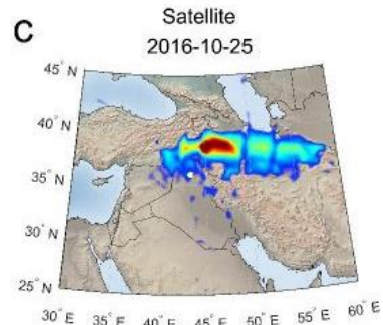
In memory of Nicholas J. Turro
and Philippe Matile



I U P A C

INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

Innovative technologies programme



Recognition of biochemical change

- If plants could talk
- Large area monitoring
- Chemical sensing



Mobile wearable point-of-care devices for collecting data



Taking samples in remote and hazardous environments

Workshop on chemical production



Chemical production programme



Aim to examine trends in all sectors of the chemical industry

- **Chemical economy**
- **Commodity chemicals**
- **Pharmaceuticals**
- **Fine/speciality chemicals**
- **Custom automated synthesis**
- **Biologicals**
- **Agricultural chemicals**
- **Regulatory issues**

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.

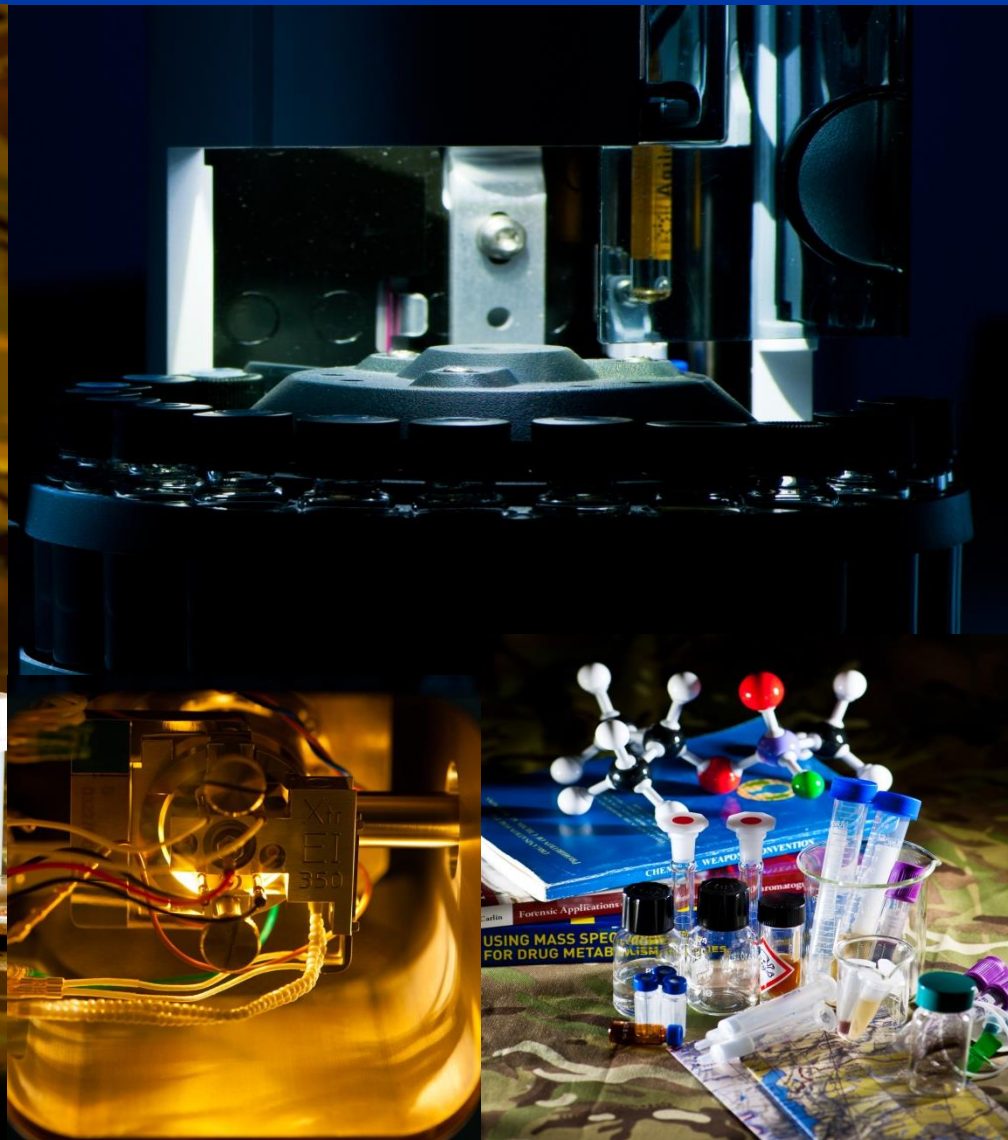
³ Verification, Report of the Scientific Advisory Board’s Temporary Working Group (SAB/REP/1/15, dated June 2015). Available at www.opcw.org/fileadmin/OPCW/SAB/en/Final_Report_of_SAB_TWG_on_Verification_-_as_presented_to_SAB.pdf

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/toc/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/CICrimJust/2012/16.pdf>



TWG on investigative studies



TWG on investigative studies



OPCW

Executive Council

Eighty-Fourth Session
7 – 10 March 2017

EC-84/DG.9
18 January 2017
Original: ENGLISH

NOTE BY THE DIRECTOR-GENERAL

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

9. In accordance with paragraph 9 of the SAB's terms of reference (C-II/DEC.10/Rev.1, dated 2 December 2004), the Director-General requests that the SAB establish a new temporary working group (TWG) and appoint a Chairperson for it. This TWG will address questions relating to science and technology relevant in investigative work, and will undertake further consideration of topics described in paragraph 8 above, other recommendations from the chemical forensics workshop, and in particular questions falling under subparagraphs 2(e) and (g) of the SAB's terms of reference relevant to investigative methods in contingency operations. The Director-General will in the near future prepare a mandate for the TWG, which should hold its first meeting before the end of the first quarter of 2018.

Terms of reference



To review S&T relevant to investigative work, especially for the validation and provenancing (determining the chronology of ownership, custody and/or location) of evidence, and the integration of multiple and diverse inputs to reconstruct a past event

Questions (a – i)

- **Which methods and capabilities used in the forensic sciences could usefully be developed and/or adopted for Chemical Weapons Convention-based investigations?**
- **What are the best practices and analysis tools used in the forensic sciences for effectively cross-referencing, validating, and linking together information related to investigation sites, materials collected/analysed and individuals interviewed?**
- **What are the best practices for management of data collected in investigations, including compilation, curation, and analytics?**
- **What are the best practices for the collection, handling, curation and storage, and annotation of evidence?**
- **Which technologies and methodologies (whether established or new) allow point-of-care and non-destructive measurements at an investigation site to help guide evidence collection?**
- **Which technologies and methodologies (whether established or new) can be used in provenancing of chemical and/or material samples collected in an investigation?**
- **Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials that can be used in the detection of toxic industrial chemicals relevant to the Convention?**
- **Which technologies and methodologies (whether established or new) can be used in provenancing of chemical and/or material samples collected in an investigation?**
- **Which technologies and methodologies (whether established or new) can be used in ensuring chain of custody and verifying authenticity (especially in regard to digital images and video recordings)?**

Questions (a – i)

- Which methods and capabilities used in the forensic sciences could usefully be developed and adopted for Chemical Weapons Convention-based investigations?
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- What are the best practices for management of data collected in investigations, including compilation, curation, and analytics?
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- Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials that can be used in the detection of toxic industrial chemicals relevant to the Convention?
- Which technologies and methodologies (whether established or new) can be used in provenancing of chemical and/or material samples collected in an investigation?
- Which technologies and methodologies (whether established or new) can be used in ensuring chain of custody and verifying authenticity (especially in regard to digital images and video recordings)?

Questions (i and k)

Which technologies and methodologies (whether established or new) can be used to ensure the integrity of an investigation site?

Do collections of physical objects, samples and other information for chemical weapons relevant analysis exist that can be made available to investigators for retrospective review? And how might these collections be used to support investigations?

Are there stakeholders that the Technical Secretariat could usefully engage with, to leverage their capabilities on investigative matters?

Medium Term Plan: Result Area 3

Universal adherence to the Convention

Medium-term goal 8:

Augmented the Organisation's efforts to reach universality

Medium-term goal 9:

Enhanced and sustainable collaboration with other international organisations

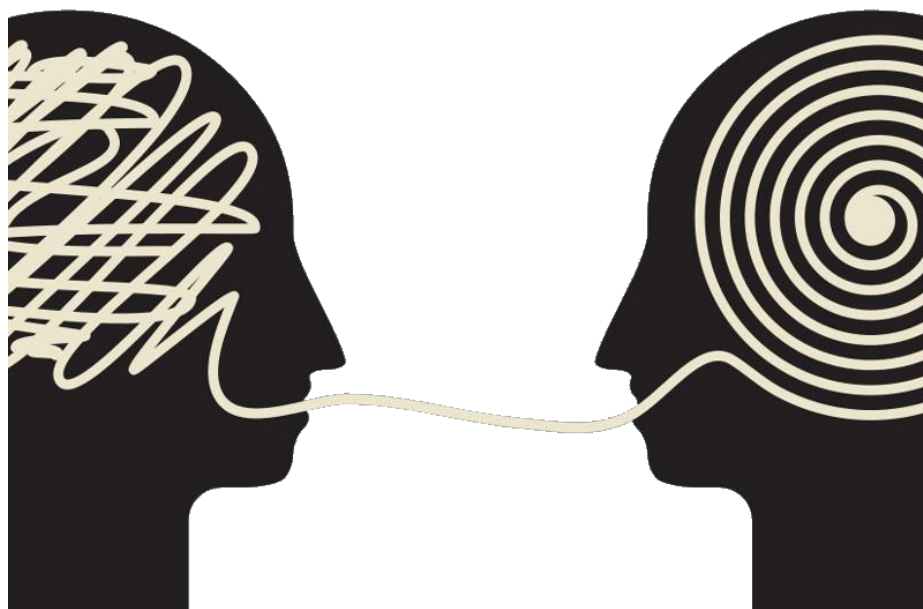
Medium-term goal 10:

Strengthened engagement with broader group of relevant stakeholders

Engagement to leverage others' capabilities

Guidance for Technical Secretariat

In addition, the TWG will provide advice on Secretariat proposals for methodologies, procedures, technologies, and equipment for investigative purposes



TWG going forward

Dr Veronica Borrett (SAB, Australia) appointed as the Chairperson of the TWG by election by the SAB

Recommend membership

The TWG will consist of individuals who collectively have expertise in theory and practice of investigative work; including but not limited to investigational chemical analysis, evidence collection, forensic sciences, informatics, crime scene reconstruction, toxicology, inspection or experience of implementation of the Chemical Weapons Convention

6-8 SAB members (including Chair) and 8-10 other experts

TWG history

- 1999-2000 Chemical weapons destruction technologies
- 1999-2000 Equipment issues
- 1999-2000 Analytical procedures
- 1999-1999 Ricin production
- 1999-1999 Adamsite
- 2000-2000 Low conc limits (Schedule 2A & 2A* chemicals)
- 2004-2007 Biomedical samples
- 2007-2012 Sampling and analysis
- 2011-2013 Convergence of chemistry and biology
- 2012-2014 Education and outreach
- 2013-2015 Verification
- 2018-2020 Investigative science and technology

TWG reports

CONVERGENCE OF CHEMISTRY AND
BIOLOGY

REPORT OF THE SCIENTIFIC ADVISORY
BOARD'S TEMPORARY WORKING GROUP

JUNE 2014



ORGANISATION FOR THE PROHIBITION
OF CHEMICAL WEAPONS



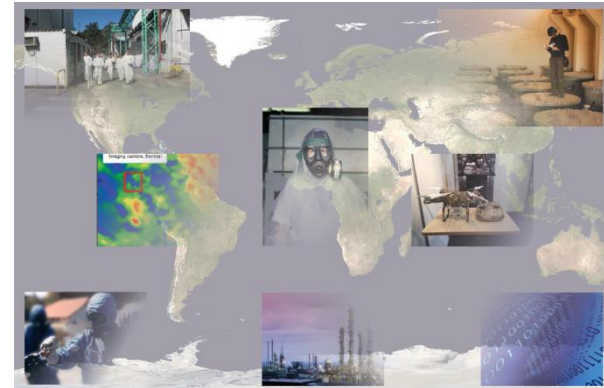
EDUCATION AND ENGAGEMENT:
Promoting a Culture of Responsible Chemistry

FINAL REPORT OF THE SCIENTIFIC ADVISORY
BOARD'S TEMPORARY WORKING GROUP

NOVEMBER 2014



ORGANISATION FOR THE PROHIBITION
OF CHEMICAL WEAPONS



VERIFICATION

REPORT OF THE SCIENTIFIC ADVISORY
BOARD'S TEMPORARY WORKING GROUP

June 2015



ORGANISATION FOR THE PROHIBITION
OF CHEMICAL WEAPONS

ACS chemical forensics workshop

ACS recognises that ‘given recent and ongoing reports of incidents involving CW agents and other weaponized toxic chemicals, there is a pressing need for an effective chemical forensics capability in order to help identify and prosecute perpetrators of chemical attacks’

- **The ACS Division of Analytical Chemistry, and ACS Chemistry and Law Division, are holding a two day symposium to review developments and topics arising in chemical forensics on 3-4 April 2017**



253rd American Chemical Society
NATIONAL MEETING & EXPOSITION
Advanced Materials, Technologies, Systems & Processes

APRIL 2-6, 2017 | San Francisco, CA



Dr Carlos Fraga



Future SAB diary and work plan

- **2-7 April: ACS Chemical forensics (San Francisco)**
- **26 April: OPCW 20 (ceremony at the Ridderzaal)**
- **3-5 July: SAB International Workshop on Innovative Technologies for Chemical Security, Rio de Janeiro (IUPAC, Brazilian Acad. Sci., Brazilian Chem. Soc.)**
- **First week in October (TBC) : SAB International Workshop on Industrial Technology, Zagreb, Croatia**
- **16-20 October : SAB-26 meeting (OPCW, The Hague)**

OPCW

1997-2017

YEARS



IEPER DECLARATION

HEEDING
THE LESSONS
OF HISTORY



IN
REMEMBRANCE

ENSURING AN ETHOS OF SCIENCE FOR PEACE

THE HAGUE ETHICAL GUIDELINES

To promote a culture of responsible conduct in the chemical sciences and to guard against the misuse of chemistry, a group of chemical practitioners from around the world formulate a set of ethical guidelines informed by the CWC.



موجبات
لاهائي الأخلاقية

تطبيق قواعد ممارسة
الكيمياء لدعم
اتفاقية الأسلحة الكيميائية

APPCW
APPCW ONLINE
APPCW COMPANYMENT
APPCW

مجلس مستشاري الأسلحة الكيميائية
APPCW



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

THE HAGUE
ETHICAL
GUIDELINES

APPCW
APPCW ONLINE
APPCW COMPANYMENT
APPCW

APPCW



Aplicar las normas
de la práctica
de la química para apoyar
la Convención sobre
las Armas Químicas

DIRECTRICES
ÉTICAS DE LA
HAYA

APPCW
APPCW ONLINE
APPCW COMPANYMENT
APPCW

APPCW



Appliquer les normes
de la pratique de la
chimie afin de soutenir
la Convention sur les
armes chimiques

LES PRINCIPES
DIRECTEURS
ÉTHIQUES DE LA
HAYA

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Применяя нормы
практики химии
поддержки
Конвенции о
химическом оружии

Гаагские
этические
принципы

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运用化学实践
规范以支
持化学武器公
约的实施

海牙伦
理准则

APPCW
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禁止化学武器组织
APPCW