OPCW Scientific Advisory Board
Briefing to State Parties

Thursday 22 March 2018
Ieper Room | 13:30-15:00
Light lunch served at 13:00

Christopher Timperley (Chairperson) and Cheng Tang (Vice-Chairperson)

Activities since SAB-26

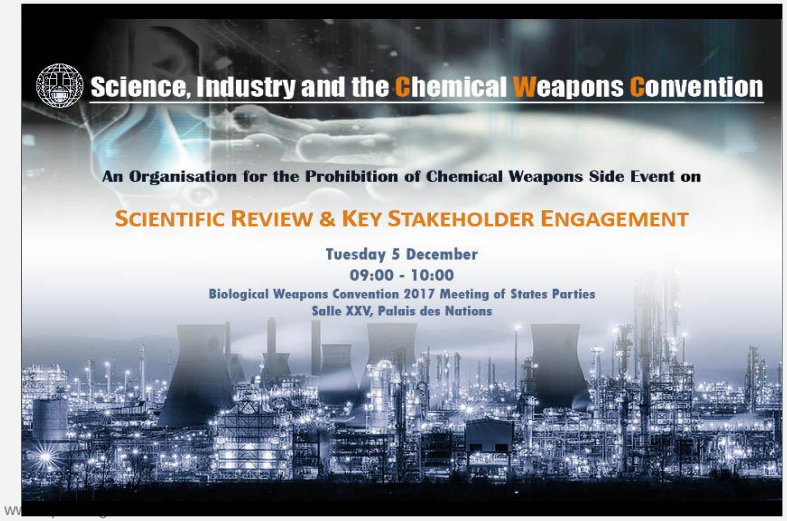
Central Nervous System-Acting Chemicals
The Scientific Perspective

Dr Christopher M. Timperley
Chair of the Scientific Advisory Board, OPCW

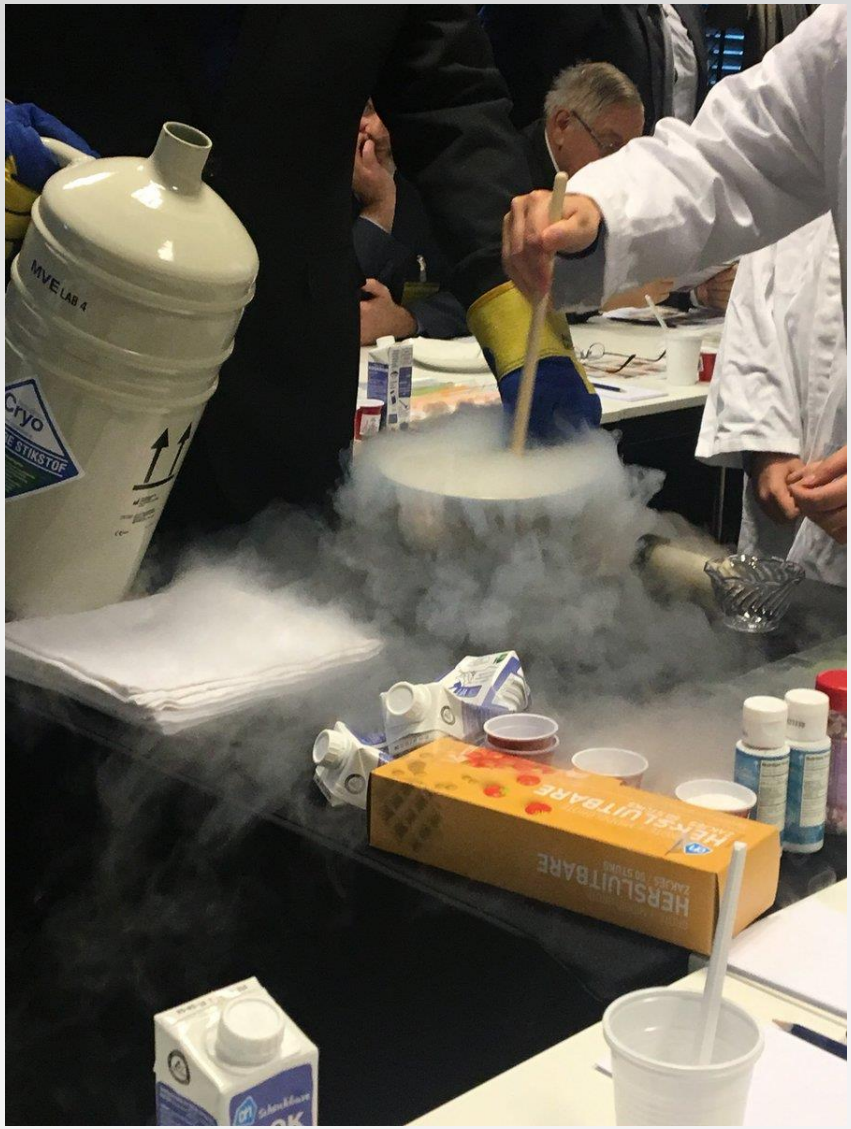
Presentation to the CSP22
28 November 2017, The Hague

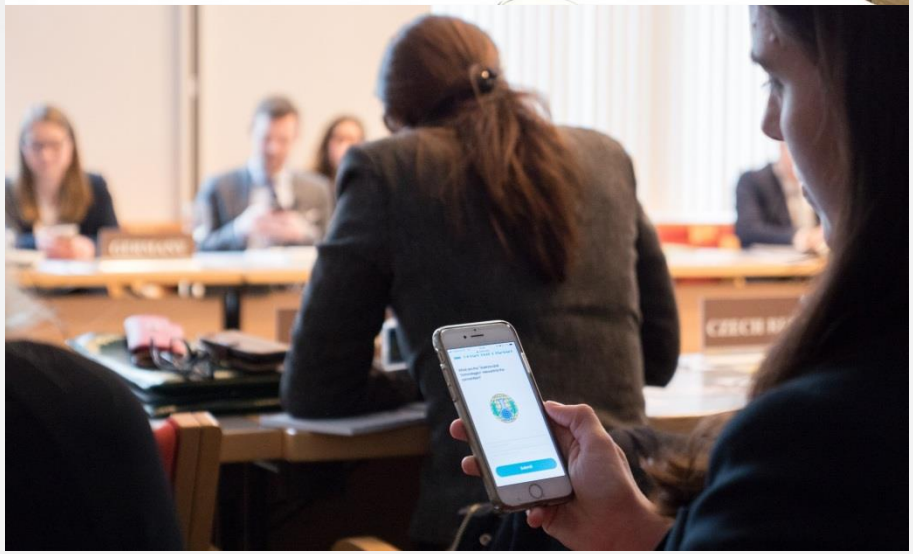
OPCWCSP22

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



Science for diplomats





Schedule 1 Users Forum

S1 Users Forum

Madrid, 13-16 January 2014

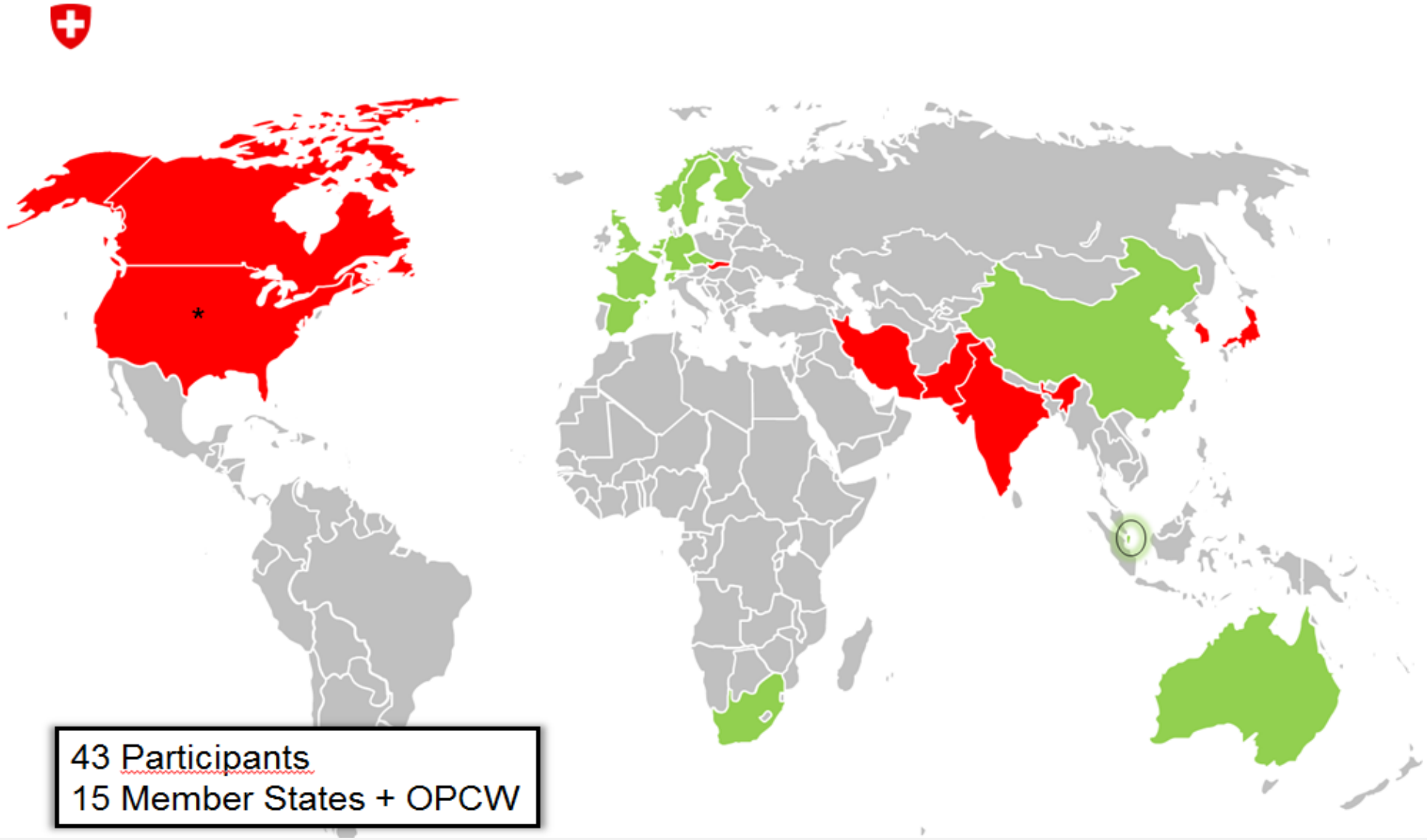
S1 Users Forum

Spiez, 22-25 January 2018

Provide a unique platform for practitioners within S1 facilities to share knowledge of

- Toxic chemicals
- Verification
- Detection
- Decontamination
- Chemical analysis

Spiez Laboratory Schedule 1 Users Forum



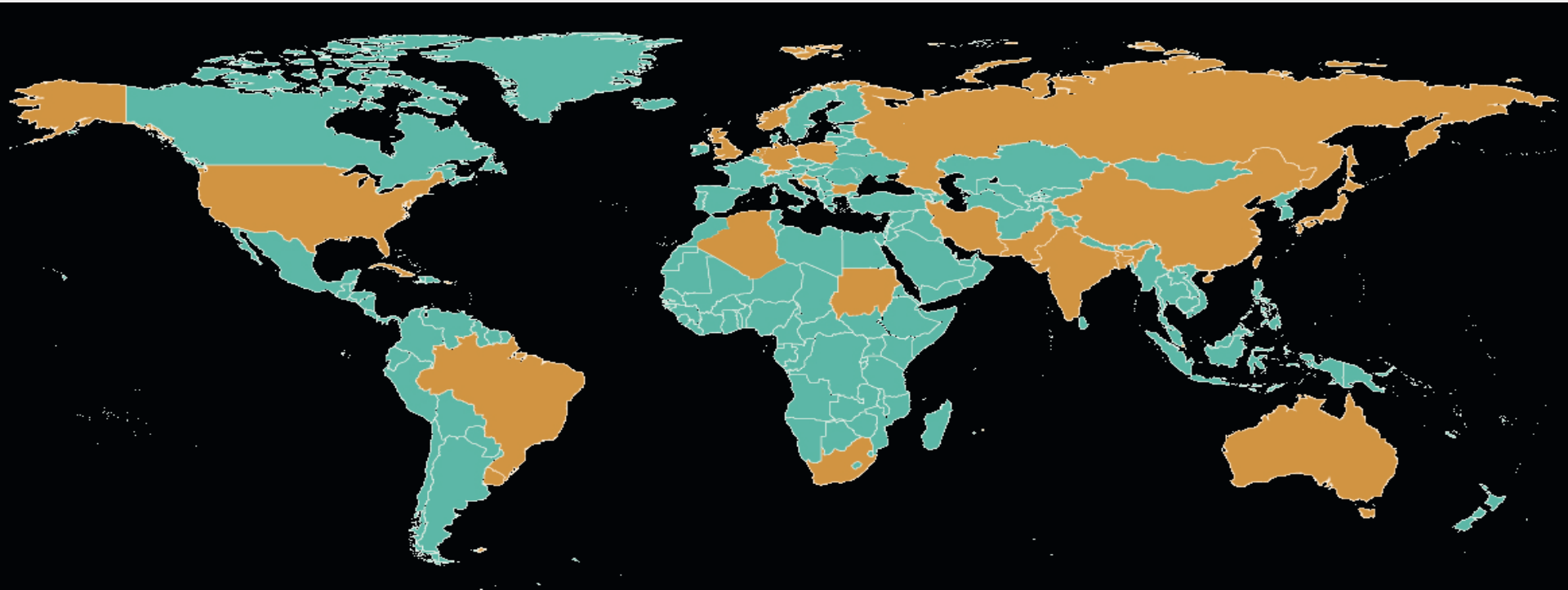
New members of SAB

Prof. Syeda Sultana Razia (of Bangladesh)

Prof. Vladimir Dimitrov (of Bulgaria)

Dr. Daan Noort (of The Netherlands)

Dr. Yasuo Seto (of Japan)



SAB-27

General updates

Update on work of the ABEO

Work of Declarations Branch

Future of industry verification

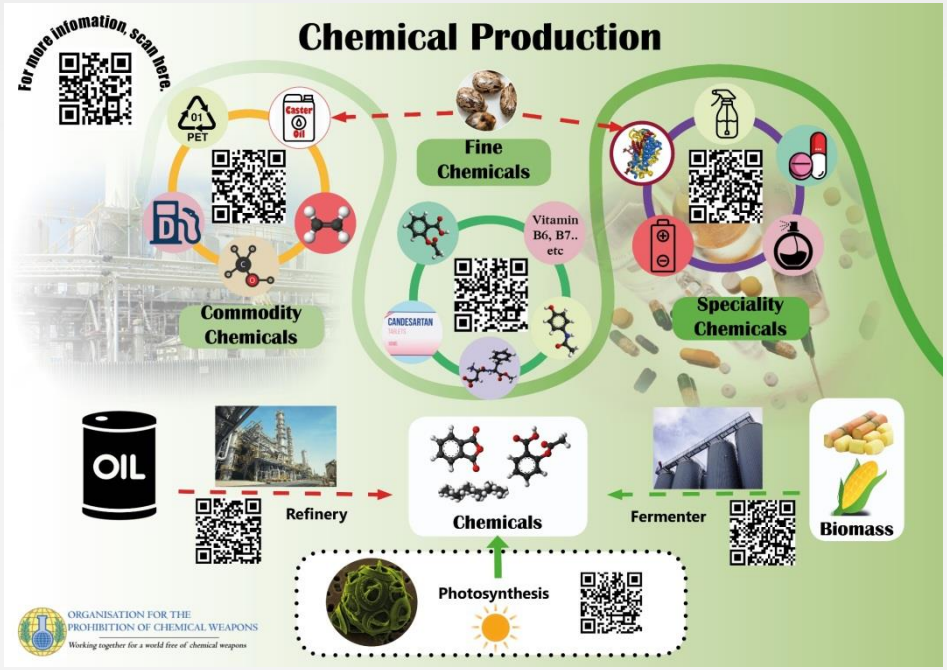
Monitoring Activities of the TS

OPCW contingency operations

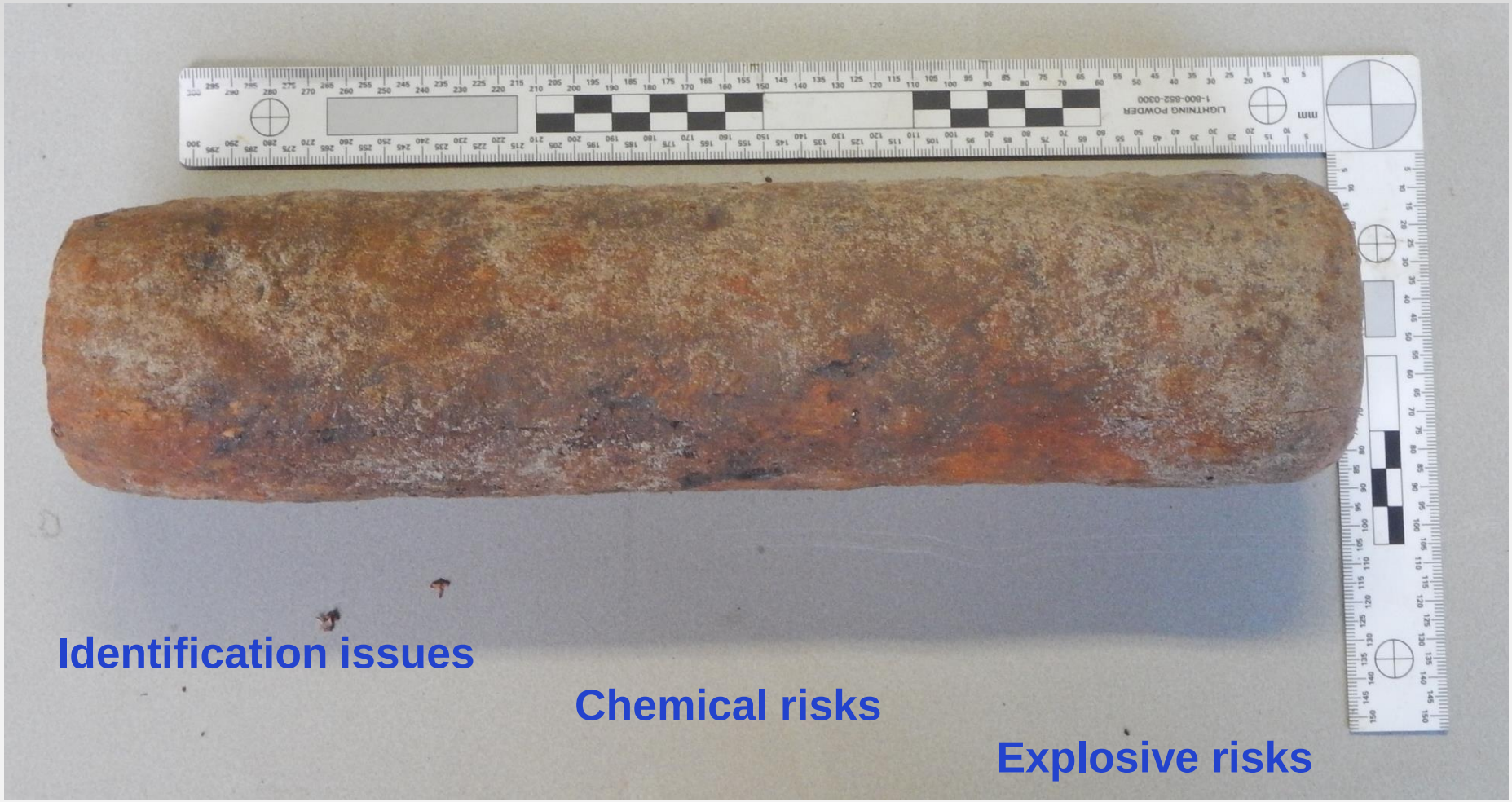
Update on work of the RRAM

OPCW-interagency cooperation

Shutting down a S1 facility



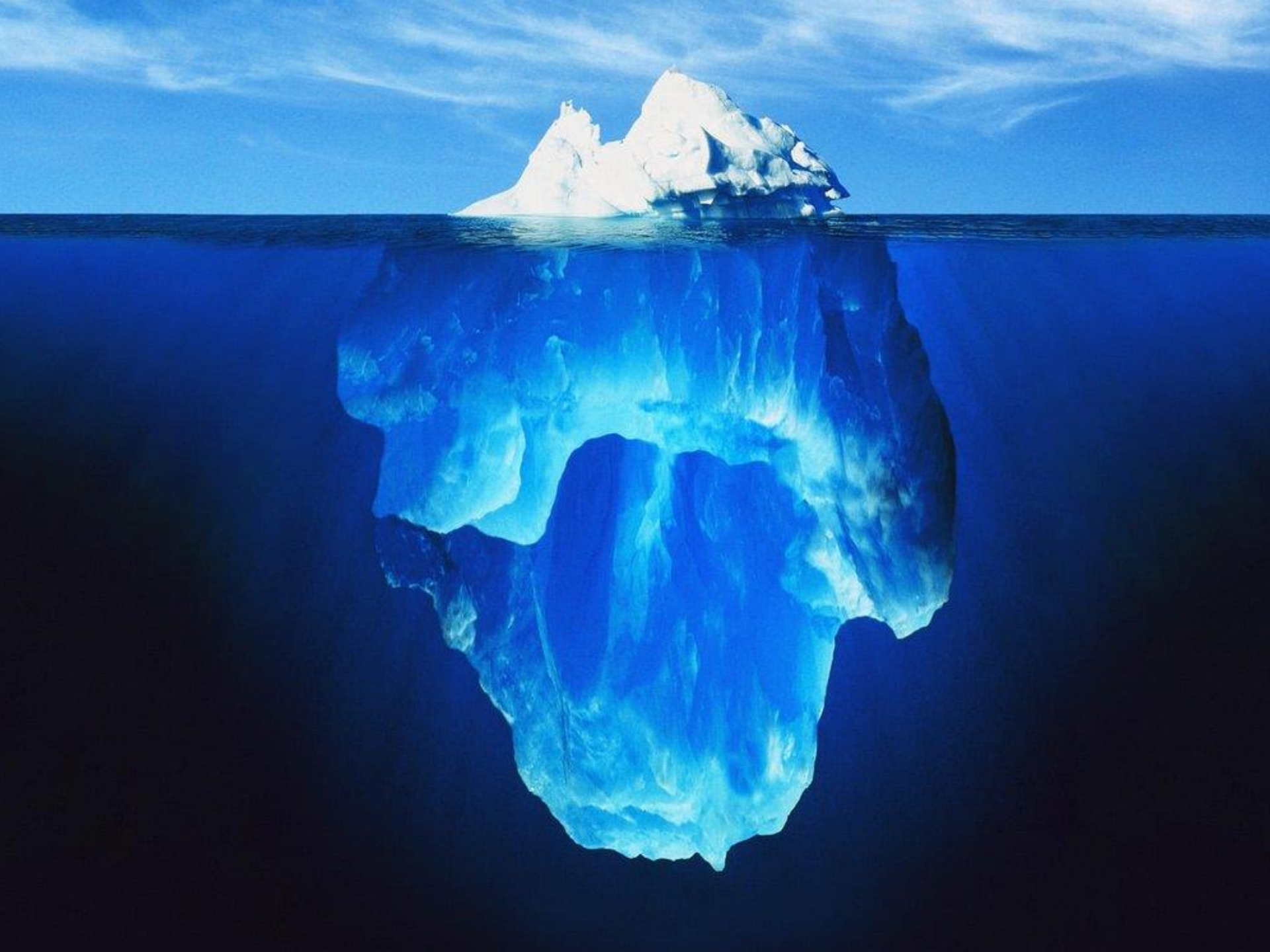
Challenges of OCW discoveries (Sven Devroe)



Challenges of OCW discoveries (Sven Devroe)

Choice based on risk assessment

Challenges of OCW discoveries (Sven Devroe)



OPCW

Technical Secretariat

United Nations A/67/997–S/2013/553

General Assembly
Security Council

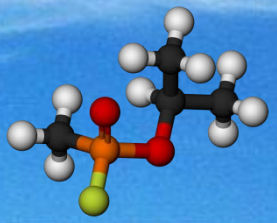
Distr.: General
16 September 2013

Original: English

General Assembly
Sixty-seventh session
Agenda item 33
Prevention of armed conflict

Security Council
Sixty-eighth year

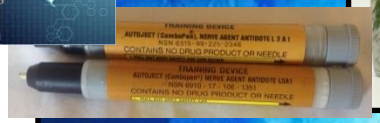
Report of the United Nations Mission to Investigate Allegations of the Use of Chemical Weapons in the Syrian Arab Republic on the alleged use of chemical weapons in the Ghouta area of Damascus on 21 August 2013

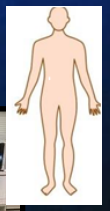


EMERGENCY

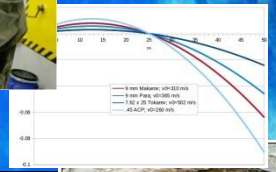
CRISIS

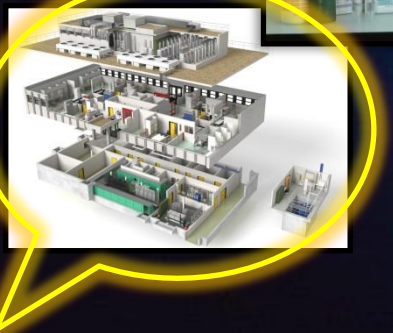
CONVERGENCE





FORENSIC





Biosensors as detectors? (Dr. Franz Worek)

Bundeswehr Institute of Pharmacology and Toxicology, Munich, Germany

Raid-M

AP4C

LCD 3.3

- **Limited spectrum**
- **Only point-detection on surfaces**
- **No easy detection of persistent agents**

Biosensors as detectors? (Dr. Franz Worek)

Toxicology Letters 262 (2016) 12–16

Contents lists available at ScienceDirect

Toxicology Letters

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

Blaptica dubia as sentinels for exposure to chemical warfare agents – a pilot study

Franz Worek*, Thomas Seeger, Katharina Neumaier, Timo Wille, Horst Thiermann

Bundeswehr Institute of Pharmacology and Toxicology, Munich, Germany

Tested agents:

Nerve agents : tabun, sarin, soman, cyclosarin, VX

Blister agents : sulfur mustard, Lewisite

Blood agents : potassium cyanide

Biosensors using acetylcholinesterase (Franz Worek)

Toxicology Letters 280 (2017) 190–194

Contents lists available at ScienceDirect

Toxicology Letters

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

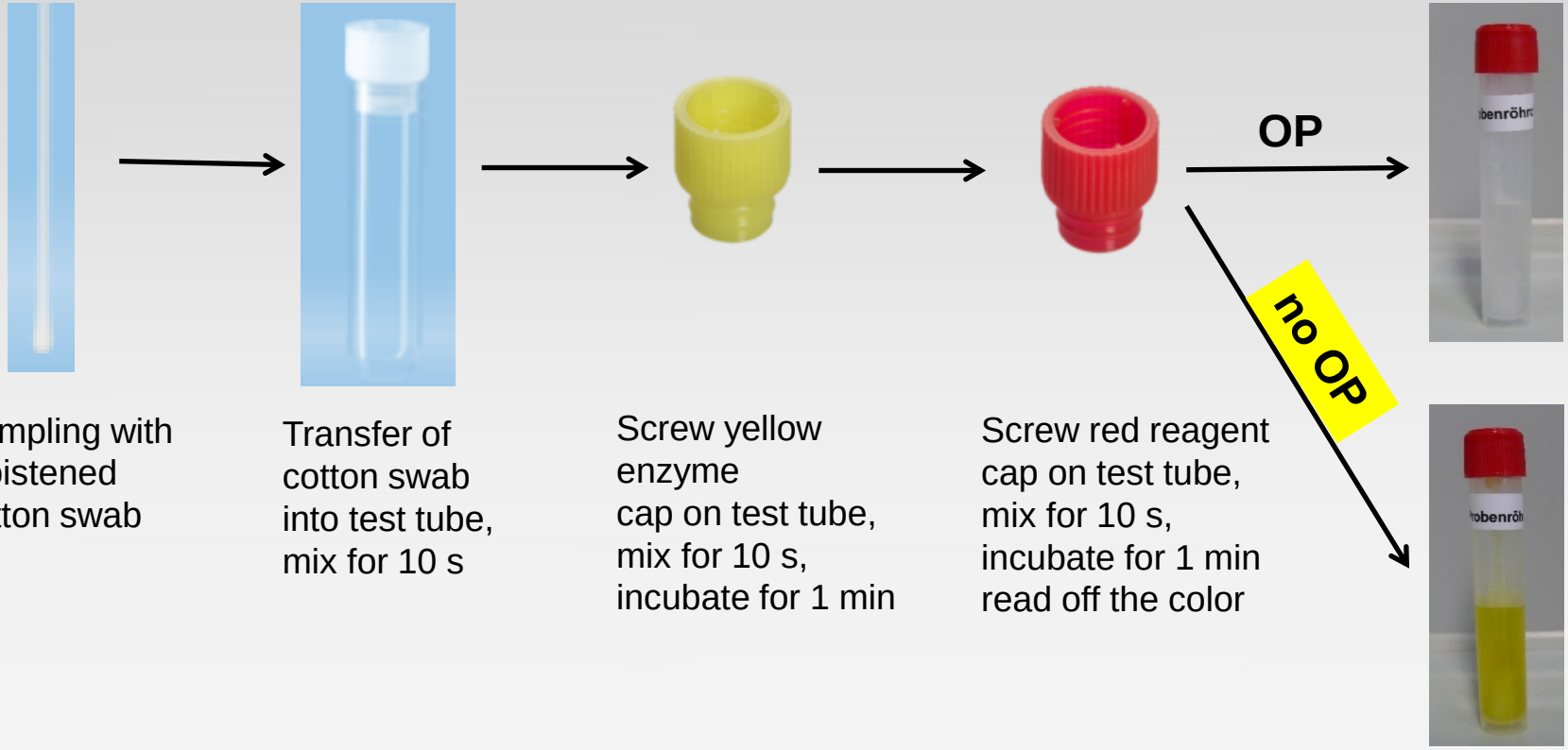
Full Length Article

Development of a sensitive, generic and easy to use organophosphate skin disclosure kit

Franz Worek*, Andreas Wosar, Madlen Baumann, Horst Thiermann, Timo Wille

Bundeswehr Institute of Pharmacology and Toxicology, Munich, Germany

Biosensors using acetylcholinesterase (AChE) (Franz Worek)



4	3	2	1	0
No AChE Inhibitor				**AChE Inhibitor**

Biosensors using acetylcholinesterase (AChE) (Franz Worek)

Portable lightweight kit for measuring red blood cell AChE activity

Useful system for determining if exposure to a nerve agent has occurred

Designed by the Bundeswehr Institute of Pharmacology and Toxicology

For further details see : www.securetec.net

“If plants could talk” (Mukremin Balci, Gareth Williams)

IMAGE

- Concept: images might be scanned using mobile phones by OPCW inspectors
- Both imaging and analysis can then be performed remotely via robotics

Supervised AI application

Not definitive output, but probable !

AI

HUMAN

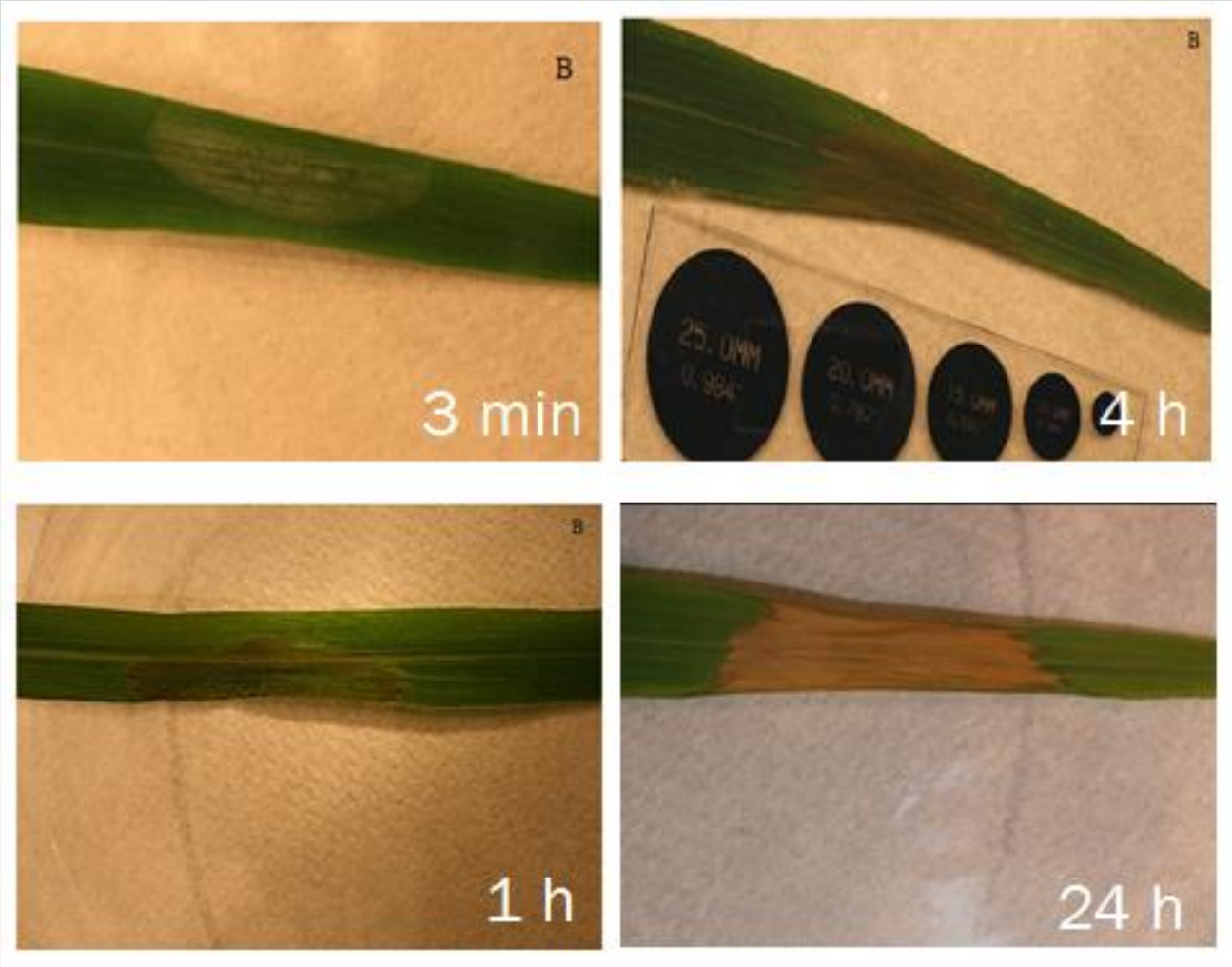
PHASE 1

- CWA Positive
- CWA Negative

PHASE 2

- Mustard
- Lewisite
- Chlorine
- CWA Negative

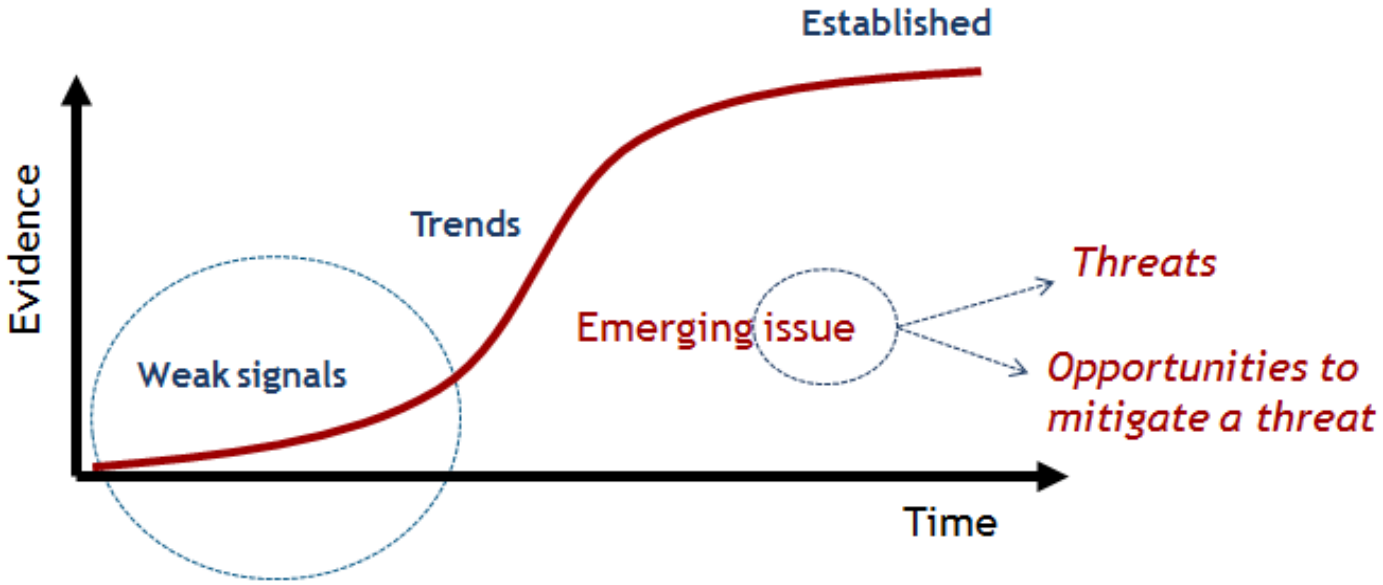
“If plants could talk”



© M Simini, R T Checkai, M V Haley. Visual characterization of VX droplets on plant foliage. Edgewood Chemical Biological Centre (ECBC), Maryland, USA, July 2016

Horizon scanning for emerging issues (B. Wintle, C. Boehm)

A **systematic** way of sifting through information, identifying and analysing early indicators of change (**weak signals of an emerging 'issue'**)



CENTRE FOR THE STUDY OF EXISTENTIAL RISK

UNIVERSITY OF CAMBRIDGE

Early warning of bioagent exposure (Dr. Albert Swiston)

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The NEW ENGLAND JOURNAL of MEDICINE

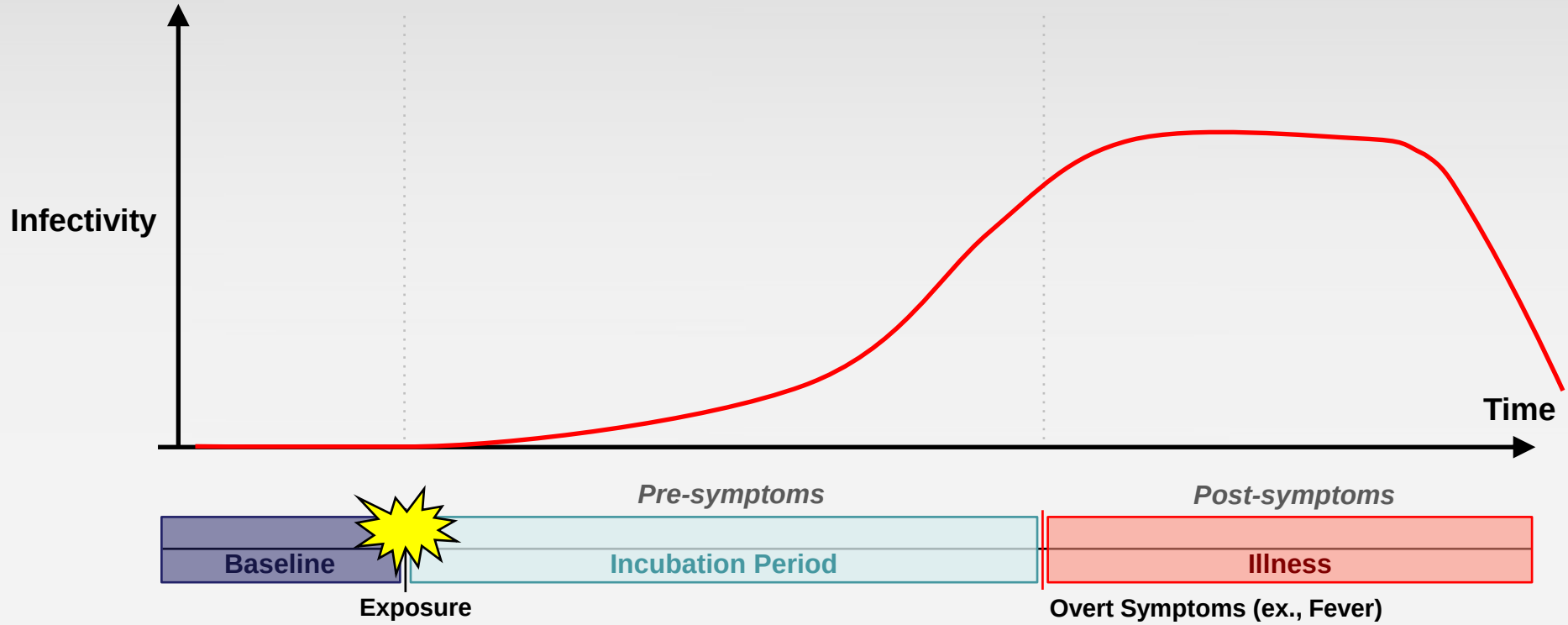
The Next Epidemic — Lessons from Ebola

Bill Gates N ENGL J MED 372;15 NEJM.ORG APRIL 9, 2015

"... of all the things that could kill more than 10 million people around the world, the most likely is an epidemic stemming from either natural causes or bioterrorism."

Early warning of bioagent exposure (Dr. Albert Swiston)

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



Early warning of bioagent exposure (Dr. Albert Swiston)

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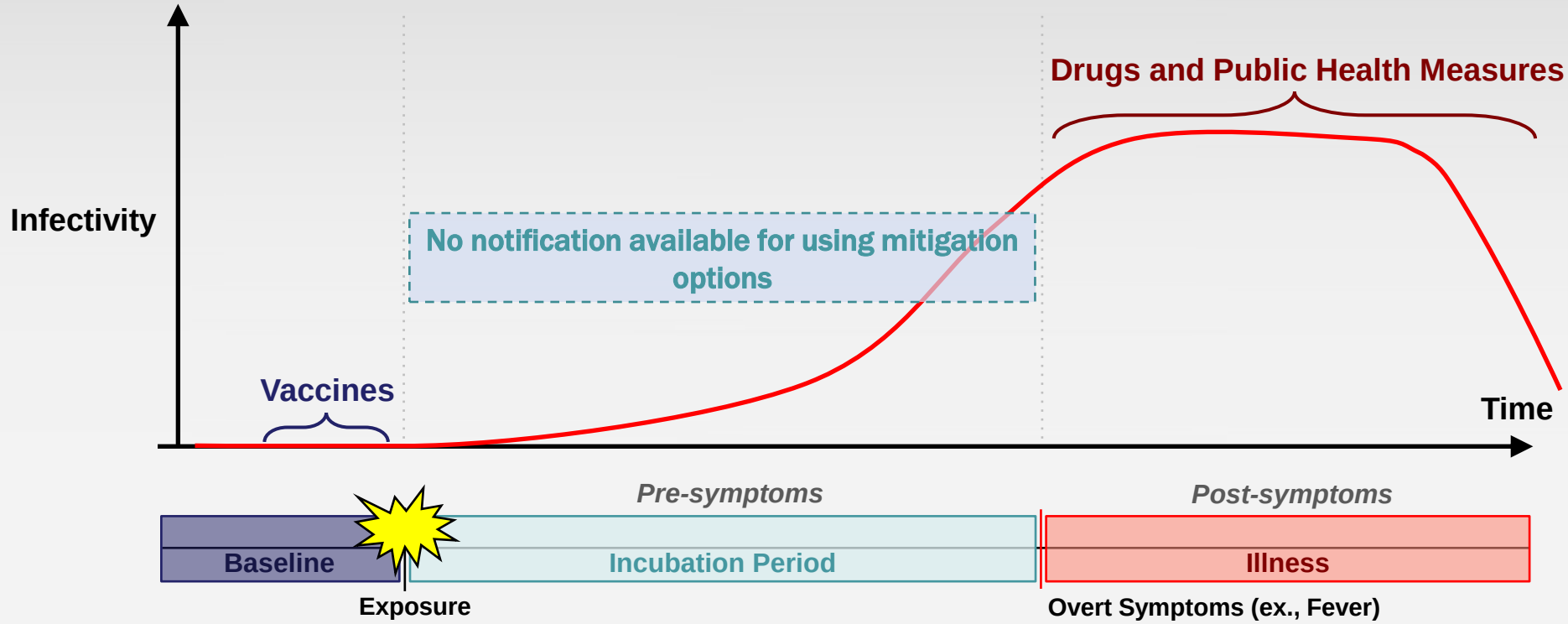
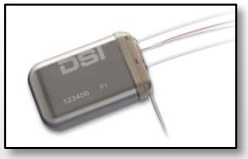


Major 'window of opportunity' for outbreak mitigation with Early Warning (EW) during incubation period

Early warning of bioagent exposure (Dr. Albert Swiston)

All Available Features



- ECG
- Pulmonary
- Hemodynamic
- Temperature

ECG Only

"Classic" version

Newest types

Heart Rate + Temperature

Heart Rate Only

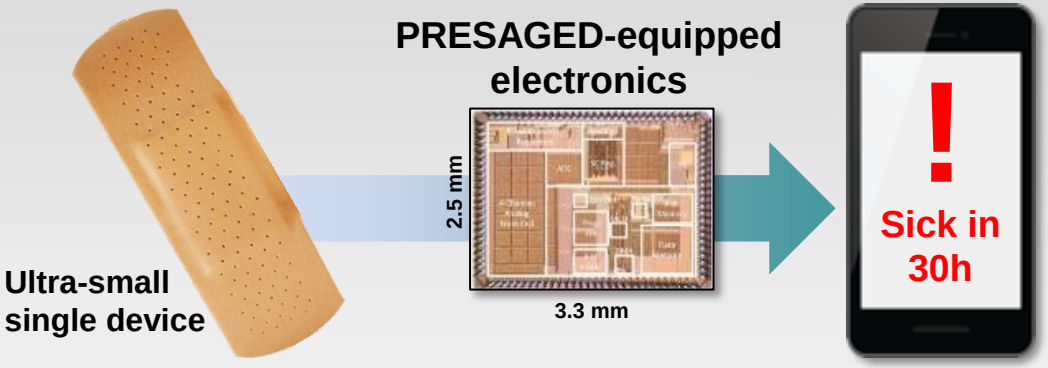
Operational Feasibility				
EW time				

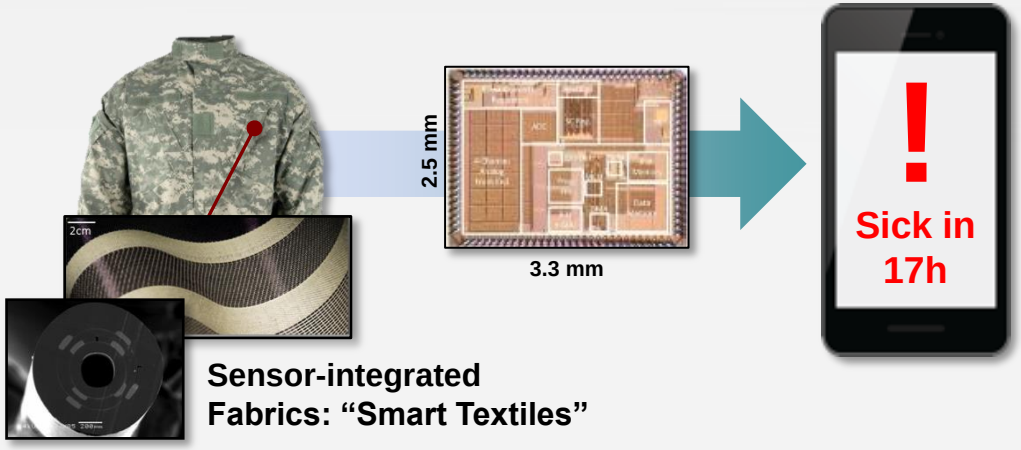
Many issues, Poor performance

Some issues, Mediocre performance

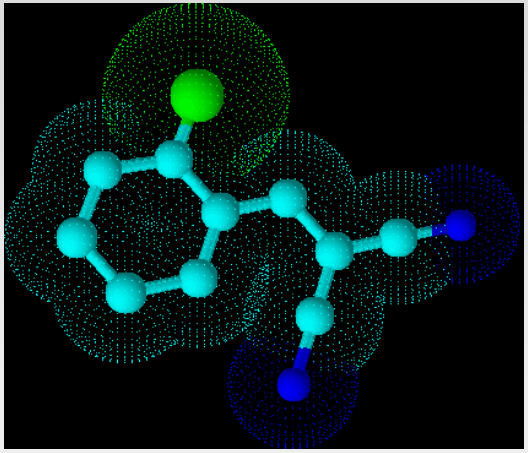
Few issues, Good performance

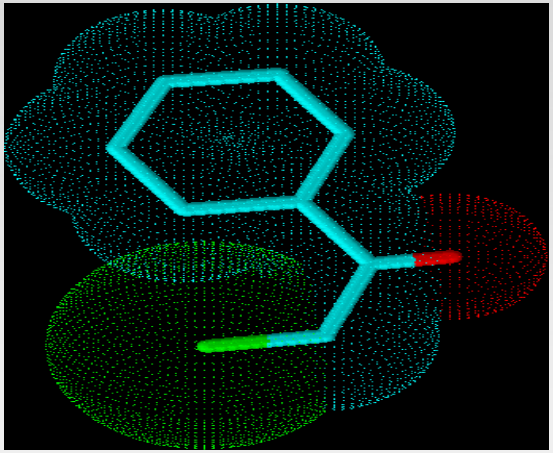
Early warning of bioagent exposure (Dr. Albert Swiston)

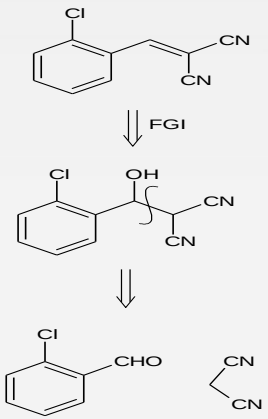


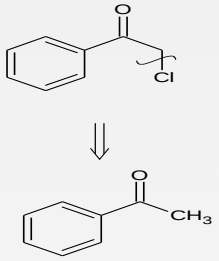


Tools for chemical production (Prof. Ahmed Saeed)









o- chlorobenzylidene malonitrile	2- chloroacetophenone

21-30 November 2018 : a time to review

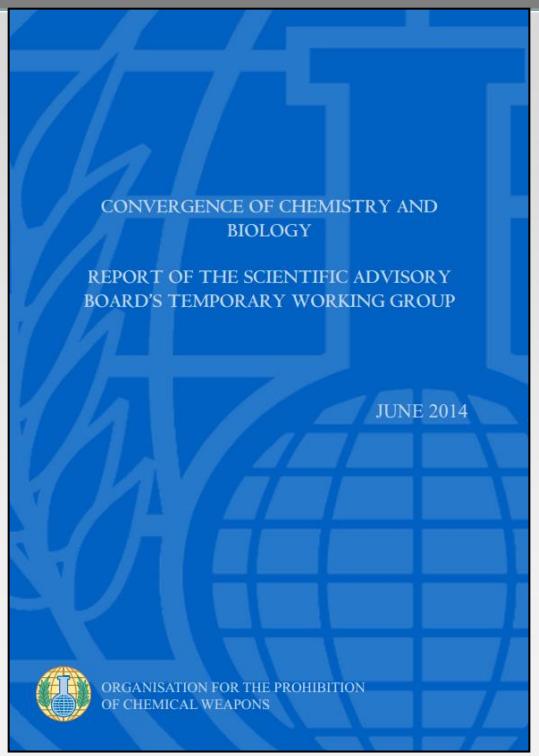
SAB report:

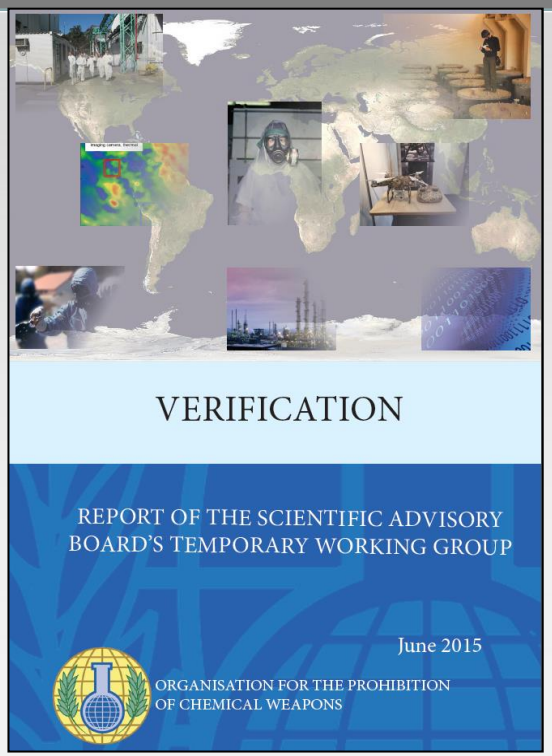
Overview of scientific and technological changes during review period

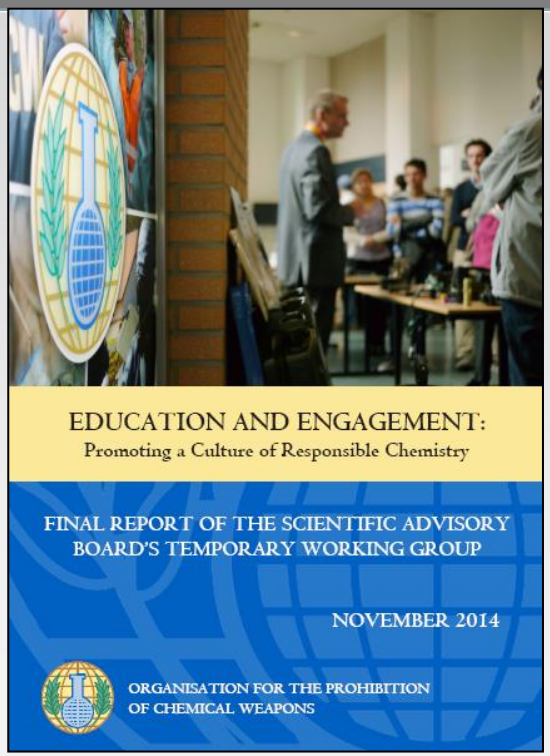
Advice on relevant and emerging areas of science and technology

Recommendations for moving forward

Where is the science review?

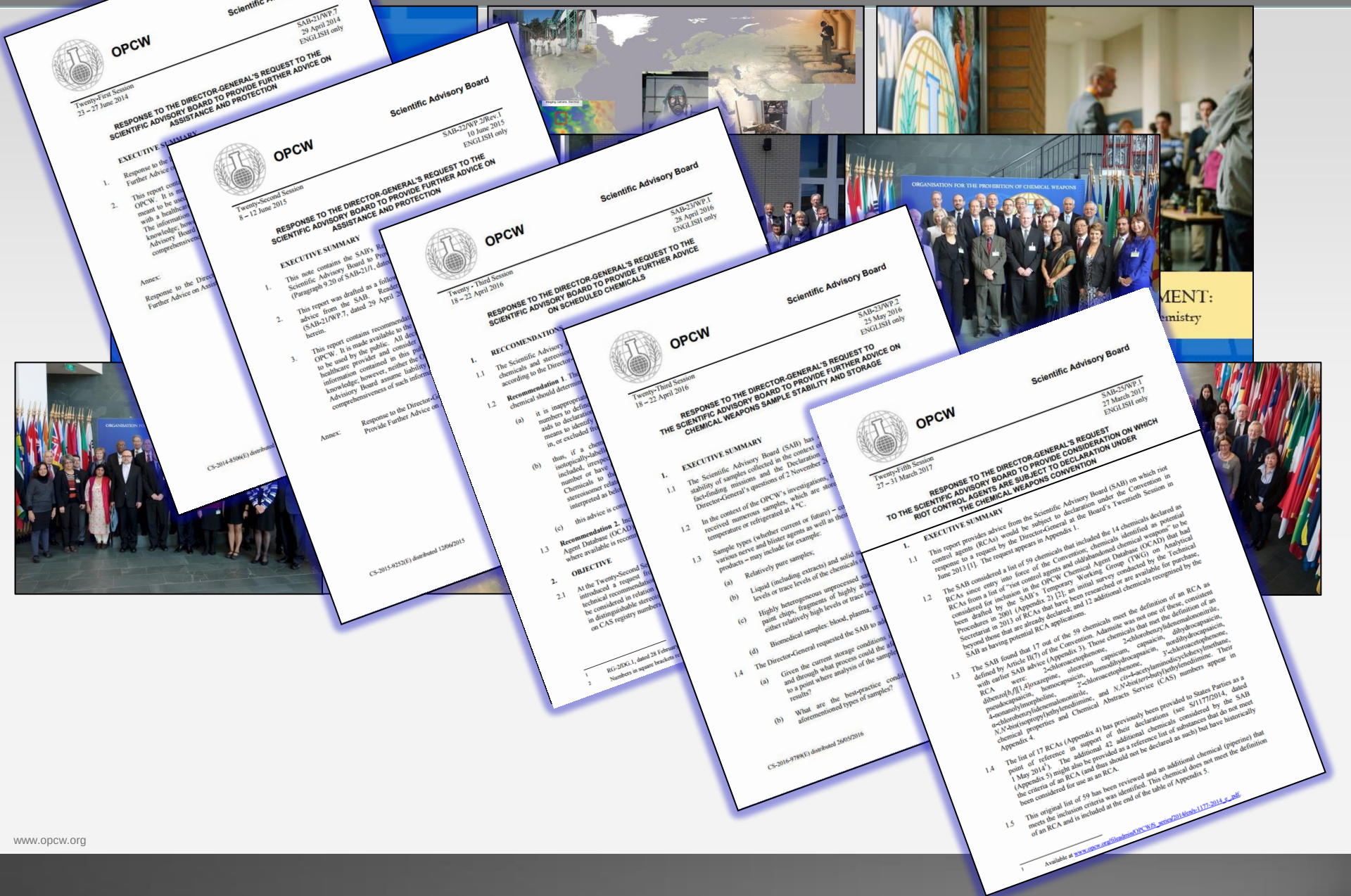






Where is the science review?

Where is the science review?



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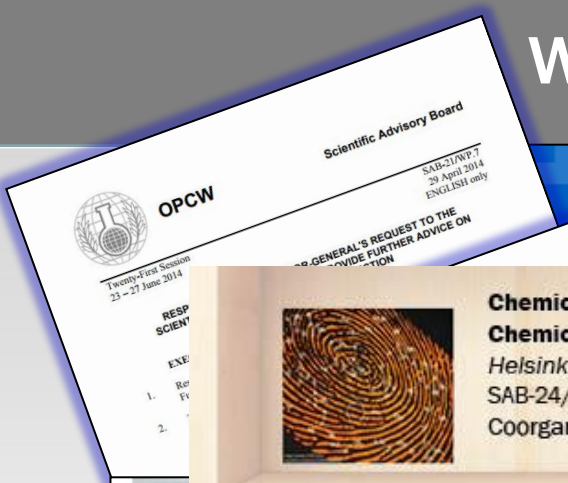
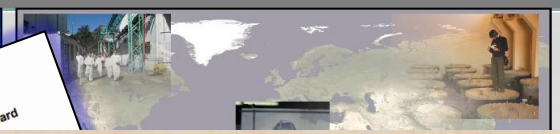




Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation

Helsinki, Finland. 20 to 22 June 2016

SAB-24/WP.1, dated 14 July 2016, URL: http://q-r.to/bap1gy

Coorganizer: VERIFIN

SCAN ME

Chemical Warfare Agents: Toxicity, Emergency Response and Medical Countermeasures

Paris, France. 26 to 27 September 2016

SAB-24/WP.2, dated 14 October 2016, URL: http://q-r.to/bap1h4

Coorganizer: SGDSN

SCAN ME

Innovative Technologies for Chemical Security

Rio de Janeiro, Brazil. 3 to 5 July 2017

SAB-26/WP.1, dated 21 July 2017, URL: http://q-r.to/bap1hC

Coorganizers: IUPAC; The National Academies of Sciences Engineering Medicine; Academia Brasileira de Ciências

SCAN ME

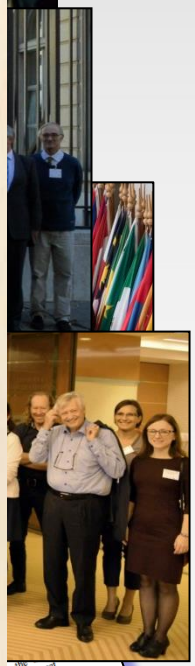
International Workshop on Trends in Chemical Production

Zagreb, the Republic of Croatia. 3 to 5 October 2017

SAB-26/WP.2, dated 19 October 2017, URL: http://q-r.to/bap1hD

Coorganizers: Zagreb; Ministry of Economy; imi

SCAN ME



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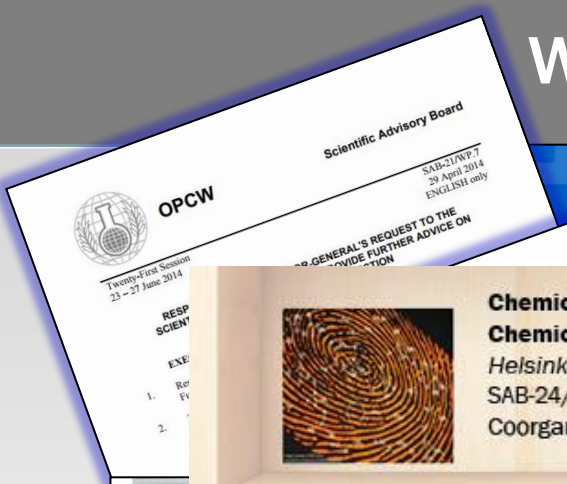

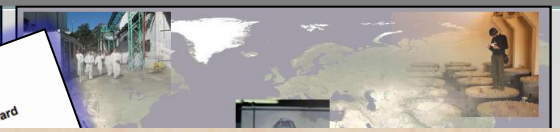

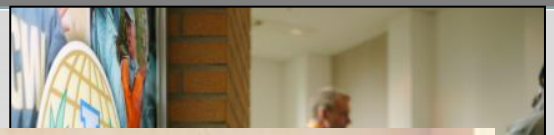

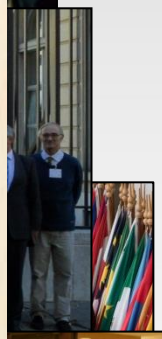

Chemical Forensics: Capabilities across the Field and the Potential Applications in Chemical Weapons Convention Implementation

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Coorganizer: VERIFIN

Chemical Warfare Agents: Toxicity, Emergency Response and Medical Countermeasures

Paris, France. 2[illegible] September 2[illegible]

SAB-24/WP.2, dated 1[illegible] October 2[illegible]

Coorganizer:

SGDSN

Innovative Technologies[illegible]

Rio de Janeiro, Brazil. 3 to 5 July 2017

SAB-26/WP.1, dated 21 July 2017, URL: http://q-r.to/bap1hC

Coorganizers:

IUPAC

SCIENCES ENGINEERING MEDICINE

ACADEMIA BRASILEIRA DE CIÊNCIAS

International Workshop on Trends in Chemical Production

Zagreb, the Republic of[illegible]. 3 to[illegible]

SAB-26/WP.2, dated 19[illegible]

Coorganizers:

Zagreb

REPUBLIC OF CROATIA MINISTRY OF ECONOMY

imi

SCAN ME

SCAN ME

SCAN ME

SCAN ME

27 events

717 attendees

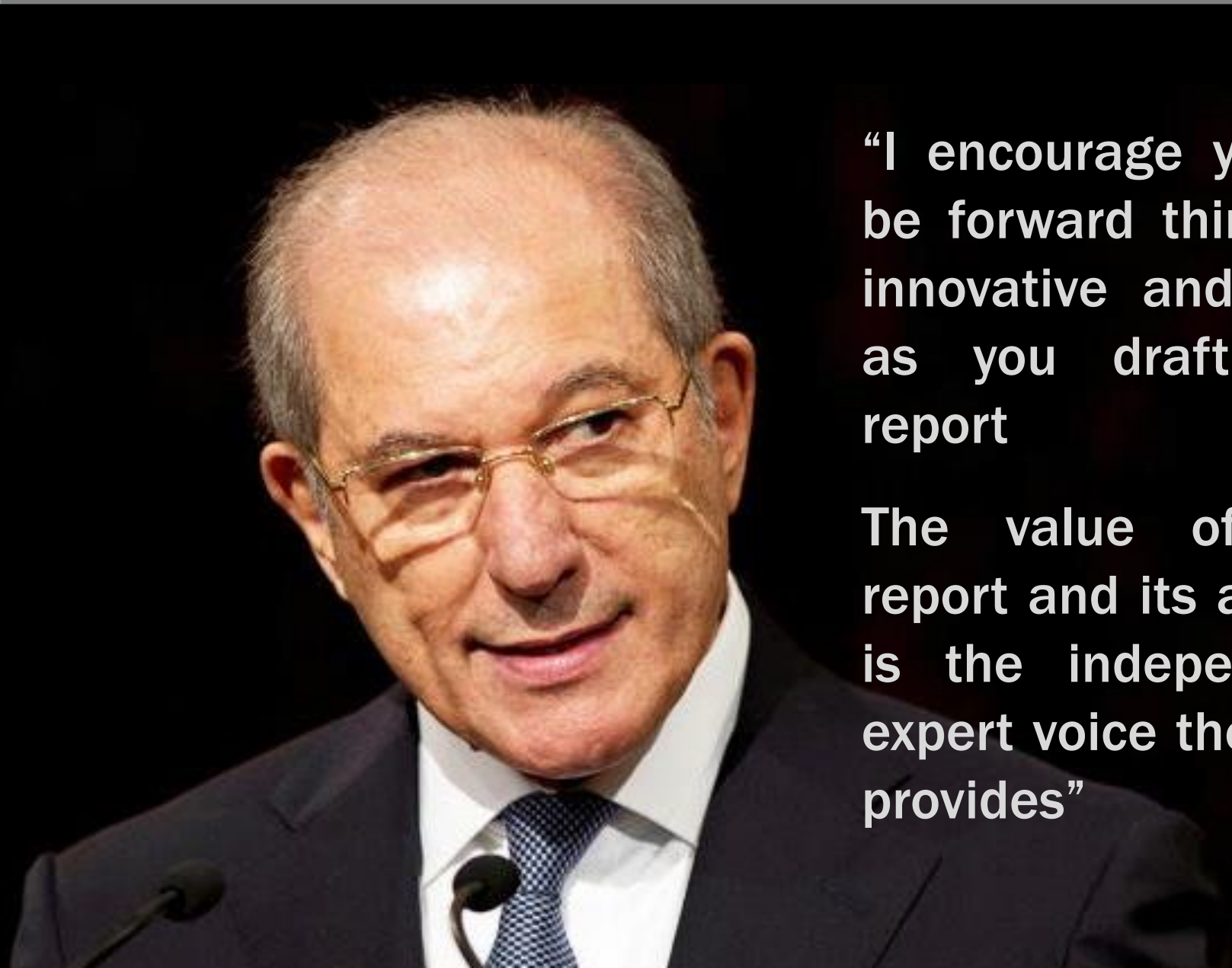
- 285 individuals
- 58 States Parties

429 speakers

- 197 individuals

31 reports

SAB report to Fourth Review Conference



"I encourage you to be forward thinking, innovative and bold as you draft this report

The value of the report and its advice is the independent expert voice the SAB provides"

General obligations, destruction and declarations

Most noted topics and issues:

- Destruction of remaining CWs, OCW and ACW discoveries
- General obligation not to use of CWs – accountability
- Prevention of re-emergence and rapid response
- Strengthening of analytical capacity of OPCW
- Improvement of VER
- Importance of accurate, timely and complete declarations
- Implementation of recommendations of the SAB-TWG on VER

Industry verification

Most noted topics and issues:

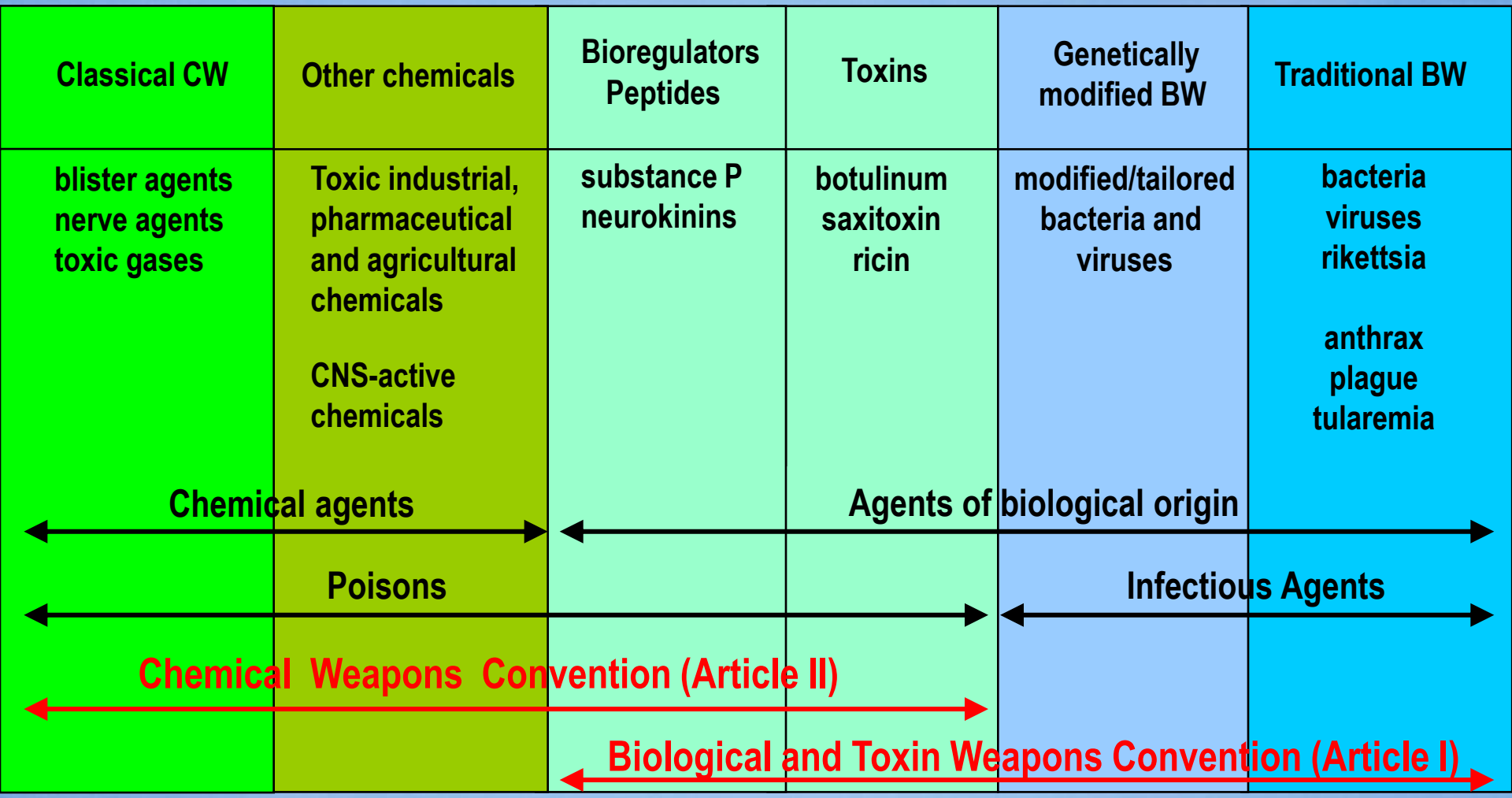
- Industry VER adapted to new challenges and risk patterns
- SAB-TWG VER recommendations, “revitalisation” industry cluster
- Improved preparedness to verify misuse of toxic chemicals
- Convergence of chemistry and biology, biomediated synthesis
- Use of sampling and analysis
- Site selection methodologies

Consultations, cooperation and fact-finding

Most noted topics and issues:

- Non-routine missions that the TS conducted since 2013
- Readiness to conduct contingency operations incl CIs and IAUs
- Cooperation with other int organisations in the context of NSA
- Expansion of the OPCW-LAB and network of designated labs
- Addition of data to OCAD including non-scheduled chemicals
- Chemical forensics

Threat spectrum



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:

(a) It has been developed, produced, stockpiled or used as a chemical weapon as defined in Article II;

(b) 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:

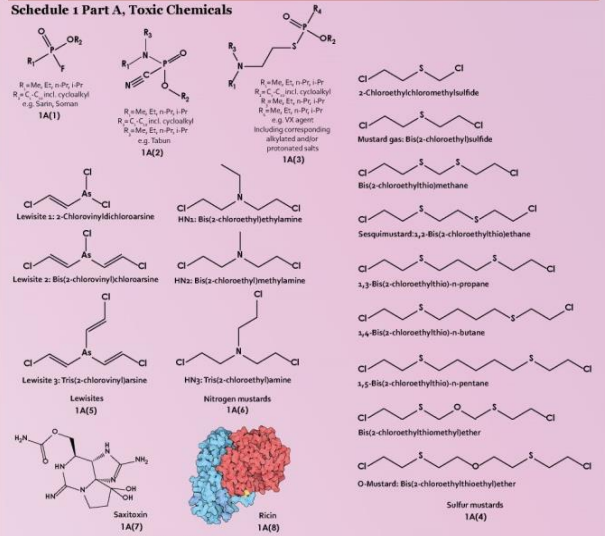
(i) It possesses a chemical structure closely related to that of other toxic chemicals listed in Schedule 1, and has, or can be expected to have, comparableproperties;

(ii) It possesses such lethal or incapacitating toxicity as well as other properties that would enable it to be used as a chemical weapon;

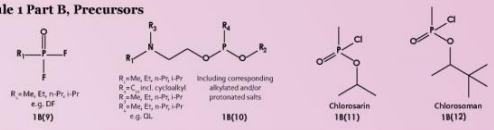
(iii) It may be used as a precursor in the final single technological stage of production of a toxic chemical listed in Schedule 1, regardless of whether this stage takes place in facilities, in munitions or elsewhere;

(c) It has little or no use for purposes not prohibited under this Convention.

Schedule 1 Part A, Toxic Chemicals



Schedule 1 Part B, Precursors



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:

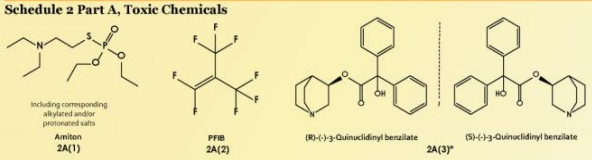
(a) It poses a significant risk to the object and purpose of this Convention because it possesses such lethal or incapacitating toxicity as well as other properties that could enable it to be used as a chemical weapon;

(b) 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;

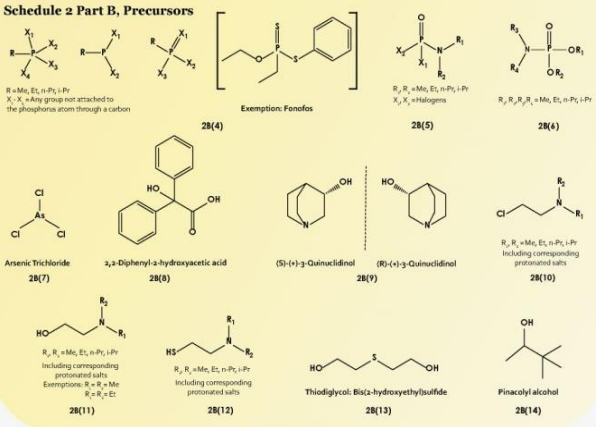
(c) It poses a significant risk to the object and purpose of this Convention by virtue of its importance in the production of a chemical listed in Schedule 1 or Schedule 2, part A;

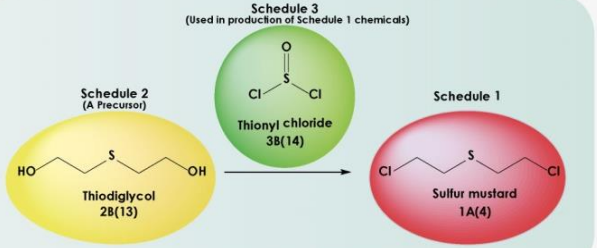
(d) It is not produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 2 Part A, Toxic Chemicals



Schedule 2 Part B, Precursors





Relationship between Schedules, illustrated with sulfur mustard.

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:

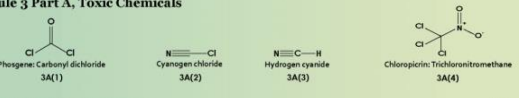
(a) It has been produced, stockpiled or used as a chemical weapon;

(b) 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 might enable it to be used as a chemical weapon;

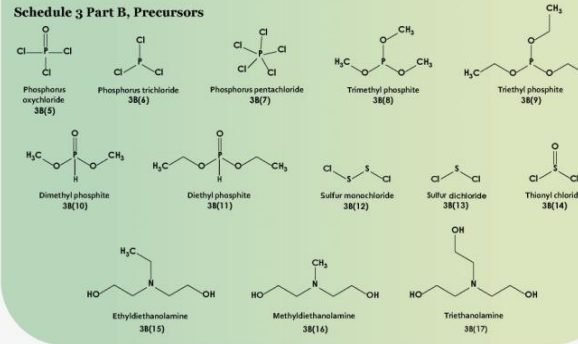
(c) It poses a risk to the object and purpose of this Convention by virtue of its importance in the production of one or more chemicals listed in Schedule 1 or Schedule 2, part B;

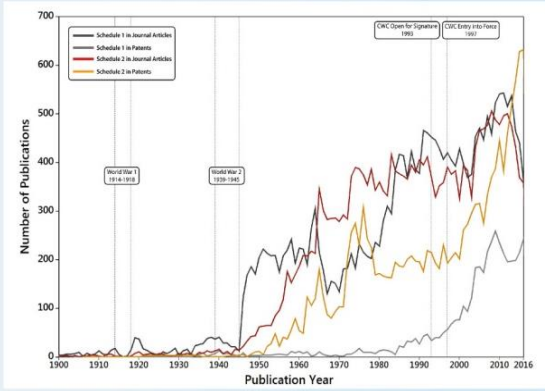
(d) It may be produced in large commercial quantities for purposes not prohibited under this Convention.

Schedule 3 Part A, Toxic Chemicals



Schedule 3 Part B, Precursors





Scheduled chemicals, including those in schedules 1 and 2, can have scientifically and economically important uses. This chart captures the number of yearly scientific publications that refer to them.

ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Working Together for a World Free of Chemical Weapons

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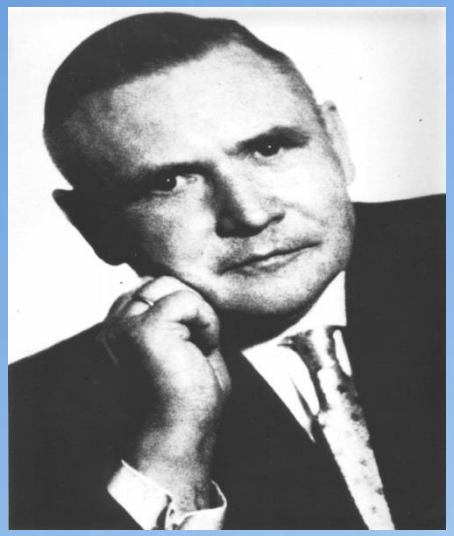
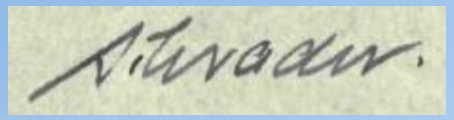
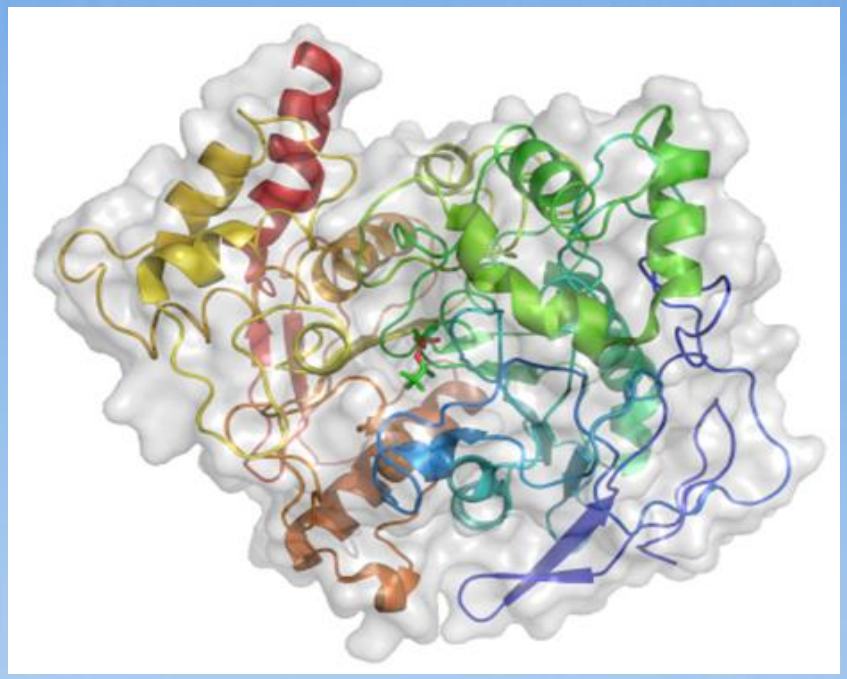
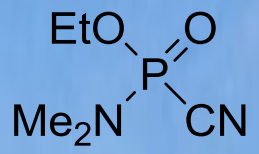
Organophosphorus nerve agents









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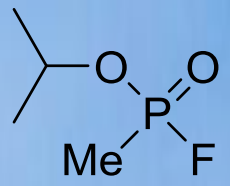

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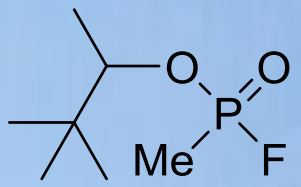

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1930s

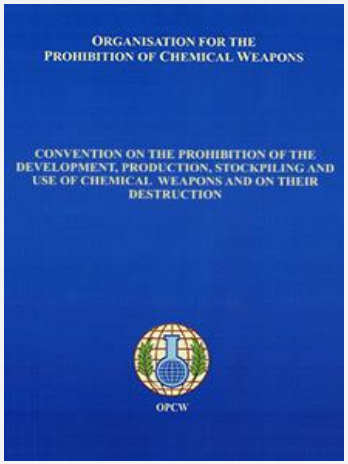
Schedules

Knowledge of chemistry related to the Schedules and industrial processes is key for inspectors

Adequate levels of scientific understanding will remain critical in making any assessments of an industrial capability or facility

A review of the schedules may be of value regarding chemicals previously not considered that are determined to pose a risk to non-proliferation, and could include :

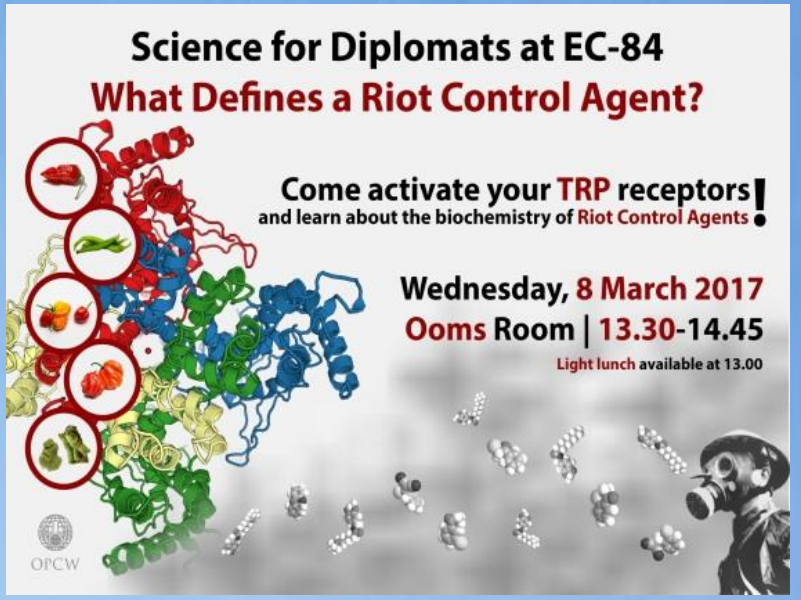
- toxic industrial chemicals
- CNS-acting chemicals
- unscheduled toxic chemicals

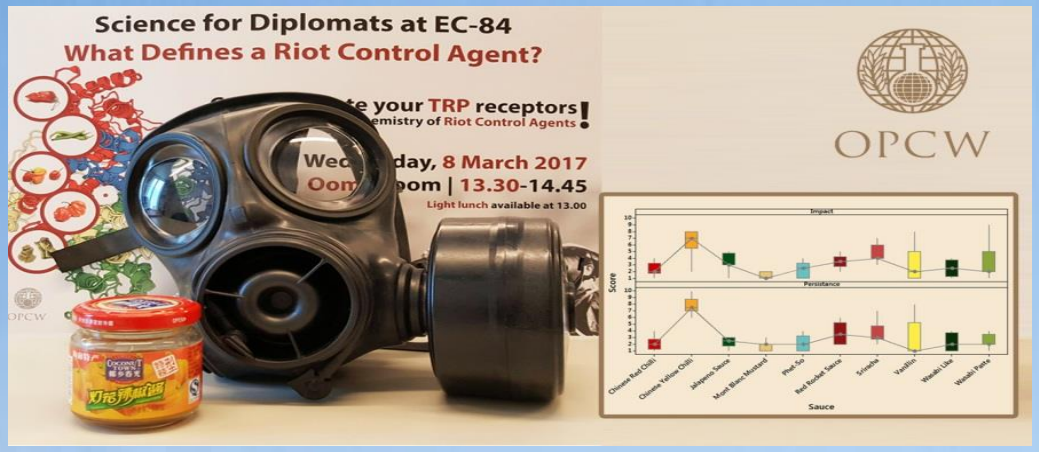


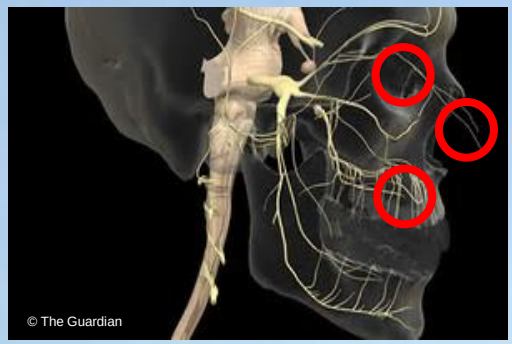
Riot control agents (RCAs)

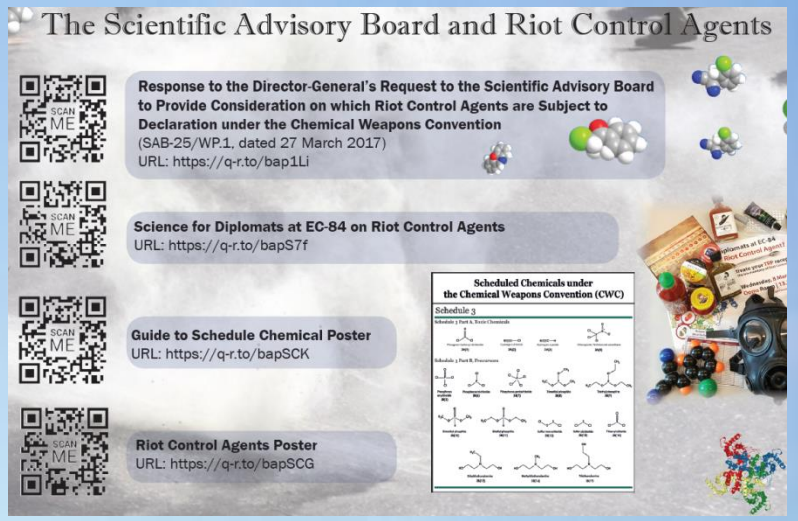
Reviewed list of 60 chemicals that had been discussed in a RCA context

Only 17 met CWC-definition of RCA

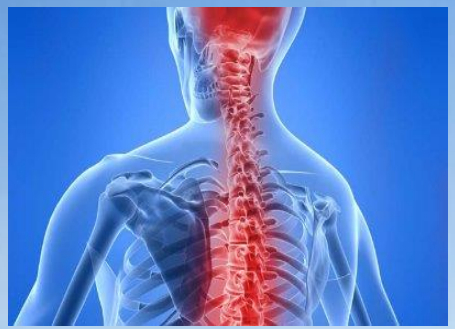








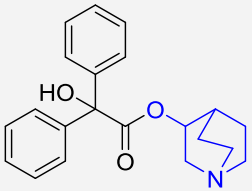
Central nervous system (CNS) acting chemicals



SAB reviewed 25 years of its advice on CNS-acting chemicals and concluded aerosolisation of these materials for law enforcement poses a significant health risk to humans

Technical discussions remain exhausted: issue now in the policy domain

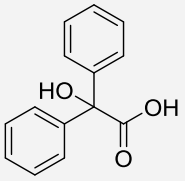
OPCW should start preparations for verification activities to prepare for any future IAU



3-quinuclidinyl benzilate (BZ)

Schedule 2.A.3

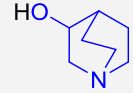
made from



2,2-diphenyl-2-hydroxyacetic acid

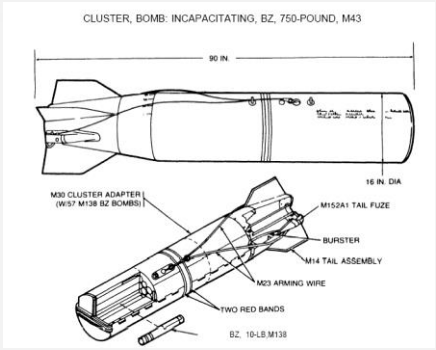
Schedule 2.B.8

and



quinuclidin-3-ol

Schedule 2.B.9



TWG on Investigative Science and Technology

TWG on Investigative Science and Technology

Contingency operations have increasingly involved investigations, analysis, and fact-finding, with collection and evaluation of oral, material, and digital evidence of the use of chemical agents

- Review science and technology relevant to investigations mandated under the CWC
- Include science and technology for the validation and provenancing (determining the chronology of ownership, custody and/or location) of evidence, and integration of multiple and diverse inputs to reconstruct a past event
- Identify capabilities, skill sets, and equipment that will augment and strengthen the investigative capabilities of OPCW





TWG on Investigative Science and Technology

Veronica Borrett (TWG Chair)	Australia
Augustin Baulig	France
Christophe Curty	Switzerland
David Gonzalez	Uruguay
Robert Mikulak	USA
Syed Raza	India
Valentin Rubaylo	Russian Federation
Francois van Straten	South Africa
Farhat Waqar	Pakistan
Daan Noort	TNO The Netherlands
Cheng Tang (SAB Vice-Chair)	China
Christopher Timperley (SAB Chair)	United Kingdom
Crister Åstot	FOI Sweden
Brigette Dorner	RKI Germany
Carlos Fraga	PNNL USA
Paula Vanninen	VERIFIN Finland
Ed van Zalen (TWG Vice-Chair)	Netherlands Forensic Institute

Temporary Working Group on Investigative Science and Technology

Reporting to the Scientific Advisory Board (SAB), the Temporary Working Group (TWG) will in particular consider the following questions:

Question 1:

Which methods and capabilities used in the forensic sciences could usefully be developed and/or adopted for Chemical Weapons Convention-based investigations?

Question 2:

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?

Question 3:

What are the best practices for management of data collected in investigations, including compilation, curation, and analytics?

Question 4:

What are the best practices for the collection, handling, curation and storage, and annotation of evidence?

Question 5:

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?

Question 6:

Which technologies and methodologies (whether established or new) can be used in the provenancing of chemical and/or material samples collected in an investigation?

Question 7:

Which methods are available (or are being developed) for the sampling and analysis of environmental and biomedical materials and can be used in the detection of toxic industrial chemicals relevant to the Chemical Weapons Convention?

Question 8:

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)?

Question 9:

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

Question 10:

Do collections of physical objects, samples, and other information for chemical weapons-related analysis exist and can they be made available to investigators for retrospective review? How might these collections be used to support investigations?

Question 11:

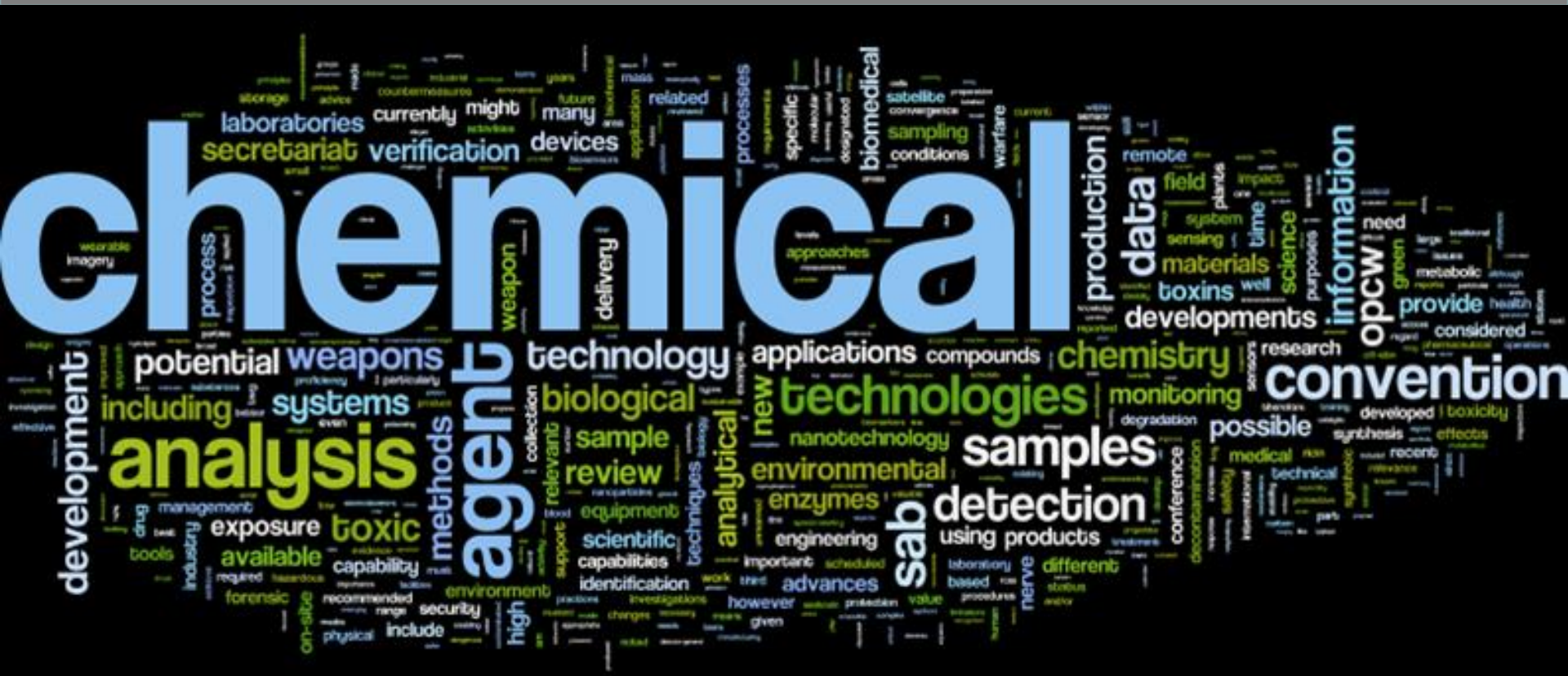
Are there stakeholders that the Technical Secretariat could usefully engage with to leverage their capabilities on investigative matters?

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

Designated laboratory network

- SAB supports expansion of the network which is a model of international cooperation
- SAB supports OPCW Laboratory redesign to a Centre for Chemistry and Technology

SAB's S&T report to the Fourth Review Conference



Inputs to S&T report finalized this week

Report submitted to Director-General in April

Response from Director-General in May

Key science and technology areas

Prevention of re-emergence: improvement of VER regime and consideration of CNS-acting chemicals/non-scheduled chemicals

Improvement of preparedness to verify the misuse of chemicals

Enhancement of analytical, forensic, and fact-finding capabilities

Gathering of more scientific evidence to support investigations and decision-making

OEWG-RC meeting to discuss science and technology

Meeting on S&T and its impact on CWC planned on 6 June

SAB Chairperson will brief the OEWG-RC on the S&T report

SAB S&T report to RC-4 and DG's response will be available

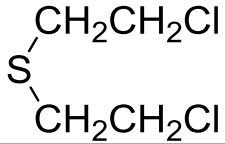
S&T sections will be included in forthcoming documents to inform the Review of the Operation on the Convention since RC-3

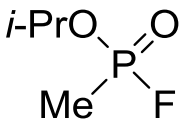
SAB review to be published in the scientific literature

Advice on chemical weapons sample stability and storage provided by the Scientific Advisory Board of the Organisation for the Prohibition of Chemical Weapons to increase investigative capabilities worldwide

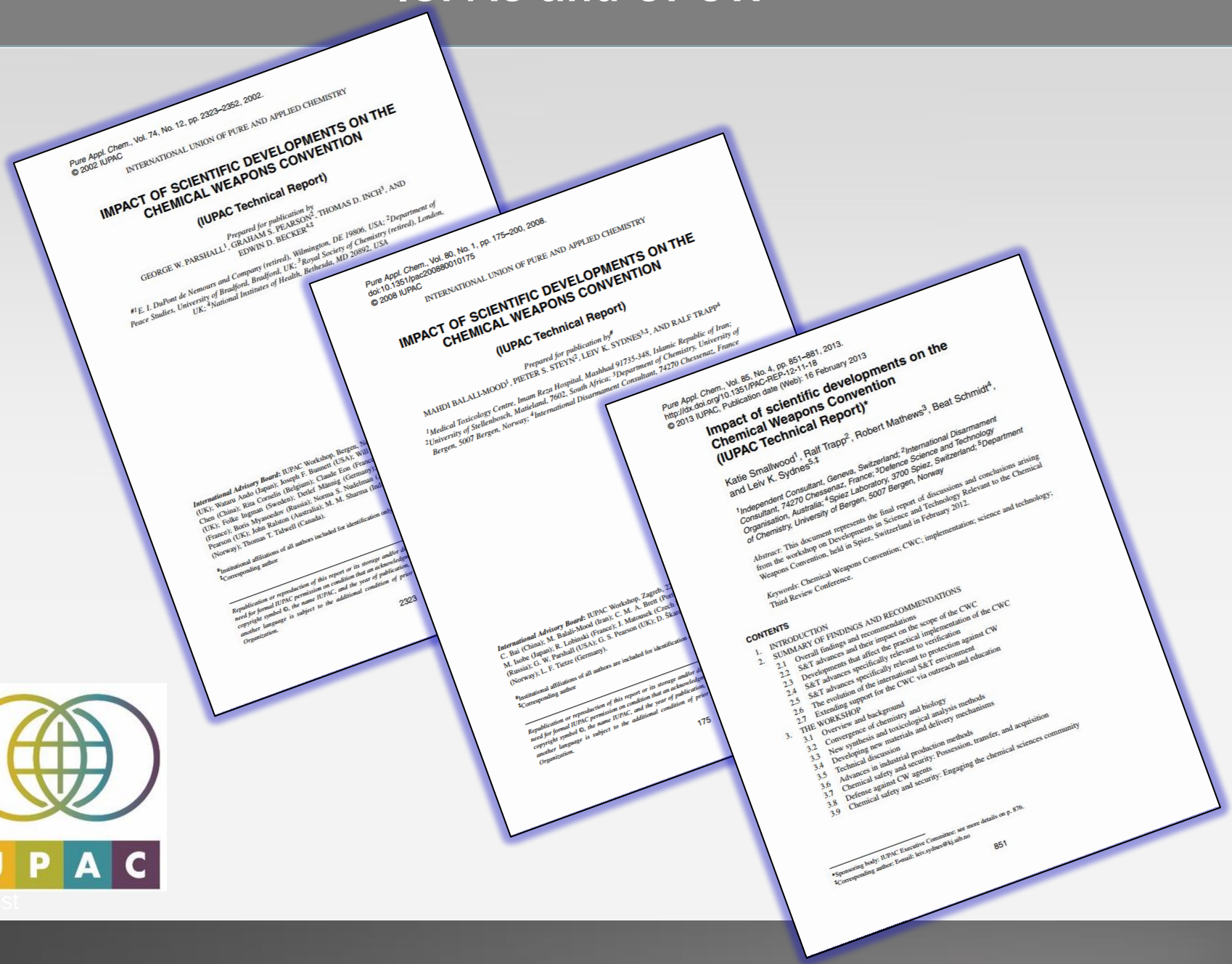
Christopher M. Timperley,[1a*] Jonathan E. Forman,[§*] Mohammad Abdollahi,[2] Abdullah Saeed Al-Amri,[3] Isel Pascual Alonso,[4] Augustin Baulig,[5] Veronica Borrett,[6] Flerida A. Cariño,[7] Christophe Curty,[8] David González Berrutti,[9] Zrinka Kovarik,[10] Roberto Martínez-Álvarez,[11] Robert Mikulak,[12] Nicia Maria Fusaro Mourão,[13] Ramasami Ponnadurai,[14] Slawomir Neffe,[15] Syed K. Raza,[16] Valentin Rubaylo,[17] Koji Takeuchi,[18] Cheng Tang,[19b] Ferruccio Trifirò,[20] Francois Mauritz van Straten,[21] Paula S. Vanninen,[22] Volodymyr Zaitsev,[23] Farhat Waqar,[24] Mongia Saïd Zina,[25] Marc-Michael Blum,[26c] Hugh Gregg[26d], Elena Fischer,[27e] Siqing Sun,[27e] Pei Yang[27e]

Review of, and advice given on, chemical weapons sample storage and stability, to assist chemical weapons-related forensic studies worldwide





IUPAC and OPCW



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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

IMPACT OF SCIENTIFIC DEVELOPMENTS ON THE CHEMICAL WEAPONS CONVENTION

(IUPAC Technical Report)

Prepared for publication by

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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

IMPACT OF SCIENTIFIC DEVELOPMENTS ON THE CHEMICAL WEAPONS CONVENTION

(IUPAC Technical Report)

Prepared for publication by

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Impact of scientific developments on the Chemical Weapons Convention (IUPAC Technical Report)*

Katie Smallwood[1], Ralf Trapp[2], Robert Mathews[3], Beat Schmidt[4], and Leiv K. Sydnes[5,‡]

[1]Independent Consultant, Geneva, Switzerland; [2]International Disarmament Consultant, 74270 Chessenaz, France; [3]Defence Science and Technology Organisation, Australia; [4]Spiez Laboratory, 3700 Spiez, Switzerland; [5]Department of Chemistry, University of Bergen, 5007 Bergen, Norway

Abstract: This document represents the final report of discussions and conclusions arising from the workshop on Developments in Science and Technology Relevant to the Chemical Weapons Convention, held in Spiez, Switzerland in February 2012.

Keywords: Chemical Weapons Convention; CWC; implementation; science and technology; Third Review Conference.

CONTENTS

*Sponsoring body: IUPAC Executive Committee; see more details on p. 876.
‡Corresponding author: E-mail: leiv.sydnes@kj.uib.no

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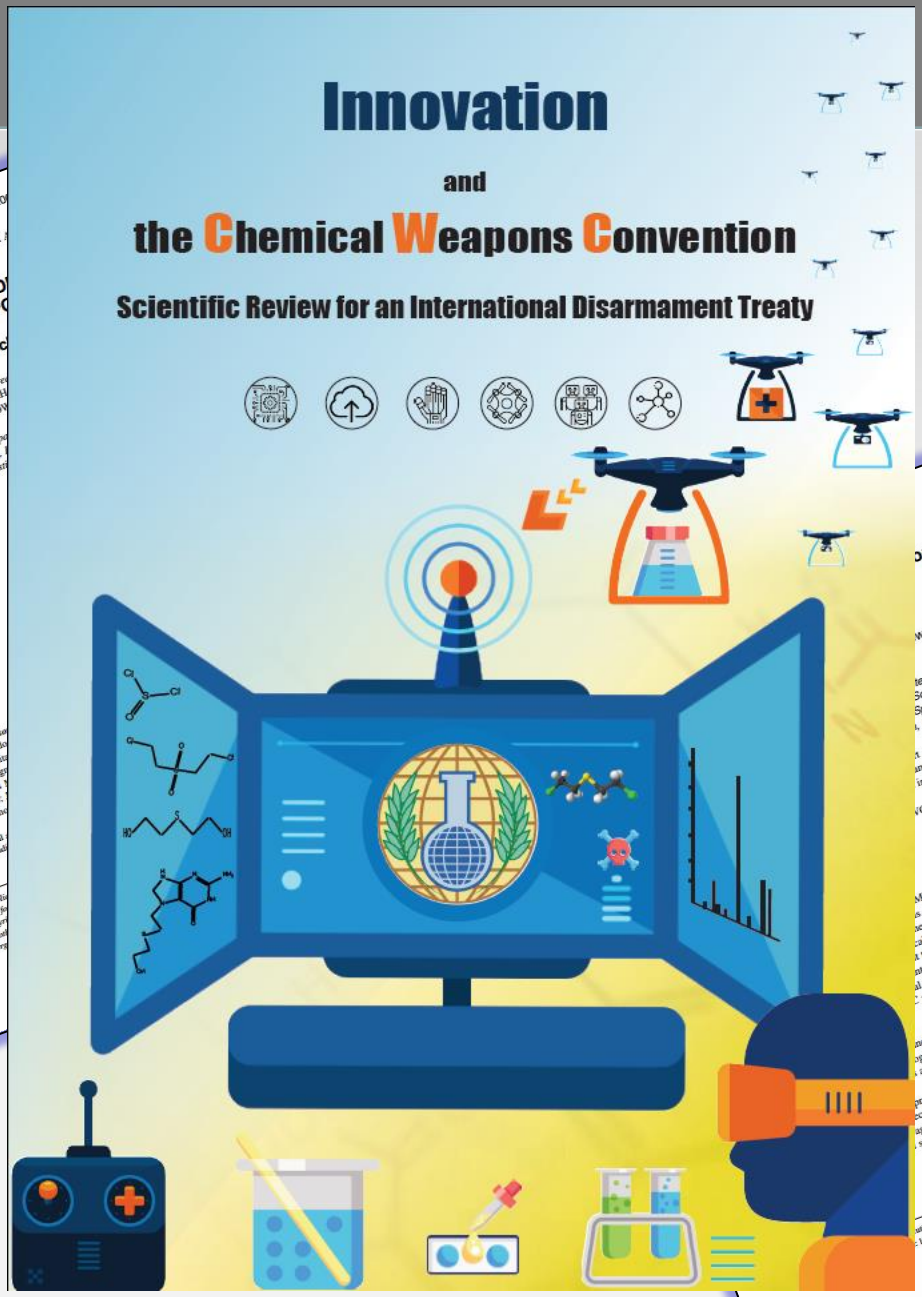
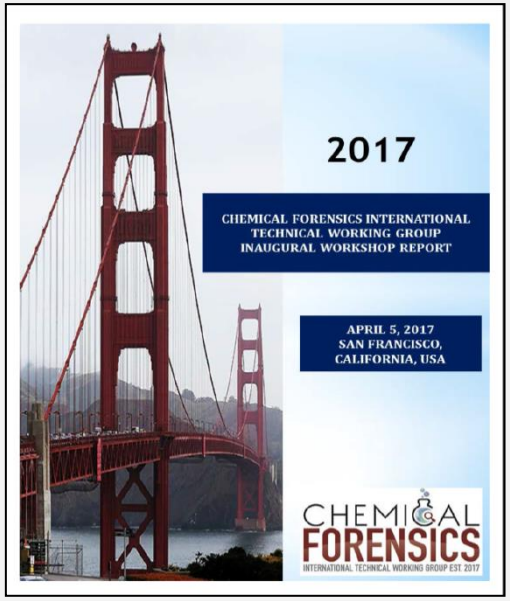

Innovation
and
the Chemical Weapons Convention
Scientific Review for an International Disarmament Treaty

Future opportunities



Thank you for your attention