



The OPCW Science & Technology Monitor

A sampling of Science & Technology
relevant to the Chemical Weapons Convention

28 October 2014

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Featured Content:

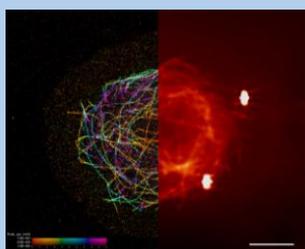


Image from Jim and Cathy Galbraith, Gleb Shtengel, Harald Hess/HHMI/Janelia Research Campus ([featured in nature News, 14 October 2014](#))

The Nobel Prize in Chemistry: Comparison of “photoactivated localization microscopy” (PALM) and a regular microscopy image of Microtubules in cells from fruit flies



Image from [Nano Lett., 2013, 13 \(6\), 2634–2639.](#)

3D printing and chemistry

Recently published meeting reports:

[Summary](#) of the Fourth Meeting of the Scientific Advisory Board's Temporary Working Group on Verification.

Welcome

Welcome to our fourth issue of *The OPCW Science and Technology Monitor*, an occasional bulletin to provide updates on developments in science and technology across a broad spectrum of topics relevant to the CWC.

We thank Philippe Denier for initiating the “S&T Puzzle”. As no one was able to find the link to the challenge photo below, we give the reward to Philippe who has requested a feature on the 2014 Nobel Prizes for science (and the secret of the link will remain as such!).



Aurora over a Glacier Lagoon by James Woodend. “[Astronomy Photographer of the Year 2014](#)” in the category “Earth and Space”

For the next instalment of the S&T Puzzle, we ask you to tell us the significance of the number 0.07 which can be found in one of our links.

As a reward to the first person to solve the puzzle, we offer the following: your choice of choosing our next featured topic or a gift of a special beverage personally selected by the Science Policy Adviser. Good luck!

In this issue:

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The Global Movement and Tracking of Chemical Manufacturing Equipment:

A [Workshop Summary](#) (National Academy of Sciences, USA, 2014)

Science Fun:

In keeping with our Nobel Prize theme (thank you Philippe!), we bring you the 2014 [Ig[®] Nobel Prizes](#).

For physics: [the coefficient of friction under a banana peel](#).

For arts: [The relative pain one suffers while being subjected to a laser beam while viewing art](#).

For psychology: [the observation that people who stay up late are more psychopathic than people who habitually wake up early](#). Please think about your sleep pattern!

Featured Crowdsourcing Challenge:

In the spirit of puzzles, our S&T Monitor will now include an interesting crowd-sourcing challenge in each issue.

Is your knowledge of the convergence of chemistry and biology strong enough to solve the [“No-Petri-Dish” Diagnostic Test Challenge?](#)

The 2014 Nobel Prizes for Science

In science, the [Nobel Prize](#) is one of the most prestigious and important recognitions one can obtain. As declared in the last will of Alfred Nobel, it is awarded to those, who confer the "greatest benefit on mankind in physics, chemistry, peace, physiology or medicine and literature. Here we highlight the recently awarded 2014 Nobel Prizes for the sciences.

[John M. O’Keefe](#), [May-Britt Moser](#) and [Edvard I. Moser](#) were awarded the prize in [physiology or medicine](#) “for their [discoveries of cells that constitute a positioning system in the brain](#)”. From studies with rats O’Keefe found the so called “place cells” in the hippocampus, [which are only active at a certain point in their environment](#) and the Moser’s (who are husband and wife) discovered [“grid cells” in the entorhinal cortex near the hippocampus](#).

In [physics](#), [Isamu Akasaki](#), [Hiroshi Amano](#) and [Suji Nakamura](#) received the prize “[For the invention of efficient blue light emitting diodes which has enabled bright and energy-saving white light sources](#)”. Professors Akasaki and Amano succeeded in building regular [gallium nitride thin films via chemical vapour deposition](#). While Professor Nakamura found an [annealing technique to remove the hydrogen, which deactivates the dopant](#). Click [Here](#) for more about LEDs.

For [chemistry](#), [Eric Betzig](#), [Stefan W. Hell](#), and [William E. Moerner](#) were awarded “[for the development of super-resolved fluorescence microscopy](#)”. Their work to overcome the so called Abbe diffraction limit (limitation of optical microscopy to the wavelength of visible light) [enabled highly resolved images of molecular structures](#); take a look at [a photo gallery](#) and [video](#). Click on these links to see peer-reviewed publications from the work of Professors [Betzig](#), [Hell](#) and [Moerner](#).

Although the prize for economics was not an original Nobel Prize, a Nobel Memorial Prize in Economic Sciences was founded by Sveriges Riksbank for their 300th anniversary in 1968. It was awarded to [Jean Tirole](#) “for his [analysis of market power and regulation](#)”.

Scientific discoveries occur on a daily basis by people who may become Nobel Prize winners in the future. In the field of chemistry, here is what was making news during the weeks of [29 September to 5 October](#), [5-11 October](#), [12 -18 October](#), and [19-25 October](#).

Toxins

Toxins are chemicals that occur in nature where they perform important functions related to predation and defence. [The use of toxins](#) is subject to both the Chemical Weapons Convention (CWC) and the [Biological Weapons Convention \(BWC\)](#).

There are two toxins included on Schedule 1: [Ricin](#), infamous for being delivered from an umbrella in the assassination of Gregory Markov; and [saxitoxin](#) which is produced by cyanobacteria and can

Upcoming S&T Related Events:

19 - 21 November 2014
[Biological and Chemical Security in an Age of Responsible Innovation](#); Organised by the Biochemical Security 2030 Project at the Royal Society, London

28 November 2014
Science and Technology Breakout Discussion as part of the 16th Annual Meeting of National Authorities, The Hague, 9:00 - 12:30.

1 - 5 December 2014
Biological Weapons Convention Meeting of States Parties; Geneva, Switzerland

5 December 2014
Science for Diplomats (3) - Details TBD

11 - 12 December 2014
New Technologies and Approaches for Information Analysis to Support Non-Proliferation and Disarmament Verification; Vienna Center for Disarmament and Non-Proliferation (VCDNP) and the James Martin Center for Non-proliferation Studies (CNS), Vienna, Austria

cause paralytic shellfish poisoning. [Saxitoxin has interesting molecular features and chemical biology making it an attractive subject in chemistry research.](#)

Toxins also have value for medicinal purposes. For example, with some tinkering, there are ways to turn a [deadly toxin into an efficient carrier for antibody drugs](#) ([technical details here](#)); use [ricin for cancer treatment](#) ([technical details here](#)); and blocking sodium channels with saxitoxin can be used in [anaesthesia](#) and to [stop itching](#).

The need for analytical method development for biological toxins is much broader than just CWC and BWC contexts as illustrated by the recently demonstrated [multielectrode array for detection of marine neurotoxins](#) in food safety testing ([technical details here](#)). To appreciate the challenges in the analysis of toxic materials in food, this recent [review](#) may also be of interest. Other security organisations interested in toxins include the [International Atomic Energy Agency \(IAEA\)](#).

Biology has given rise to a multitude of toxin producing microbes, plants and animals (many producing [toxins more potent than ricin or saxitoxin](#)). If you are interested in knowing more about toxic plants, the [Poison Garden](#) at England's Alnwick Garden might be of interest. A beautiful garden, filled with plants that can kill you. [Step inside if you dare!](#)

3D Printing

3D printing is becoming more and more accessible to the public with affordable [3D printers](#) that can be applied to a broad range of industrial and home uses.

There have been many clever examples of the use of 3D printing for [applications that include the chemical sciences](#); in the production of biomaterials such as [prosthetic devices](#) ([technical details here](#)), [bones](#), and even [organs](#); and there is particular interest in [3D printed food](#).

In the context of [chemistry and biotechnology](#), 3D printed [lab equipment](#) ([technical details here](#)), [reactionware](#), and [continuous flow devices](#) have been demonstrated. 3D printing may even save costs in setting up a [laboratory](#).

For anyone interested in 3D printing your own ideas, you can find [\(free\) modelling software](#) online or download this [Ipad App](#). [Just be careful what you print!](#)

40th Meeting of the OPCW Validation Group

We present here a guest contribution from the OPCW Validation Group describing their 40th meeting. We welcome guest contributions and invite all who are interested to make submissions (these articles would also be considered for upcoming [S&T themed issues of OPCW Today](#)).

11 - 12 March 2015

[249th American Chemical Society \(ACS\) National Meeting & Exposition](#). Denver, Colorado, USA.

During the open session of the ACS Board of Directors meeting, the 2013 Nobel Peace Prize recipient, the OPCW will be honoured for its work in finding peaceful applications of chemical sciences worldwide.

27 September - 1 October 2015

[ECCE10 \(10th European Congress of Chemical Engineering\)](#)

[ECAB3 \(3rd European Congress of Applied Biotechnology\)](#)

[EPIC5 \(5th European Process Intensification Conference\)](#)

Nice, France.

[Conference organisers are currently accepting abstracts for participation.](#)

Contact:

Questions, comments, suggestions, contributions? Or to be added to the mailing list, please contact the [Science Policy Adviser](#) in the Office of Strategy and Policy

Introduction

The OPCW Validation Group is an international group of scientific experts that meet biannually at the OPCW headquarters to validate the contents of the organisation's analytical database: the OPCW Central Analytical Database (OCAD). Recently the group conducted its fortieth meeting.

OCAD and its application

OCAD is a database of gas chromatography retention index (GC(RI)), infrared (IR), mass spectrometry (MS) and nuclear magnetic resonance (NMR) data for Chemical Weapons Convention (CWC) scheduled chemicals and their analytical derivatives. The primary purpose of the database is to support the OPCW Sampling and Analysis (S&A) inspections. The primary on-site analytical tool used is gas chromatography/mass spectrometry (GCMS), and the GC(RI) and MS data in the OCAD are the primary references used in the analysis. The CWC writes that for standard S&A OPCW inspections:

Sampling and analysis shall be undertaken to check for the absence of undeclared scheduled chemicals.



Attendees of the 40th Validation Group meeting. Back row: Alexander Theologhidis (OPCW), Hugh Gregg (OPCW), Eric Wils (Netherlands), Armando Alcaraz (USA), Ferdinand Visser (S Africa), Leo de Reuver (Netherlands), Alexandre Bennett (UK). Center row: Gary Mallard (USA), Jiri Cermak (Czech Republic), James Riches (UK), Sten-Åke Fredriksson (Sweden), Takeharu Wada (Japan). Front row: Sohrab Mirabi (Iran), Liu Jingquan (China), Zdeňka Fabiánová (Czech Republic), Vesa Häkkinen (Finland), Mehran Babri (Iran).

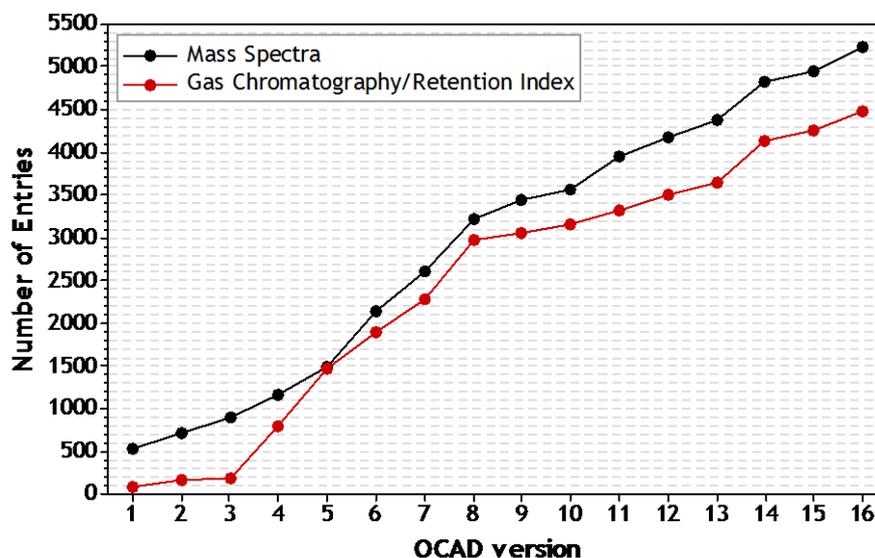
Confidential Business Information is protected during standard S&A OPCW inspections, as the OCAD only contains approved data relevant to the CWC, this ensures that undeclared trade secret chemicals and processes remain unknown, not even the highly trained Analytical Chemist Inspectors operating the GCMS Instrument would know.

The database is also used by OPCW Designated Laboratories to support on-going capability development, proficiency testing and supporting the OPCW's missions on request.

Database details

Throughout the forty meetings, the group has validated some 5,200 MS, 4,400 GC(RI), 1,300 NMR and 900 IR approved data entries.

The OCAD is updated annually and is available free of charge to member states on request at the document counter in the OPCW headquarters. The Group has also validated data for relevant non-scheduled degradation products of scheduled chemicals and their analytical derivatives, riot control agents and chemicals relevant to allegations of use of chemical weapons. These validated data are not approved for use in Article VI missions, and is why they are not currently part of the OCAD, but may be necessary for on-site analysis in support of a challenge inspection or investigation of alleged use. A recent initiative has resulted in a growing collection of data from tandem mass spectrometry instruments.



Mass Spectra and Gas Chromatography/Retention index in the OCAD

The validation process

Data is submitted voluntarily, and under contract, by member states, and the OPCW. The data is collated by the group's secretary, Alexander Theologhidis, Senior Analytical Chemist at the OPCW Laboratory, and distributed to the expert members of the group. A subgroup co-ordinator collates the individual evaluations of the technical experts which are then discussed at the group's meetings. Data must be accepted by at least three experts attending the meeting. Consensus decisions are made taking into account the responses of any experts not present at the meeting who have submitted data evaluations. The group's meeting report lists the data recommended for inclusion on the OCAD. These lists are forwarded to the Executive Council for approval. Approved data is included in the next version of the OCAD.

Procedures for rapid data validation outside the normal timeframe of the meetings have also been agreed if data is required to support inspections at short notice.

The current subgroup co-ordinators are as follows: Martin Söderström (GC(RI)), Armando Alcaraz (IR), Sten-Åke Fredriksson (MS), Damian Magiera (NMR) and the Chair of the Validation Group is James Riches. Member States currently contributing scientific experts to the Validation Group at no cost to the OPCW are: Finland, United Kingdom of Great Britain and Northern Ireland, Japan, South Africa, Netherlands, India, Switzerland, United States of America, Germany, Czech Republic, China, Sweden, Islamic Republic of Iran, Spain and France.

History

The origin of the Validation Group dates back to the early days of the Preparatory Commission of the OPCW. In August 1993, a note was sent to the Member States with the request to provide analytical data and in March 1994 a first meeting of analytical experts was organized in The Hague. This resulted in the formation of a specialist task force to evaluate the received data and which held nine meetings in the period 1994-1997. In addition to the actual evaluation of the data, much attention was given to the procedures of the whole process. The results of the task force were approved by the First Conference of States Parties in September 1997 and formed the basis for the first release of the OCAD in hard copy format in 1998. It was quickly realized that the work was far from finalized and a lot more had to be done. A new start was made in July 1998 with the first meeting of the current Group. Five experts that attended this first meeting are still members of the Group.

The organisation and extraction of the OCAD is one of the OPCWs accredited scopes of activities, and is independently audited by the Dutch Accreditation Council, RvA. Authentication of the data extracted in a standard S&A mission, is performed by the Head of Laboratory, Hugh Gregg.

It has been commented that OCAD is the most scrutinised and validated collection of analytical data ever produced in the world to date.

The Group welcomes new members to validate data and contribute to the submission process. Requests for details on how to be nominated by their countries' representatives to the OPCW to join the Group and/or guidance on the submission of data by any Laboratory can be made at the following address ocad@opcw.org.

The links to articles, papers, reports, websites or other materials incorporated herein are being provided for information purposes only. The views and opinions expressed in the aforementioned materials are those of the authors and do not necessarily reflect the views of the OPCW. These items are cited as a service to readers and do not imply endorsement by the OPCW. The OPCW does not provide any guarantee, express or implied, that the information presented is accurate or timely, and does not contain inadvertent technical or factual inaccuracies. The OPCW is not responsible for the content of third party websites.