

**Stephen MATLIN**

Stephen Matlin is Adjunct Professor in the Institute of Global Health Innovation, Imperial College London UK and a member of the governing board of IOCD. For more information on IOCD's history, strategy and programmes see [www.iocd.org](http://www.iocd.org) [s.matlin@imperial.ac.uk](mailto:s.matlin@imperial.ac.uk)

# IOCD: Looking to the Future Role of the Chemical Sciences in Development

## 2011 Milestones

The 30<sup>th</sup> anniversary of the International Organization for Chemical Sciences in Development (1) (IOCD) coincided with the 2011 International Year of Chemistry (IYC2011) and IOCD made several contributions to the year-long round of activities to mark IYC2011. At the official launch ceremony of IYC2011 on 27-28 January in Paris at the headquarters of UNESCO, Jean-Marie Lehn, chemistry Nobel prize winner and IOCD's President, gave the Introductory Lecture and framed the importance of the year in his talk entitled *"From Matter to Life: Chemistry!"*(2) (3) and in his piece for the opening programme on *"Protecting our planet: the role of chemistry in creating a sustainable future"*(4). Professor Lehn also participated in a number of other meetings associated with IYC2011, including several in France, Japan and Poland (5). Writing on *"Chemistry: The science and art of matter"* in a special edition of the *UNESCO Courier* (6) marking the start of IYC2011, Professor Lehn highlighted the pivotal role that chemistry has to play in relation to many aspects of human progress, including food and medicines, clothes and housing, energy and raw materials, transport and communications and much else. His comment *"Chemistry will undoubtedly remain the central science in the 21<sup>st</sup> century"* was featured, among other places, at the front of the Royal Australian Chemical Institute's IYC2011 Media Kit (7). IOCD's Executive Director, the distinguished Belgian chemist Alain Krief of Namur University, participated in the December 2011 Closing Ceremony of IYC2011 in Brussels (8). IOCD Senior Advisory Council member Berhanu Abegaz and Board member Stephen Matlin contributed a major review of *"Chemistry for Development"* in the book *"The Chemical Element: Chemistry's Contribution to Our Global Future"*, published (9) to mark IYC2011.

Chemistry will undoubtedly  
remain the central science  
in the 21<sup>st</sup> century.

Established in 1981 as the first international non-governmental organization specifically focused on the role of the chemical sciences in development and involving chemists in low- and middle-income countries (LMICs) (10), IOCD has much to be proud of in its first three decades of work. The overall impact of IOCD has been to help highlight the importance of chemical sciences as contributors to development; raise the profile of the field and its practitioners; initiate, promote or sustain a number of technical, managerial, policy and collaborative projects or networks advancing chemical sciences in LMICs; and contribute to vital resources for teaching, learning and research (11). Commemorating the 30<sup>th</sup> anniversary of its foundation, IOCD's Annual Meeting in Strasbourg in April 2011 included a special session reflecting on its history and attended by Marie-Noelle Crabbé, daughter of IOCD's late founder Pierre Crabbé who was a Belgian chemist and inspired humanitarian (12).

## A new strategy for changing times

Many changes have taken place in the landscape of science and development since IOCD was founded more than 30 years ago. There are many new actors and new sources of funding targeted at specific areas such as tropical diseases; many LMICs are advancing economically (e.g. Brazil, China and India are now among the largest economies in the world and are become leaders in areas of advanced technology); and the paradigm of development has shifted from 'aid-as-charity' provided by high-income countries (HICs) and focused on individual training and institutional capacity building: it is now centred on enabling LMICs to establish and manage their own systems, including in science, technology and innovation – where appropriate, facilitated by 'south-south' partnerships or 'triangular' partnerships involving collaborations between a HIC, an LMIC with an emerging economy and a lower income country. There is also now much greater emphasis on inter-disciplinarity and recognition of the value of working at the interfaces between traditional sciences – as highlighted in IYC2011.

Looking to the future, IOCD's 30<sup>th</sup> anniversary year therefore also marked the initiation of a new strategy (13). This sustains IOCD's mission of promoting the pursuit and application of the chemical

sciences for sustainable, equitable human development and economic growth, especially LMICs, through: raising the profile of the chemical sciences in development among researchers, funders and policy-makers; increasing the capacity to conduct and use the chemical sciences in LMICs to advance their development by strengthening capacities at the individual, institutional and national/systems levels to apply the chemical sciences to meet current and future challenges; and strengthening the participation of LMIC researchers in the chemical sciences in national and global priority areas. IOCD's work builds on its strengths and now focuses on three strategic priorities:

### Chemistry for Better Health

The nature of health challenges faced in every part of the world is changing, as a result of shifting patterns of disease, the globalization of health threats, changes in the environment and in human behaviour. IOCD's strategy is to support capacity building for medicinal chemistry, including drug analysis, discovery and development, in and for the health needs of LMICs; and chemists working on the isolation, structure elucidation and bioassay of natural products. IOCD's Plant Chemistry Working Group has a long track record of working in this field, including supporting structure elucidation and regular symposia on plant chemistry (1). The 2012 IOCD International Conference on Functional Molecules In Nature, held in Nanjing, China on 22-24 September 2012, was co-organized with Nanjing University and China Pharmaceutical University and co-sponsored by the National Natural Science Foundation of China. The conference discussed trends, presented the latest results and exchanged ideas relevant to the chemistry and biology (particularly pharmacy) of natural products including phytochemicals and microbial secondary metabolites (14).

IOCD's Biotic Exploration Fund (BEF) was established in 1995 in collaboration with Thomas Eisner (known as the "father of chemical ecology"). The BEF has worked in a number of countries in Latin America, Asia and Africa, assisting the development of policies and programmes for ethical, sustainable bioprospecting (1). In Kenya, the BEF collaborated for several years to facilitate the development of a national strategy for bioprospecting. On 3 November 2011 Dr. John Kilama, Chair of the BEF, participated in Nairobi in the launch of the Kenya Bioprospecting Strategy, which received Sh10 billion of government funding (15). The strategy, spearheaded by the Ministry of Forestry and Wildlife and Kenya Wildlife Service (KWS), will provide structures and systems to manage and regulate bioprospecting activities in Kenya. It will seek to tap the huge market of bioprospecting and generate wealth and knowledge for the country. The launch makes Kenya among the first countries in the world to have a bioprospecting roadmap after establishment of the Nagoya Protocol (16).

### Chemistry for a Better Environment

Concern for the environment, including contamination of air, land and water, has become increasingly a matter for global attention. Countries are now learning how to engage in sustainable development and avoid the historic pathways which have led to pollution, exhaustion of resources and loss of biodiversity. IOCD's strategy is to enhance capacities for environmental chemical analysis and sustainable use of biological resources. IOCD's Environmental

Chemical Analysis Working Group was initiated in 1993 in collaboration with IUPAC and over the years it has held activities in many countries, providing workshops and training in laboratory management and in practical analytical techniques, including for the analysis of pesticide residues and water quality (1). The emphasis of the Working Group has increasingly been on building capacity to tackle nationally-relevant analytical challenges.

Countries are now learning how to engage in sustainable development and avoid the historic pathways which have led to pollution, exhaustion of resources and loss of biodiversity.

- The IOCD Working Group has partnered with the Uganda National Bureau of Standards (UNBS) to strengthen its capacity to test export commodities to international standards and IOCD scientists have provided technical consulting to seven Ugandan Commodity Testing Laboratories engaged in testing commodities for export. UNBS has continued to enhance its capabilities for internationally acceptable analytical methodology — for example, in 2011 receiving certification from the South African National Accreditation System as an accredited calibration laboratory (17).
- Because of increasing urbanization, the rise in vehicle emissions and the trend towards greater industrialization, urban air quality in many countries is worsening. This is notably the case in Africa, where currently 38% of the continent's population is living in urban areas and it is estimated that this proportion will rise to 54% by 2030. A large number of African countries have begun to adopt air quality management legislation, regulations, or policies as a consequence of the high concentration of air pollution, particularly in the large cities, and its adverse effect on human health. Other countries are recognizing the need for improving air quality and moving to control emissions. In collaboration with the International Atomic Energy Agency and the Tanzania Atomic Energy Commission, IOCD's Environmental Analytical Chemistry Working Group organized a workshop in Arusha in 2011, which focused on the analysis of air particulate matter (18).

### Capacity Building in Chemical Education

LMICs need to put in place a broad array of capacities and enabling factors so they can acquire specific technologies and also use the chemical sciences in responding to changing conditions and new challenges over time and become self-reliant in their abilities to determine their own futures. IOCD's strategy is to assist in enhancing capacities for chemical education. Initiatives include:

- **Web-based resources:** IOCD groups have developed on-line tutorials in organic chemistry, available in Spanish, as

well as training in practical medicinal chemistry, available on-line and as a CD, to help up-grade the skills of chemists in the field of drug design and development (19).

- **Books for libraries:** an IOCD Working Group on Books for International Development collects university textbooks across all disciplines, including the chemical sciences, as well as laboratory equipment and computers, and in collaboration with UNESCO makes a number of shipments each year to universities in Africa, Asia and Latin America (20).
- **Micro-scale science kits:** Together with IUPAC, UNESCO and the International Foundation for Science Education, IOCD has supported the Global Microscience Project, providing portable micro-scale kits enabling chemical reactions to be conducted with very small quantities of chemicals. The kits and materials are designed to be easily adaptable to different national curricula, and different language versions are in preparation (21).

Moving forward, IOCD sees a need to strengthen chemical education by developing a broader, global approach that will enhance access for all to high quality stores of knowledge and that will reflect the changing opportunities for learning in a digital age. IOCD is currently exploring how to develop a new kind of knowledge repository, freely accessible on line, that would have elements related to, but be distinct from, encyclopaedias, textbooks and lecture notes. The knowledge base would be organized as lucid and clearly illustrated descriptions and explanations, which may be used as sources for work by teachers or students, providing a global standard of knowledge at a specified level – whether for school- or university-level study or for broader understanding by the public and policy-makers.

## Chemical Sciences in a Changing World

Several key considerations underpin IOCD's current efforts to ensure its future relevance in a globalized, rapidly changing world:

- It is no longer relevant to consider the needs of 'developing' countries as being separate from those of the rest of the world and to focus only on the 'less developed' ones (22). IOCD aims at contributing to solving global problems while giving special emphasis to the problems that are most relevant to LMICs – where, for example, Africa can be an 'arena of special attention'.
- In tackling major global problems (e.g. in energy, environment, health, food and nutrition, materials, water), it is increasingly evident that multi-disciplinary approaches are required and that solutions are often found at the interfaces between sciences. While IOCD had long recognised that chemistry is a key, central science for many other disciplines that depend on understanding the behaviour of atomic, molecular and aggregate materials, there is further scope for IOCD to embrace 'contemporary sciences' more broadly, address a broader audience and bring an understanding that chemistry had a special problem-solving role and is part of the solution to problems.
- The application of science to development problems should place stronger emphasis on the concepts of 'equity'; 'inclusive, sustainable development'; and 'frugal technologies' that, having been developed for use in resource-poor settings, could be of global benefit (23).
- In promoting the greater integration of science with

innovation systems at national and global levels, there needs to be greater emphasis on the role of entrepreneurship. This is a key both to solving problems and to attracting young, creative people to work in science and innovation.

- Ensuring that science plays a key role in development also requires engagement at the science/policy interface, helping to translate science into policy and ensuring that science priorities are also informed by policy needs. One aspect of the science/policy interface that is currently beginning to receive much attention is that of 'science diplomacy'. This field includes the dimensions of diplomacy for science; science in diplomacy; and science for diplomacy (24).

On 5 July 2012, IOCD co-organized a 1-day meeting in Namur, Belgium in collaboration with the Namur Advanced Research College (NARC) at Namur University. The first part of the day was an entitled "**Chemical Development: Chemistry, a Crossway Towards Interdisciplinary Science**", featuring lectures by the chemistry Nobel Laureate Ryoji Noyori (Saitama) on "**Facts are the enemy of truth**", Don Hilvert (Zurich) on "**Designer enzymes**", Luisa De Cola (Munster) on "**Functional materials by self-assembly. From solution to *in vivo***", Klaus Mullen (Mainz) "**Is the Future Black? – The Chemist's Search for Graphene and Carbon Materials**" and Peter Seeberger (Potsdam) on "**Preventing and curing infectious diseases: Carbohydrate vaccines and continuous flow synthesis**". The lectures highlighted some of the many ways that chemistry, working at the interfaces with many other sciences including biology and physics, is contributing new insights and new materials with important applications of global significance.

The International Symposium was followed by a Public Seminar featuring three speakers. Berhanu Abegaz (Executive Director, African Academy of Sciences, Kenya) introduced a session in which Stephen Matlin (London) spoke about "**New challenges in chemical sciences for development**". He emphasised that the chemical sciences had made major contributions to human health, wellbeing and wealth during the last two centuries – but not all populations had benefitted equally from this, resulting in some stark inequalities between richer and poorer nations. In addition to these persisting inequities, in the 21<sup>st</sup> century the world was faced with a number of new challenges as the population of the planet continued to grow and there were pressures on energy, material resources and the quality of the environment. He spoke about the changing role of IOCD and especially the contribution it was seeking to make at the critical interface between science and policy.

Introduced by session chair Nicole Moreau, (IUPAC past President, France) Gerhard Bringmann (Würzburg) gave a talk on "**The BEBUC Scholarship System: Re-Installation of excellence in the Congo**", describing his success in supporting efforts to improve school education in the Congo and to assist young scholars there to pursue advanced learning.



Professor Ryoji Noyori, President of RIKEN and University Professor at Nagoya University, Japan, during his visit to Namur on 5 July 2012.

Professor Noyori, shared the 2001 Nobel Prize in Chemistry for the development of chiral catalysts for asymmetric synthesis.

The Public Seminar concluded with a session introduced by Leopold Demiddeleer (Solvay Company, Belgium) in which Ryoji Noyori lectured on “**Science and Technology for Future Generations**”. Noyori reflected on the challenges he had faced and lessons learned during his long career working on asymmetric catalysis. He noted that science is inevitably closely intertwined with society and there were now many opportunities for chemistry to contribute to ‘green’ issues and assist in areas such as the more efficient, cleaner production of energy. The Japanese organization RIKEN, of which Noyori is currently President, pursues innovative basic science and aims to return the results of research to society.

Noyori observed that there have been many benefits of S&T to society, including helping to secure adequate food sources, enhancing life expectancy and quality of life and providing means for high-speed communication globally. But there were many new challenges in the modern world – including water, energy, health, agriculture, biodiversity, environment and poverty - and a better prioritization and balancing of culture and technology was required. Noyori ended his talk with a call for scientists and technologists to help create a civilization that respects cultures and works through international cooperation.

- Further information about the International Organization for Chemical Sciences in Development, its history and Working Groups can be found on the website: [www.ioecd.org](http://www.ioecd.org).
- International Year of Chemistry, 2011: *Echoes from Paris, 11 February 2011*. [www.chemistry2011.org/about-iyf/news/The-Year-Begins/](http://www.chemistry2011.org/about-iyf/news/The-Year-Begins/)
- International Year of Chemistry, 2011: *Official International Launch, UNESCO, Paris 27-28 January 2011*. [www.lem7.cnrs.fr/reportages/IYC2011\\_AIC2011/IYC-official-launch-of-the-international-year-of-chemistry-Paris-Unesco\\_27-28-january-2011\\_2.htm](http://www.lem7.cnrs.fr/reportages/IYC2011_AIC2011/IYC-official-launch-of-the-international-year-of-chemistry-Paris-Unesco_27-28-january-2011_2.htm)
- JM Lehn. *Protecting our planet: the role of chemistry in creating a sustainable future*. In: *IYC2011 Launch Programme: Chemistry – our life, our future*. Paris: UNESCO, 2011; 5. [www.chemistry2011.org/system/documents/128/original/01\\_IYC\\_180111\\_ENG.pdf?1298304882](http://www.chemistry2011.org/system/documents/128/original/01_IYC_180111_ENG.pdf?1298304882)
- Contributions by IOCD's President Jean-Marie Lehn to IYC2011. Namur, IOCD, 2012. [www.ioecd.org/WhatWeDo/promoting.shtml](http://www.ioecd.org/WhatWeDo/promoting.shtml)
- JM Lehn. *Chemistry – the art and science of matter*. UNESCO Courier, Jan-March 2011, 7-9. <http://unesdoc.unesco.org/images/0019/001906/190645e.pdf>
- Royal Australian Chemical Institute. *IYC2011 Media Kit*. Melbourne: RACI, 2011, 12pp. [http://iyf2011.org.au/assets/downloads/RACI\\_IYC2011\\_Media%20Kit.pdf](http://iyf2011.org.au/assets/downloads/RACI_IYC2011_Media%20Kit.pdf)
- IYC2011. *Chemistry's future takes centre stage at IYC closing ceremony in Brussels. IYC2011, 5 December 2011*. [www.chemistry2011.org/about-iyf/news/Chemistrysfuture/](http://www.chemistry2011.org/about-iyf/news/Chemistrysfuture/)
- SA Matlin, BM Abegaz. *Chemistry for development*, in: J. Garcia-Martinez, E. Serrano-Torregrosa (eds), *The Chemical Element: Chemistry's Contribution to Our Global Future*, Wiley-VCH, Weinheim, 2011, Chapter 1, 1-70. [www.thechemicalelement.com](http://www.thechemicalelement.com)
- GT Seaborg. *An international effort in chemical science*, Science, 1984, 223, 9. [www.sciencemag.org/cgi/pdf\\_extract/223/4631/9](http://www.sciencemag.org/cgi/pdf_extract/223/4631/9)
- JM Lehn, ER Blout, RH Maybury. *IOCD: 20 Years of Building Capacity in Chemistry in Developing Countries*. Chemistry International, 2002, 24(3), 3-5. [www.iupac.org/publications/ci/2002/2403/CI2403.pdf](http://www.iupac.org/publications/ci/2002/2403/CI2403.pdf)
- SA Matlin. *Pierre Crabbé Memorial Oration*, delivered during the opening of the First Asian and Oceanic Congress of Andrology, 9-12 November 1992, Nanjing, China. [www.ioecd.org/v2\\_PDF/Crabb%C3%A9-Memorial-Oration1992p.pdf](http://www.ioecd.org/v2_PDF/Crabb%C3%A9-Memorial-Oration1992p.pdf)
- Strategy 2011-2020*. Namur, IOCD, 2011. [www.ioecd.org/WhatWeDo/strategy.shtml](http://www.ioecd.org/WhatWeDo/strategy.shtml)
- 2012 IOCD International Conference on Functional Molecules in Nature, Nanjing, China 22-24 September 2012*. <http://conference.nju.edu.cn/iocd2012/>
- IOCD participation in launch of the Kenya Bioprospecting Strategy in launch of the Kenya Bioprospecting Strategy, Nairobi 3 November 2011*. [www.ioecd.org/v2\\_index.shtml](http://www.ioecd.org/v2_index.shtml)
- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*. Montreal: Convention on Biological Diversity, 2012. [www.cbd.int/abs/](http://www.cbd.int/abs/)
- Certificate of Accreditation: Uganda National Bureau of Standards*. [www.sanas.co.za/schedules/calibration/1462-06-2011.pdf](http://www.sanas.co.za/schedules/calibration/1462-06-2011.pdf)
- Report on the AFRA Workshop on Environmental Analytical Chemistry, Arusha-Tanzania, 23-24 May 2011*. [www.ioecd.org/v2\\_PDF/ReportArushaWorkshop2011p.pdf](http://www.ioecd.org/v2_PDF/ReportArushaWorkshop2011p.pdf)
- Open and distance learning in chemistry*. Namur: IOCD, 2012. [www.ioecd.org/WhatWeDo/distEdu.shtml](http://www.ioecd.org/WhatWeDo/distEdu.shtml)
- IOCD Working Group on Books for International Development*. Namur: IOCD, 2012. [www.ioecd.org/WhatWeDo/books.shtml](http://www.ioecd.org/WhatWeDo/books.shtml)
- Global Microscience Project*. Namur: IOCD, 2012. [www.ioecd.org/WhatWeDo/microscience.shtml](http://www.ioecd.org/WhatWeDo/microscience.shtml)
- IOCD avoids the use of terms such as ‘developing countries’ and prefers ‘low- and middle-income countries’ and ‘high-income countries’, as classified by the World Bank.
- The term ‘frugal technologies’ was used recently in: P. Howitt et al. *Technologies for Global Health*. The Lancet, 2012, 380, 507-35. <http://download.thelancet.com/pdfs/journals/lancet/PIIS0140673612611271.pdf?id=5bbe37e152166496:6ddde29f:13943155b5a:55071345455180373>
- New frontiers in science diplomacy*. The Royal Society, London, 2010. <http://royalsociety.org/policy/publications/2010/new-frontiers-science-diplomacy>