

Science and Society

 The European Chemical Society (EuChemS)David J. Cole-Hamilton^[a]

Abstract: The European Chemical Society (EuChemS) coordinates the work of almost all the European Chemical Societies. As an organization, it provides an independent and authoritative voice on all matters relating to chemistry, and try to place chemistry at the heart of policy in Europe. Furthermore, EuChemS seeks to develop its members through vari-

ous activities, workshops and awards. Particularly, EuChemS has fostered growth in its young members through the European Young Chemists' Network. Beyond Europe, EuChemS has collaborated with various organizations in bringing chemistry out of the lab and into society in building a sustainable future for everyone.

Introduction and Structure

The European Chemical Society, formerly (2004–2018) the European Association for Chemical and Molecular Sciences (EuChemS) and before that (1970–2004) the Federation of European Chemical Societies (FECS), is an organisation that coordinates the work of almost all the European Chemical Societies. Its aim is to provide an independent and authoritative voice on all matters relating to chemistry in the European context and beyond and to place chemistry at the heart of policy in Europe. Since chemistry impinges on everything we do, it is essential that chemical aspects be considered when drafting and debating all new legislation.

EuChemS has 41 Member Societies covering 32 countries in Geographical Europe and Israel. These numbers are expected to increase by 1 with the admission of Bulgaria at the General Assembly in August, 2018. Through these Member Societies, EuChemS speaks on behalf of ~150 000 professional chemists. There is an increasing number of carefully selected Supporting Members (currently 6), which are Societies, Federations, Centres of Excellence, Research Networks or Institutes covering areas of chemistry, but who do not have their own individual members. EuChemS collaborates with these supporting members in activities which are mutually beneficial such as Parliamentary Workshops, Conferences, open meetings, and European Union (EU) proposals. The presidents of the Member and Supporting Societies make up the General Assembly, which meets annually and decides on various issues as defined by the constitution.

EuChemS activities are overseen by an Executive Board consisting of elected and appointed members (currently 17 mem-

bers) presided over by a President (Pilar Goya Laza, Madrid), Vice President (David Cole-Hamilton, St. Andrews) and Treasurer (Eckart Rühl, Berlin). All the day-to-day work is carried out by a Secretariat based in Brussels consisting of the General Secretary (Nineta Hrastelj), Communication and Policy Officer (Alex Schiphorst) and Administrative Officer Marta Kucza.

Scientifically, EuChemS covers most areas of chemistry through Divisions and Working Parties.

Activities

EuChemS engages in a wide variety of activities, including advising European Institutions (science-policy communication), raising public awareness, conferences, science communication to citizens and engaging with the international community.

EuChemS is registered in the Transparency register and is a recognised stakeholder of ECHA and EFSA.

Scientific evidence-based advice to European Institutions (science-policy communication)

Since many EuChemS member societies are from countries within the European Union, EuChemS lobbies the European Parliament and Commission through writing to key members of the Commission, replying to European Commission consultations, releasing position papers, and running workshops in and for the European Parliament. EuChemS attends and contributes to many European meetings and debates whilst two current Executive Board members are members of the MEP–Scientist pairing scheme (MEP = Member of the European Parliament). Pavel Drašer is paired with Pavel Poc, MEP and I am paired with Catherine Stihler, MEP. This scheme allows MEPs to learn much more about science and scientists to learn much more about how the European Parliament works. In addition, practical support and assistance is offered in both directions.

Because we represent a large number of chemists, we also use our independent and authoritative voice to lobby beyond Europe.

[a] Prof. Dr. D. J. Cole-Hamilton
EaStChem, School of Chemistry, University of St. Andrews
St. Andrews, KY16 9ST, (United Kingdom)
E-mail: djc@st-andrews.ac.uk

 Part of the Special Issue for the 7th EuChemS Chemistry Congress consisting of contributions from selected speakers and conveners. To view the complete issue, visit Issue 46.

Letters

Recent direct approaches to the President of the European Commission include a letter on Scientific Advice.^[1] The proposal not to have a scientific adviser, which was opposed in the letter, was dropped and a High-Level Group on Scientific Advice containing experts covering wide areas of science now operates. The strict regulations to limit carbon emissions agreed by the Commission and subsequently reflected in the Paris agreement were largely in line with the arguments put through the EuChemS letter^[2] on climate change and we strongly opposed^[3] the removal of funding from the Horizon 2020 budget of money to fund the joint infrastructure fund. Although this was not completely successful, the European Research Council, which funds fundamental research in Europe was completely protected.

It would be disingenuous to claim that these evidence-based letters on their own led to any change of thinking in the circles of European power, but they added to the weight of evidence upon which the Commission made its decisions and recommendations.

Outside of the EU, we have worked with Professor Ehud Keinan, President of the Israeli Chemical Society, in his attempts to persuade Israel to ratify the Chemical Weapons Convention (CWC), which it has already signed. Keinan wrote to the President and then the Prime Minister of Israel but, receiving no response, he published an open letter to Prime Minister Netanyahu.^[4] EuChemS supported this activity by publicising the open letter,^[5] publishing in English for the first time,^[6] writing a joint article,^[7] and by writing individual letters to Prime Minister Netanyahu, as well as Presidents Obama and Trump. We believe that awareness of this issue has been significantly raised, although we still await a positive outcome.

EU Consultations

EuChemS responds to as many of the EU consultations which relate to chemistry as it can. Usually we involve experts through our Member Societies, but increasingly through the Divisions and Working Parties. The strong evidence base for our responses means that often comments made in the EuChemS submissions are quoted directly in final reports. Very recent examples of EuChemS responses include those on Missions in Horizon Europe,^[8] trans fats,^[9] acrylamide^[10] (these last two in collaboration with our Division of Food Chemistry), antimicrobial resistance^[11] (with supporting member, the European Federation for Medicinal Chemists), European Cultural Heritage Labels^[12] (with the Working parties on Chemistry for Cultural Heritage and History of Chemistry) and Brexit.^[13]

Brexit

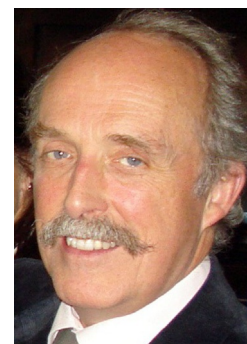
I love my country and am a devoted European, so it breaks my heart that the UK has voted to leave the EU. As I flew in from Brussels a few days ago over the green and pleasant land of Britain, sparkling in the vibrant green of late spring, I could not help wondering what will happen to our country now and I

wept inside. One aspect where being in the EU has been hugely beneficial to the UK and to the rest of Europe has been the whole area of research and innovation, largely delivered through the Framework programmes. Through the European Research Council (ERC), where intense competition has driven up the quality of fundamental research, through mobility actions, which have expanded the gene pool and brought new ideas and ways of thinking to all European countries including the UK, through collaborative projects which allow large consortia to be built between academia and industry to tackle really important problems and which give new developments for industry throughout Europe including the UK, through major international facilities or through the emerging European Innovation Council (EIC), which will drive up standards in innovation and commercialisation just as the ERC has for fundamental research, the quality and impact of research and innovation has improved immeasurably more than it could have without these instruments. The UK has been amongst the foremost countries in participation in all aspects of the Framework programmes and has helped in their design and construction.

EuChemS recognises the importance of the UK to the Framework programmes as well as the importance of the Framework programmes to the UK so it has published a position paper for the European negotiators.^[13] This argues strongly that the settlement between the EU and the UK should give provision for the UK to remain fully integrated into Horizon 2020 and its successors, concluding:

"Research and industrial competitiveness across the EU greatly benefit from the input of UK researchers and vice versa. Withdrawal of the UK from the many funding schemes would remove some of the key quality drivers and fundamentally damage research and innovation in Europe as well as in the United Kingdom...As negotiations proceed to determine the relationship between the EU and the UK following the latter's withdrawal, EU scientists urge the negotiators to retain as strong as possible a relationship between EU and UK researchers. Continued collaboration without borders will improve research across all European countries for the benefit of mankind."

David Cole-Hamilton is Vice-President of EuChemS, having been President from 2013–2017. He held the Irvine Chair of Chemistry in St. Andrews (1985–2014). Much of his recent work has concerned the development of new catalytic processes for the upgrading of plant wastes. In addition to his work with EuChemS, David spends significant time helping the Royal Society of Edinburgh develop policy on school-based education and on a research and innovation strategy for the UK as it leaves the EU.



Workshops in and for the European Parliament

EuChemS organises regular workshops to inform European Parliamentarians of key issues relating to chemistry. These are chaired by Members of the European Parliament (MEPs) and attract other MEPs. Some are held in collaboration with STOA, the Scientific Foresight group of the European Parliament. Often these engender lively debate and high-level reports are released afterwards. Some recent workshop topics include: making chemicals from CO₂,^[14] antibiotic resistance in collaboration with the European Federation of Medicinal Chemists (EFMC) chaired by P. Rubig MEP,^[15] Endangered Elements, chaired by Ian Duncan MEP,^[16] (Re)searching for jobs (Figure 1), chaired by Catherine Stihler MEP,^[17] and Glyphosate (Figure 2), chaired by Pavel Poc MEP.^[18] A forthcoming one on Parkinson's disease, which will focus on causes and cures, also chaired by Pavel Poc promises to be very stimulating.

Position papers

From time to time, EuChemS, sometimes in collaboration with others, publishes position papers on key emerging areas of



Figure 1. Viviana Fluxà, Reiner Salzer, Catherine Stihler MEP, David Cole-Hamilton, Margaret Waters, and Cristina Todasca at the European Parliamentary Workshop on (Re)Searching for jobs.



Figure 2. Pilar Goya, Pavel Poc, MEP and Pavel Drašer at the European Parliamentary Workshop on Glyphosate.

chemistry. Perhaps the most important one in recent times is *Solar Driven Chemistry*, coordinated by EuChemS past President, Ulrich Schubert.^[19] This encourages thinking about the use of sunlight in chemical reactions and in fuels and proposes ways in which sunlight or heat can be used to reduce the current consumption of fossil fuels. This white paper has been widely welcomed by the community and taken forward into a proposal for a flagship project specifically on the use of the sun for energy purposes. This proposal has passed the first hurdle and Executive Board member, Nicola Armaroli, is now heavily involved in the next phases for the development of the proposal.

Direct assistance to the Commission

As the profile of EuChemS has risen the European Commission has started to include EuChemS nominees in its High-Level Groups and has invited EuChemS to nominate members of Missions. Wolfram Koch, Geschäftsführer of the German Chemical Society and EuChemS Executive Board member, sits as EuChemS representative on the Open Science Policy Platform, which advises Commissioner Moedas.

Following its submission to the Consultation on the Circular Economy,^[20] EuChemS has accepted invitations from the Commission to participate in EC Missions on the Circular Economy to Chile,^[21] China,^[22] South Africa,^[23] Columbia^[24] and soon, Japan and Indonesia. Nicola Armaroli, Executive Board Member and previous Chair of the Working Party on Chemistry and Energy, has been an energetic and highly valued member of most of these missions, although his place was very ably taken by Santiago Luis, then Chair of the Division for Chemistry in the Environment, in South Africa.

These Missions involve visits to important industrial and government run establishments aiming to repair, recycle and reuse common household and industrial goods. This is a key technology to ensure a sustainable future, so exchanging best practice, ideas and methodologies is crucial in accelerating the pace of the introduction of the circular economy.

Informing the public

Regular lectures or half day meetings are held to inform the general public of chemical aspects relevant to key debates. Some of these are held in the context of welcoming member states as they take on the Presidency of the European Council. In this context, Italy was welcomed through a three day meeting on Energy, Food and the Environment.^[25] This meeting stimulated great media interest and one of the speakers (now a EuChemS Board member), Nicola Armaroli, was interviewed on state television. For the Netherlands presidency, a meeting on Open Access^[26] was held in Amsterdam and one on Medicines in the Circular Economy^[27] greeted the Maltese Presidency.

Other open lectures have included a half-day meeting in Edinburgh on Zero Carbon Energy^[28] and an extremely successful series of seven lectures and Round Table discussions laid on by EuChemS then Executive Board member and one of this year's

recipients of the European Service Award, Sergio Facchetti, in the European or Italian pavilions at EXPO 2015 in Milan.^[29] These lectures by international experts all attracted good audiences and stimulated energetic discussions (Figure 3)



Figure 3. Roseangela Marchelli and Sergio Facchetti at a round table discussion on *The Molecular Secrets of Italian Gastronomy* EXPO, Milan.

Chemical Weapons

Following my visit to the most moving commemoration of all those who have been damaged or have died as a result of the use of chemical weapons, which was organised by the Organisation for the Prohibition of Chemical Weapons (OPCW) in Ypres in April, 2015, where I joined Dr. Thomas Geelhaar, then President of the German Chemical Society and Professor David Phillips, previous President of the Royal Society of Chemistry (Figure 4) in standing “beside all right thinking people in deploring chemical weapons and calling for their complete elimination in all countries,”^[30] EuChemS has taken a strong public stand in favour of the complete elimination of the dreadful scourge of chemical weapons from the planet by writing articles^[31] and making public statements.



Figure 4. David Phillips, David Cole-Hamilton and Thomas Geelhaar at the OPCW Commemoration, Ypres, April, 2015.

As a result of the amazing work of the OPCW, only 4 countries remain to be persuaded (Israel, Egypt, Southern Sudan, and North Korea). I have already detailed the efforts of Ehud Keinan with regard to Israel but more must be done. Even though Syria signed and ratify the CWC after using chemical weapons in 2012, and all their stock were destroyed under inspection in agreement with the requirements of the Convention, chemical weapons have been used in that troubled country several times. First, the use of chlorine hit the headlines. Chlorine is what is called a dual-purpose chemical. It is essential for use in water purification and chemical synthesis, but, a cylinder of chlorine placed in a barrel containing high explosives becomes a chemical weapon. At the EuChemS General Assembly held during the 6th European Chemistry Congress held in Seville in September, 2016, 36 Presidents of Chemical Societies or their deputies signed *The Seville declaration on the use of chlorine in warfare*.^[32] It reads:

“We, the Member Societies of the European Association for Chemical and Molecular Sciences (EuChemS), deplore the use of chlorine in the Syrian conflict or any other and call upon the international community to bring to justice those responsible for the misuse of chlorine.”

Chlorine has been used since in Syria, but an even more sinister development was the use of sarin in Douma, Syria in April 2018. Although the source of the sarin has not been confirmed, recent press reports have hinted that North Korea, which is known to hold stockpiles of chemical weapons may have been involved. Whatever the source, the use of sarin is completely unacceptable so EuChemS issued another press release.^[33]

The futility of chemical weapons and the importance of The Hague Ethical Guidelines also feature in an Editorial in the journal *Toxicology and Environmental Chemistry* penned by Hartmut Frank, Chair of the EuChemS Working Party on Ethics in Chemistry, Jonathan Edwards, OPCW and me.^[34]

Engaging with members

Conferences

The major conference run by EuChemS is the biennial EuChemS Chemistry Congress (ECC), inaugurated in Budapest in 2006. The ECCs have grown to become the most important pan chemistry congresses in Europe, becoming major festivals of chemistry and attracting over 2000 people to Seville in 2016. They involve high level speakers in all areas of chemistry with the idea that individual researchers can see where their chemistry might expand into cognate areas. It is a place to meet chemists from your own and other disciplines and to build new collaborations. The 7th Congress in Liverpool 26–30th August 2018^[35] will also include a number of themed symposia proposed by EuChemS professional networks as well as Award presentations and the disclosure of the first sites to be awarded European Chemical Landmarks.^[36]

In the odd numbered years, most of the Division hold their biennial meetings covering almost all aspects of chemistry in a focused way. In many cases these are stand-alone conferences,



Figure 5. Attendants at the EYCN Delegates' Assembly in Turin. EuChemS President, Pilar Goya is 6th from the right in the second row (Light blue top) with EYCN President Alice Soldà next to her (Green).

but sometimes, in order not to proliferate new conferences Divisions or Working Parties (e.g., Chemistry and Energy or Chemistry in Life Sciences) team up to enhance well established conference series.

Many Divisions run highly successful summer schools and the European Young Chemists' Network (Figure 5)^[37] has recently initiated a European Young Chemists Congress. This is a hugely exciting development, where young chemists from around Europe can get together to discuss chemistry. It will be the place where new groupings are built and proposals developed. It will allow even more penetration of young people into the European chemical community and funding streams. The next one will be held in Bremen, Germany in 2019. Divisions and Working Parties provide the focus for a range of activities within their area of expertise. Amongst them the European Young Chemists' Network EYCN runs very many different activities aimed at improving curricula vitae, honing interview skills and general life skills.

Awards

EuChemS has developed a series of Awards, some of which will be awarded for the first time this year. The first ever European Chemistry Gold Medal^[38] will be awarded to Ben Feringa, Groningen (Figure 6), for his work on molecular machines, for which he also won the Nobel Prize in 2016 shortly after he had

given the closing Lecture at ECC-6 in Seville. The first of the new style of EuChemS Lecture Award,^[39] which is for work carried out by people within 10 years of their PhD, will be presented to Anna Laura Capriotti (Figure 7), Sapienza University, Rome, for her work on LCMS applied to the determination of peptides and small molecules present in food, beverages, and biological samples at very low concentration. She will give a lecture at Euroanalysis in Istanbul.^[40]



Figure 6. European Gold Medal winner, Ben Feringa giving the closing (August Wilhelm von Hofmann Denkmünze) lecture at ECC-6 weeks before being awarded the Nobel Prize in Chemistry.



Figure 7. 2018 EuCheMS Lecture Award winner, Anna Laura Capriotti

EuChemS rewards service for chemistry in Europe and to EuChemS.^[41] This year, three such awards have been made (Figure 8). Franco de Angelis has offered leadership and financial stability to EuChemS through being its Treasurer for the last 6 years. He has been President of the Italian Chemical Society, President of the European Chemistry Thematic Network (ECTN), which coordinates the teaching of chemistry at tertiary level throughout Europe, and co-President of ChemPubSoc Europe. Sergio Facchetti led the team that sorted out what had gone wrong in the Soveso disaster and, as a result was invited to become a special advisor to the US President. He also proposed and developed the isotopic analysis that was used to confirm that high levels of lead in people near large road networks did indeed arise because of the use of lead in petrol. These two monumental contributions make Sergio an ideal person for a Service Award, but in addition, he has given an astonishing 47 years of very active service to the Executive Boards of EuCheMS and FECS. Finally, Reiner Salzer has, through his work with the ECTN, been instrumental in setting up and developing the labels for degrees such as Euromaster and Eurobatchelor, thus ensuring some consistency in standards across all EU universities. He has extended this work by initiating discussions with ACS on global standards in education, which have now been joined by the Federation of Asian Chemical Societies and by IUPAC. Reiner also initiated, proposed ran and analysed the First European Employment

Survey for Chemists. He ran a second one jointly with ACS and is now preparing for a third. Read his publication in *Chemistry – A European Journal*,^[42] which received amongst the top 5% of downloads for the year of publication.

A new European Chemical Landmark scheme has been initiated this year to honour people or places who/which have had a major impact on chemistry in Europe. There are two categories, European and Regional. The first awards will be presented in Liverpool to The Ytterby mine, Sweden (European Level), where 9 new elements were discovered in the 19th century. The award seems highly appropriate since we shall celebrate the International Year of the Periodic Table in 2019. The Landmark at the regional level will go to ABEA in Chania Crete, Greece for applying chemical principles and vertical integration so that all parts of the olive harvest can be utilised in table olives, olive oil, various types of soap, refined kitchen oil, animal feed - even olive kernels were used as the energy source in burning ovens. In so doing ABEA became a paradigm for other companies to imitate.

Various Divisions have initiated awards and the Italian Chemical Society together with Federazione Nazionale degli Ordini dei Chimici e dei Fisici in Italy (formerly Consiglio Nazionale de Chimici) sponsor the European Young Chemist Awards,^[43] presented at the ECC. EuChemS sponsors a prize every year for the best chemistry contribution at the European Union Contest for Young Scientist (EUCYS).^[44]

Internationalisation

In recent years, EuCheMS has been seeking to find ways with which it can productively collaborate with similar organisations around the globe. Special symposia have been held with the Federation of Asian Chemical Societies at ECC-5 in Istanbul and with Federation of Latin American Chemical Societies in Seville.

The European Young Chemists' Network (EYCN)^[37] is a key player along with ACS in initiating discussions and setting up an International Young Chemists Network (IYCN)^[45] affiliated to IUPAC. EuChemS is also working with IUPAC on some projects, especially the International Year of the Periodic Table and one



Figure 8. EuCheMS Service Award winners, Sergio Facchetti, Franco De Angelis and Reiner Salzer.

of the Bureau members, Jan Reedijk (Leiden) attends, on invitation, EuChemS Executive Board meetings.

A Memorandum of Understanding^[46] between EuChemS and the ACS, whose individual membership number is similar to the sum of those from EuChemS Member Societies, was signed in Seville during ECC-6 (Figure 9). The two societies agreed to work together to “promote the ethical use of chemistry” and “collaborate for the good of the chemical enterprise, of their members, and of the subject of chemistry” in such areas as events, surveys, lobbying, ethics and safety, global challenges, exchange programmes, the public understanding of chemistry, etc. ACS members can attend ECCs and members of EuChemS Member Societies can attend ACS meetings at a reduced registration rate.



Figure 9. A memorandum of understanding being signed between the ACS represented by Diane Grob-Schmist, past President (centre), and EuChemS (Nineta Hraselj and David Cole-Hamilton).

Already, joint workshops in the area of education and employability have been held in ECC-6 Seville^[47] and in the ACS Fall meeting, 2017, Washington. Another is planned for Liverpool. There is collaboration over the Employment Surveys, the third of which is on-going^[48] and in trying to develop global standards in chemistry teaching.

One significant development to come out of this collaboration was the first Atlantic Basin Conference on Chemistry (ABCChem, Figure 10).^[49] This conference, which is aimed at bringing together chemists from countries around the Atlantic and especially at building collaborations between people from disparate countries who would not otherwise meet, is sponsored by ACS, the Brazilian Chemical Society, the Canadian Society for Chemistry, EuChemS, and the Mexican Chemical Society, and is supported by the Federation of Chemical Societies of Africa, the South African Chemical Institute, and the Federation of Latin American Chemical Societies. The first ABCChem, held in Cancun, Mexico attracted > 200 people from around the Atlantic and provided a forum for chemists of very different backgrounds to exchange ideas and start to build collaborations. Discussions are ongoing as to where, when and whether this experiment should be repeated.



Figure 10. A group of Mexican students enjoying ABCChem in Cancun, January 2018.

EYCN runs a highly successful *Young Chemists Crossing Borders*^[50] scheme, which allows 5–6 young European Chemists to attend ACS meetings and 5–6 young chemists from the USA to attend the European Chemistry Congress.

Where is EuChemS going?

In addition to attempting to continue to raise its profile and influence through continuing to do all the things described above to a higher level, EuChemS is involved in a number of very exciting initiatives that will come to fruition over the next 1–2 years. Two of the major things are a new course on Ethics for chemists and activities surrounding the International Year of the Periodic Table in 2019.

Good chemistry: methodological, ethical and social dimensions

Chemistry is a subject where we seek after the truth based on experimental observations. It is, therefore, essential that honesty and integrity are at the forefront of every chemist's mind. Although in years gone by most people were raised in an environment where religious instruction, practice and observance played an important part, this is usually not the case now. Whatever one thinks of such instruction, there can be little doubt that most religions instil into their followers a deep sense of what is right and wrong; what is acceptable or unacceptable. The demise in religious teaching of ethics, morals, integrity and honesty has not been compensated by a dramatic rise in teaching of these issues in schools or in many cases in families, so many people starting on a scientific career will be less aware of what they should do than were their predecessors. In addition, few teachers in chemistry departments have the ability or motivation to teach ethical principles.

With this in mind, EuChemS has commissioned its Working Party on Ethics in Chemistry and Division for Education in Chemistry to develop an on-line module (1 ECTS credit) suitable for delivery to final year Masters' students or first year post-

graduates. The course will be capable of being taken entirely as an on-line course, but teachers who wish to teach a similar course themselves will be able to use any or all of the on-line material to support their teaching. The course will consist of 16 x 45-minute lectures broken up by original cases for dissection or discussion, quizzes, assignments and an assessment. 1 ECTS credit will consist of a selection of core and optional lectures tailored to meet the needs of the particular student(s).

The lectures have already been recorded by Dr. Jan Melich, who is an expert in scientific ethics from Germany currently working in Taiwan. He is also developing many of the case studies. Currently Iwona Maciejowska, Chair Division for Chemical Education, is leading a team aimed at producing the quizzes, assignments and assessments. It is anticipated that the whole course will be ready for approval by the EuChemS General Assembly in August and that it will be piloted by a selected number of chemistry departments through the last quarter of 2018. Reacting to feedback from the piloting universities, the course will be modified and then made available to chemistry departments affiliated to all EuChemS Member Societies at no cost to them.

International Year of the Periodic Table

In 2019, it will be 150 years since Dmitri Mendeleev wrote down the version of the Periodic Table that we now use.^[51] This development ushered in significant advances in the understanding of chemical systems and the development of new chemical reactions. Following a proposal from IUPAC, supported by EuChemS amongst others, UNESCO has proclaimed 2019 as the International Year of the Periodic Table of Chemical Elements (Figure 11).^[52] EuChemS is working with its Divisions, Working Parties and Member Societies, together with IUPAC to develop a number of activities throughout the year to celebrate the Periodic Table.

Just to give you a flavour of some of the new activities that are proposed, the Division for Inorganic Chemistry will hold its biennial conference in St. Petersburg, one of the places where Mendeleev worked, with the centrepiece being a celebration of the Periodic Table. The Working Party on the History of Chemistry together with IUPAC and the University of Murcia will run an international symposium, *Setting their Table: Women and the Periodic Table of Elements* in Murcia, Spain,



Figure 11. Logo for the International Year of the Periodic Table, proclaimed by UNESCO for 2019.

where the entire wall of one chemistry building is a huge Periodic Table (11–12th February, 2019). The Working Party will also produce a book entitled *Women in their element. The Historic Role of Female Scientists in the (Pre)History of the Periodic Table* edited by Annette Lykknes and their Chair, Brigitte van Tiggelen.

The EuChemS Executive Board has endorsed a proposal to produce a Periodic Table for schools, which will be made available in electronic or wallchart form. The idea is that this Periodic Table will complement existing ones, by featuring element availability and vulnerability as well as highlighting which elements appear in a mobile (cell) phone. It will look quite different from any other wallchart but will inspire discussion and thought.

A video game aimed at 11–15-year olds has also been commissioned. It will involve various challenges in order to collect individual elements or whole groups sometimes under difficult circumstances. Once again this will be made available free of charge.

Finally, EYCN, in collaboration with IUPAC and the EuChemS Division of Chemical Education are holding a second video making competition, Chemistry Rediscovered, with the title, *In Your Element*. There will be two contestant categories: 12–17 and 18–30 years old. The competition is due to be launched on 1st October.

The future of Chemistry

Some people say that chemistry is a mature subject with little more to offer, but you only have to look at the 17 UN Sustainability Goals^[53] to see that chemistry has a huge role to play in saving the planet. Without chemistry we are nothing; without chemistry we cannot survive. When we look at the great challenges facing us: global warming and climate change, clean and abundant food and water for all, zero carbon emission industry and transport, replacing fossil fuel feedstocks for chemical production with renewables, clean air for everyone, removal of plastic pollution for the seas, developing a cleaner safer world, curing new and more complicated diseases, giving a better quality of life to those who live longer, tackling diseases arising from poor lifestyles, the list is endless, we see that new chemistry must be developed for all of these challenges and much of this must be done right here in Europe. We must train the very best people to have the very best ideas and carry out the very best research at the highest level. Europe, more than anywhere else has the ability to do this—and do it must.

In EuChemS, we have taken the first steps in thinking about how we should prioritise these issues and what advice we can give others in terms of developing a strategy. In our response on potential missions for Horizon Europe,^[8] we proposed a series of missions that should be seen as very high priorities:

- 1) *Enabling Our Ageing Population*—Developing new technologies, services and systems to support an aging population is a pressing current challenge that will take on further urgency as the proportion of older people increases globally.

Themes would encompass advances in personalised medicine, medical diagnostics and assisted living technologies, as well as new models for social care and services tailored for an ageing population.

- 2) *Averting an Antimicrobial Resistance Apocalypse*—A mission that addresses the challenge of antimicrobial resistance using a one-health approach. Alongside the development of new drugs and types of therapeutics, strands under this mission could include understanding mechanisms of resistance and understanding the spread of resistance (particularly through environmental pathways), identifying ways to prevent the spread and transmission of infection, development and implementation of rapid and accurate diagnostics, and effective public health interventions, including public understanding of and attitudes towards antimicrobial resistance.
- 3) *Sustainable Low Carbon Energy for All*—A mission to deliver advances across energy efficiency, exploitation, storage and distribution to ensure adequate, equitable and sustainable energy for all. The mission will need to encompass research into materials and processes to deliver new and improved technologies, as well as routes to implementation on the scale needed for public and industrial use. In addition, research into markets, consumer attitudes and preferences will be essential to understand how to undertake changes across the current system.
- 4) *Forming a fit-for purpose Food Landscape*—This mission will deliver safe, sustainable and sufficient food supplies across the world. It will encompass methods to improve production, develop innovations in new foods, reduce waste and ensure food safety and authenticity. Examining our social and cultural relationships with food, alongside research into public health interventions that encourage improvements in diet would also be part of this mission.
- 5) *Nuclear Energy and Waste*—A mission that will address whether to continue or not with nuclear and which will develop the expertise as many things have to be done to replace nuclear or to treat waste.
- 6) *A Clean Sustainable World*—This mission strives to engender resource efficiency, the circular economy the protection and replacement of critical elements and the use of sunlight to drive chemical and fuel manufacture. Urgent targets include reducing the use of, reusing and recycling plastics with an aim to have zero plastics being added to the environment by 2030; recycling and reusing phosphorus from human waste, traceability and recycling of all elements in disposable electronic gadgets. There is a large social element in altering attitudes towards recycling, recycled goods and reduced packaging.
- 7) *Eliminating Lifestyle Diseases*—led by sociological and psychological efforts to change behaviours that lead to such illnesses as obesity, diabetes, addictions and anorexia, this Mission will use all the tools of food chemistry and formulation as well as medical interventions to improve the health, quality of life and life expectancy of a sector of society that is growing at an alarming rate.

- 8) *Smart non-invasive Medical Diagnostics*—This mission will lead to smart fast non-invasive diagnostics for a whole range of diseases, as well as imaging hard and soft tissue allowing the phasing out of X-radiography and other potentially harmful techniques.

As required for missions, all of these involve several different disciplines, but chemistry is central to all of them. They represent huge challenges, but they really must be tackled and the problems overcome. Chemistry will make the major contribution and above all, we shall provide hope of a happy sustainable and fulfilled life for generations to come. Without chemistry that is impossible.

EuChemS has a huge amount of work to do!

Keywords: chemistry · Europe · general chemistry · science and society

- [1] Letter to European Commission, "Chief Scientific Adviser", http://www.euchems.eu/wp-content/uploads/141117_letter_Chief_Scientific_Adviser.pdf.
- [2] Letter to the European Commission and the European Parliament, "Reduction of greenhouse effect gases", http://www.euchems.eu/wp-content/uploads/EuCheMS_letter_greenhouse.pdf.
- [3] Letter to the European Commission, "Transfer of funds from Horizon 2020 to the new European Fund for Strategic Investments", <http://www.euchems.eu/wp-content/uploads/150205letterResearchFunds.pdf>.
- [4] E. Keinan, (in Hebrew) <http://www.calcalist.co.il/Local/articles/0,7340,3688668,00.html>.
- [5] *EuCheMS News*, "Chemists Urge Israel to Ban Chemical Weapons" Published on: July 7, 2016, <http://www.euchems.eu/president-israeli-chemical-society-publishes-open-letter-state-president-urging-ratification-chemical-weapons-convention/>.
- [6] English translation of Ref. [4]: <http://www.euchems.eu/wp-content/uploads/2016/07/Chemical-Weapons-open-letter-translation.pdf>.
- [7] D. J. Cole-Hamilton, E. Keinan, *The Conversation*, Published on: September 16, 2016, <https://theconversation.com/why-ratifying-the-chemical-weapons-convention-is-in-israels-best-interest-63889>.
- [8] EuCheMS Response to Public Call for Feedback on Missions in the Future Framework Programme 9: <http://www.euchems.eu/policy-and-communication/policy-positions/euchems-response-to-public-call-for-feedback-on-missions-in-the-future-framework-programme-9/>.
- [9] EuCheMS Response to the Public Consultation on Trans Fatty Acids, <http://www.euchems.eu/policy-and-communication/policy-positions/euchems-response-public-consultation-trans-fatty-acids/>.
- [10] Feedback from EuCheMS on Acrylamide Mitigation Strategies, https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-2895100/feedback/F1943_en.
- [11] EuCheMS Response to the Public Consultation on Antimicrobial Resistance, <http://www.euchems.eu/policy-and-communication/policy-positions/euchems-response-public-consultation-antimicrobial-resistance/>.
- [12] EuCheMS response to the consultation on the evaluation of the European Heritage Label Action, <http://www.euchems.eu/euchems-response-to-the-consultation-on-the-evaluation-of-the-european-heritage-label-action/>.
- [13] Research and Education Without Borders After Brexit: A Position Paper <http://www.euchems.eu/policy-and-communication/policy-positions/research-education-without-borders-brexit-position-paper/>.
- [14] Integrating CO₂ in the Value Chain: The Role of Chemistry, <http://www.euchems.eu/policy-and-communication/policy-workshops/integrating-co2-in-the-value-chain-the-role-of-chemistry/>.
- [15] Solving Antibiotic Resistance, <http://www.euchems.eu/policy-and-communication/policy-workshops/solving-antibiotic-resistance/>.
- [16] Protecting Endangered Elements, <http://www.euchems.eu/policy-and-communication/policy-workshops/protecting-endangered-elements/>.

- [17] (Re)searching for Jobs, <http://www.euchems.eu/policy-and-communication/policy-workshops/researching-for-jobs/>.
- [18] Glyphosate: Harmless Tool or Sneaky Poison? <http://www.euchems.eu/policy-and-communication/policy-workshops/glyphosate-harmless-tool-sneaky-poison/>.
- [19] EuCheMS Position Paper: Solar Driven Chemistry, **2016** <http://www.euchems.eu/wp-content/uploads/2016/10/161012-Solar-Driven-Chemistry.pdf>.
- [20] EuCheMS Response to the Public Consultation on Circular Economy <http://www.euchems.eu/policy-and-communication/policy-positions/euchems-responce-to-the-public-consultation-on-circular-economy/>.
- [21] *EuCheMS News*, "EuCheMS at the EC Mission to Chile on Circular Economy", Published on April 11, 2016, <http://www.euchems.eu/euchems-ec-mission-chile-circular-economy/>.
- [22] *EuCheMS News*, "Circular Economy—EuCheMS at European Commission Mission to China", Published on November 22, 2016, <http://www.euchems.eu/circular-economy-euchems-european-commission-mission-china/>.
- [23] *EuCheMS News*, "EuCheMS at the Circular Economy Mission to South Africa", Published on May 15, 2017, <http://www.euchems.eu/euchems-circular-economy-mission-south-africa/>.
- [24] *EuCheMS News*, "EuCheMS at the Circular Economy Mission to Colombia", Published on November 15, 2017, <http://www.euchems.eu/euchems-circular-economy-mission-colombia/>.
- [25] Chemistry for the Future of Europe—Energy, Food, Environment, <http://www.euchems.eu/policy-and-communication/policy-workshops/chemistry-for-the-future-of-europe-energy-food-environment/>.
- [26] Science: How Close to Open? <http://www.euchems.eu/policy-and-communication/policy-workshops/science-close-open/>.
- [27] From Waste to Health, <http://www.euchems.eu/policy-and-communication/policy-workshops/from-waste-to-health/>.
- [28] Zero Carbon Energy: The Future, <http://www.euchems.eu/policy-and-communication/policy-workshops/zero-carbon-energy-the-future/>.
- [29] *EuCheMS News*, "Outcomes of EuCheMS CNC Lectures at Expo 2015", Published on March 15, 2016, <http://www.euchems.eu/outcomes-euchems-cnc-lectures-expo-2015/>.
- [30] Chemists Against Chemical Weapons, <http://www.euchems.eu/policy-and-communication/policy-positions/chemists-against-chemical-weapons/>.
- [31] D. J. Cole-Hamilton, *The Conversation*, Published on April 22, 2015, <https://theconversation.com/a-century-after-wwi-gas-attacks-scientists-must-unite-against-chemical-weapons-40521>.
- [32] *EuCheMS News*, "The Seville Declaration on the use of Chlorine in Warfare", Published on October 12, 2016, <http://www.euchems.eu/seville-declaration-use-chlorine-warfare/>.
- [33] *EuCheMS Press Release*, "EuCheMS statement on the use of Chemical Weapons in Syria", Published on April 11, 2018, <http://www.euchems.eu/wp-content/uploads/2018/04/1804-Chemical-Weapons-Use-declaration.pdf>.
- [34] H. Frank, J. E. Forman, D. Cole-Hamilton, *Toxicol. Environ. Chem.* **2018**, *100*, 1–5.
- [35] 7th EuCheMS Chemistry Congress: <https://www.euchems2018.org/>.
- [36] *EuCheMS News*, "A New Award—EuCheMS Historical Landmarks", Published on September 5, 2017, <http://www.euchems.eu/new-award-euchems-historical-landmarks/>.
- [37] European Young Chemists' Network (EYCN): <http://www.euchems.eu/divisions/european-young-chemists-network/>.
- [38] European Chemistry Gold Medal: <http://www.euchems.eu/awards/european-chemistry-gold-medal/>.
- [39] EuCheMS Lecture Award: <http://www.euchems.eu/awards/lecture-award/>.
- [40] Euroanalysis XX Conference: <http://euroanalysis2019.com/>.
- [41] EuCheMS Award for Service: <http://www.euchems.eu/awards/award-for-service-new1/>.
- [42] R. Salzer, P. Taylor, N. H. Majcen, F. De Angelis, S. Wilmet, E. Varella, I. Kozaris, *Chem. Eur. J.* **2015**, *21*, 9921.
- [43] European Young Chemist Award: <http://www.euchems.eu/awards/european-young-chemists-award/>.
- [44] EuCheMS European Union Contest for Young Scientist (EUCYS) Award: <http://www.euchems.eu/awards/euchems-eucys-award/>.
- [45] International Younger Chemists Network (IYCN): https://iupac.org/projects/project-details/?project_nr=2017-002-1-020.
- [46] *EuCheMS News*, "EuCheMS–ACS Sign Memorandum of Understanding", Published on September 13, 2016, <http://www.euchems.eu/euchems-acs-sign-memorandum-understanding/>.
- [47] Preparing for Employment in a Global Workforce, <http://www.euchems.eu/policy-and-communication/policy-workshops/preparing-employment-global-workforce/>.
- [48] <http://www.euchems.eu/policy-and-communication/projects/euchems-acs-employment-survey-2020-planning/>.
- [49] Atlantic Basin Conference on Chemistry: <http://abcchem.org/>.
- [50] *EYCN News*, <http://www.euchems.eu/divisions/european-young-chemists-network/news/>.
- [51] D. I. Mendeleev, *Osnovy Khimii [Elements of Chemistry]*, St. Petersburg, **1869**.
- [52] "2019 is proclaimed the International Year of the Periodic Table of Chemical Elements", Published on March 22, 2018, <https://en.unesco.org/news/2019-proclaimed-international-year-periodic-table-chemical-elements>.
- [53] United Nations Sustainable Development Goals, <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.

Manuscript received: June 26, 2018
Version of record online: July 31, 2018