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I. A message from the Chairman of DAC: "A focus on conference fragmentation"

The Euroanalysis conference series constitutes the cornerstone activity of the Division of Analytical Chemistry (DAC) of the European Association for Chemical and Molecular Sciences (EuCheMS). Hence this column reports on the last Euroanalysis conference held in Innsbruck, Austria, in September 2009. The present column also follows up the pattern from the previous two columns; namely to invite a European analytical chemist to give his or her view on a certain topic of interest. This time Professor Paul Worsfold gives his personal view on water quality in the developing world.

The Euroanalysis conferences are organised every second year and the event in Innsbruck in 2009 was the 15th in the series. Euroanalysis conferences cover all aspects of Analytical Chemistry and doubts have been raised about organising such broad based conferences at a time when specialised and topic focused conferences are very popular. The discipline of Analytical Chemistry has long been subjected to fragmentation in that the formation of groups, clusters, societies or clubs is a common occurrence. Thus, experts in a particular area of analytical chemistry have a tendency to focus on their own specialisation. This is to some extent understandable but it is also a danger since new paradigms very often arise when several scientific areas meet in a combined effort to solve a specific problem. So, consider the question "What kind of area-focused conference should the following analytical chemist attend?”. This analytical chemist is working with beverages trying to develop methods for the determination of pesticides using advanced sampling, sample pre-treatment and separation methods, mass spectrometry detection and chemometrics to treat the data. There are specialised conferences for all these individual areas within analytical chemistry and also for specific applications such as beer, wine and pesticides. In addition, there are national and international divisions and/or societies focussed on, e.g. “food”, “environment” and “chemometrics” that would be relevant and welcome this analytical chemist as a member and appreciate their contribution on advanced analytical techniques. Therefore why not go to a broad analytical chemistry conference such as Euroanalysis instead? The last Euroanalysis conference in Innsbruck attracted more than 700 attendees, demonstrating that this conference concept is still very viable and has a bright future.

The Division of Analytical Chemistry is open to all analytical chemists. Within this conference the existing “sub-groups” are welcome to organise thematic sessions so that experts can meet and disseminate their knowledge and at the same time be inspired by experts representing other sub-groups. The next Euroanalysis conference will be in Belgrade, Serbia, 11-15 September, 2011 (see http://www.euroanalysis2011.rs) and we really look forward to seeing you there! The year 2011 is also the International Year of Chemistry (see http://www.chemistry2011.org) which will add to the occasion.

II. Personal View

Water Quality in the Developing World – Challenges for Analytical Chemistry

In the previous European Analytical Column the challenges for Analytical Chemistry in the context of the European Union Policy for Sustainable Development were highlighted [1]. The key thematic areas considered were air quality, water quality and quantity, climate change and global poverty and development co-operation. Analytical Chemistry has a pivotal role to play in all of these areas over the next decade. With regard to water quality, for example, there is a growing need for *in situ* sensor technologies that can provide high temporal and spatial resolution data in real time, with an appropriate standard of data quality, to supplement techniques and methods for laboratory analysis.

1. Water quality

Water quality can be defined by its chemical, physical, and biological characteristics and needs to be considered in the context of whether it is fit for purpose. This will depend on its intended use, e.g. agriculture, manufacturing, mining, human consumption, food production, recreation or for broader human and ecosystem health. Water quality is impacted by natural processes (e.g. seasonal trends, underlying geology and hydrology, weather and climate) and human activities (e.g. agriculture, industry, environmental engineering). In order to achieve effective water quality management, a balance must be met between socio-economic pressures and environmental sustainability / protection. Good environmental monitoring operating within a robust legislative framework is an essential prerequisite for achieving that balance. Poor water quality can lead to lower agricultural yields and higher treatment costs for good quality potable water and water used by industry. In addition to having systems in place for water quality monitoring, the sources, transport, fate and persistence of chemical contaminants in the aquatic environment also need to be understood within local, national and international contexts. Key processes that impact on water quality include;

- Eutrophication, i.e. elevated nutrient concentrations leading to excessive algal growth and deoxygenation, due to diffuse run-off from agricultural land and point source discharges from wastewater treatment plants.
- Diffuse and point source discharges/drainage from mining activities that increase acidity and dissolved metal concentrations.
- Localised discharges of organic micropollutants, metals, radionuclides and nutrients from specific industries and domestic wastewater.
- Saline intrusion into groundwater in coastal areas.
- Erosion and sedimentation from, e.g. deforestation, rainfall events (which are temporally and spatially highly variable) and engineering projects.

2. Eutrophication

Taking eutrophication as a specific example, there are many ecological and socio-economic drivers that require the reliable measurement of nutrients in natural waters. The oceans (coastal, shelf and open ocean waters) have been estimated to contribute ~21 trillion US$ per year to human welfare (compared with a global GNP of ~25 trillion US$) [2]. Catchments and coastal waters of industrialised countries have received elevated inputs of nutrients for decades, in many cases giving rise to cultural eutrophication i.e. the anthropogenic enrichment of the environment with nutrients and the concomitant production of undesirable effects. Enhanced nutrient concentrations do not irrevocably lead to changes in the trophic status of natural water systems, but they are the primary cause where this occurs. Many areas of the globe are undergoing cultural eutrophication because of continuing population growth, urbanisation and industrialisation. Many undesirable effects resulting from nutrient enrichment have been documented, ranging from localised high concentrations of suspended algae to marked dissolved oxygen depletion and death of biota. The economic costs of these effects are potentially large, but are infrequently assessed. In addition, our understanding of the role of nutrients in the sequestration of atmospheric carbon by oceans is far from complete. For example, subtropical oligotrophic (low nutrient and low biomass) areas of the ocean represent nearly half of the Earth's surface. These oceanic habitats, once thought to be homogenous and constant in time, exhibit transient pulses of carbon sequestration in response to episodic nutrient inputs. The significance of this phenomenon to carbon cycling is not known. Nutrient measurements in these environments are challenging because of the generally very low concentrations encountered. Furthermore, oceanic nutrient datasets have insufficient spatial and temporal coverage to satisfactorily test biogeochemical models of the global ocean.

Legislation and guidelines designed to protect vulnerable marine and freshwater environments has been introduced nationally and internationally. For example, the Paris, Helsinki and Barcelona Conventions, EU Directives (e.g. Species and Habitats, Nitrates, Urban Wastewater and Water Framework), and USEPA guidelines. Remediation strategies require nutrient measurements to assess their efficacy, including the use of diagnostic models. Therefore nutrient measurements are critical, whether they are undertaken in a 'monitoring' context, i.e. mapping of the affected environment spatially and/or temporally, or used to examine key nutrient transport and cycling processes. The measurement of nutrients should include all of those fractions (dissolved inorganic and organic, particle-associated) that may be bioavailable within the timeframe(s) of the system's dynamics. Any effective decision support tool (conceptual model) for determining the causes and effects of eutrophication needs to link bottom-up causes with top-down consequences. The former requires information on nutrient inputs and biogeochemical cycling which, in turn, necessitates reliable analytical techniques.

3. *In situ* analytical technologies

There is a plethora of analytical methods for the determination of nutrients, particularly nitrogen and phosphorus species, in the aquatic environment. In recent years techniques such as flow injection analysis have become popular because of their portability, which allows remote (*in situ*) deployment in order to provide high quality analytical data with good temporal and spatial resolution [3]. The key requirements for *in situ* technologies include;

- Easy to use, rugged and automated instrumentation.
- On-line or in-line devices to minimise contamination.
- Sensitive and selective detection.
- Elimination of matrix interferences.
- System stability (e.g. reagents, standards, pumps, detector).
- On-board filtration and prevention of bio-fouling.
- Remote calibration, validation and maintenance.

4. Water quality in the developing world

The challenges for providing good water quality are particularly acute in parts of the developing world, e.g. in Africa. Increasing population growth and demand for water from food production and industry, loss of surface and groundwater resources and climate change, combined with a lack of stringent environmental safeguards, has led to serious concerns about water quality (and quantity), which threaten human health and the environment. To help address these concerns, increasing Africa's capacity in analytical chemistry is imperative. In order to support chemical monitoring and management activities there is an urgent need for scientifically qualified and practically trained personnel in relevant advanced analytical chemistry techniques. Thus, it is essential to create and support centres of excellence in analytical chemistry that involve a critical mass of experts in African universities (and other organisations).

The status of instrumentation in African Higher Education institutions is a critical issue which urgently needs to be addressed, not only at a government level, by the provision of funds to enable universities to access and maintain the required equipment but also, most importantly, by facilitating and sustaining the training of analytical chemists and associated staff. Optimisation of resources is crucial if funds are to be used wisely, e.g. by establishing national and regional centres of excellence, with shared research facilities, as part of this effort.

The Pan Africa Chemistry Network [4], co-ordinated by the Royal Society of Chemistry, is a good example of capacity building activities in this area. Activities include the commissioning, installation and maintenance of analytical instrumentation, facilitating networking activities of African and non-African scientists in water research and management and the provision of analytical training courses for researchers across Africa. The ultimate aim is to develop well-equipped chemical research communities by creating regional centres of excellence. It is important that these centres are supported, promoted and continuously funded.

The Division of Analytical Chemistry within the European Association for Chemical and Molecular Sciences (DAC-EuCheMS) is part of a network of European chemical societies and has members working in all fields of Analytical Science. One of its aims is to develop close links with related organisations all over the world. As part of this remit, support for capacity building in Analytical Science in the developing world would make an important contribution to tackling global issues such as water quality (and quantity) and climate change.

III. Information from the EuCheMS Division of Analytical Chemistry

Innsbruck was the venue of Euroanalysis 15 [5] organised by Wolfgang Buchberger and Wolfgang Lindner. Despite much anxiety due to the global economic situation, the Conference was well attended, with over 700 participants from 53 countries presenting 130 lectures and 640 posters under the theme "The Impact of Analytical Chemistry on the Quality of Life". Contributions were made from many areas of analytical chemistry and EUROANALYSIS maintained its position as one of the most important international broad spectrum analytical science conferences. Slavica Razic is the Conference Chair for Euroanalysis 16 in Belgrade, Serbia in 2011 [6] with the motto "Challenges in Modern Analytical Chemistry". At the Annual Meeting of EuCheMS DAC in Innsbruck it was decided that Euroanalysis 17 will be held in Warzaw, Poland, on August 23 – 25, 2013. In the near future, analytical science will also be well represented at the 3rd EuCheMS Chemistry Congress on August 29 – September 2, 2010, in Nuremberg, Germany [7].

At Euroanalysis 15 the Robert-Kellner Lecture sponsored by Springer-Heidelberg was awarded to Boris Mizaikoff, University of Ulm. The Robert-Kellner Lecture was established by EuCheMS DAC in memory of the late Prof. Robert Kellner of Vienna University of Technology, and the Robert-Kellner Lecture is awarded to scientists who qualify according to the statute: "This award shall distinguish a person who has made a substantial contribution to the advancement of Analytical Chemistry in research or education". The Austrian Society of Analytical Chemistry honoured two outstanding scientists with the prestigious awards: The Pregl Medal and the Emich Plaque. The Pregl Medal was awarded to Prof. Friedrich Lottspeich (Max-Planck-Institute, Martinsried, Germany), and the Emich Plaque to Prof. Harald Fuchs (University Muenster, Germany). Furthermore, Prof. Lindner was presented with the Martin Gold Medal of the Chromatographic Society.

Reiner Salzer offers a template for the development of a shared set of case studies which is available from the DAC/EuCheMS website. Scientists are encouraged to contribute case studies that are well suited to teaching in higher education. A new initiative was started to facilitate the formation of national or international consortia for education in Analytical Chemistry. The focus is on two aspects; (i) achieving the highest scientific standard of education in Analytical Chemistry and (ii) improving the employability of graduates from such programmes. Details can be found at Anal. Bioanal. Chem. (2009) 394:649–653.

Hendrik Emons is the EuCheMS DAC liaison person to CITAC and he reported on new initiatives in legislation. In Germany, new legislation on accreditation was introduced as a result of harmonisation with new EU legislation. He also raised awareness of ISO Guide 99 on concepts and terminology of metrology which contains a lot of information relevant to analytical chemists. This guide, also known as VIM 3, is freely available at the BIPM webpage [9]. It is also important to enlighten students about the topic.

George Horvai of the DAC Bioanalytics Study Group reported that it is necessary to search ways to bring the analytical and bioanalytical chemistry communities closer together. Several analytical journals have moved strongly in the direction of bioanalytical chemistry, and a significant fraction of authors publishing bioanalytical papers in analytical chemistry journals come from outside traditional analytical workplaces. Moreover, important journals which have historically covered areas other than analytical chemistry have moved strongly into the analytical field. This report should initiate much debate on the position, development and teaching of Bioanalytics, which is one of the largest single subject areas within the range of analytical disciplines. The challenges include proteomics and analysis of GMOs. It should be stressed that the approaches and procedures used in Analytical Chemistry also apply to Bioanalytics. The Delegates expressed concern about a lack of formal education in Chemistry for those working in the Bioanalytics field, which may pose a problem in the interpretation of results obtained by analytical chemistry methodologies.

Bioanalytical chemistry is also considered one of the emerging issues of the Analytical Chemistry Division (ACD) of IUPAC. Indeed at the 2009 IUPAC Congress in Glasgow there was a high proportion of biochemistry presentations. In the Analytical Chemistry Division, work on a new edition of the Orange Book has just started and Jose Pingarron and Jan Labuda are responsible for a chapter on bioanalytical methods in the methodological section of the Orange Book. Jan Labuda, a titular member of the Analytical Chemistry Division of IUPAC (2006-2009) and chair of the task group of

IUPAC project No. 2006-026-1-500 entitled “Electrochemical DNA-based biosensors: terms and methodology“, organised a project workshop in Seville, Spain, on 6 September, 2008 and lead the preparation of an IUPAC technical report on the subject.

It was reported by IRMM of the European Commission that calls have been announced on the CORDIS webpage for topics in the areas of Problem Solving, Decision Making, Method Development, Competitiveness, Fundamentals and Environment, and funding of 400 M euro has been allocated for Metrology over the next seven years. There is no specific Analytical Chemistry call. Electrochemistry topics, including those that are analytical chemistry orientated, are funded by 35 M euro per year in a three year programme. Calls under Energy are closing in November 2010. Positions are available for young scientists at IRMM. Moreover, analytical laboratories which can execute appropriate validated methods can apply for participation in IRMM's reference material programme (http://irmm.jrc.ec.europa.eu).

Bo Karlberg announced his retirement as Chair of EuCheMS DAC in 2010, and encourages the Delegates of member societies to nominate candidates to be elected at the Annual Meeting in Nuremberg in conjunction with the 3rd EuCheMS Conference on Chemistry [7]. The website of EAConweb will continue to be maintained by DAC / Bo Karlberg with the support of the Swedish Chemical Society.

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