THE ROYAL SOCIETY OF CHEMISTRY

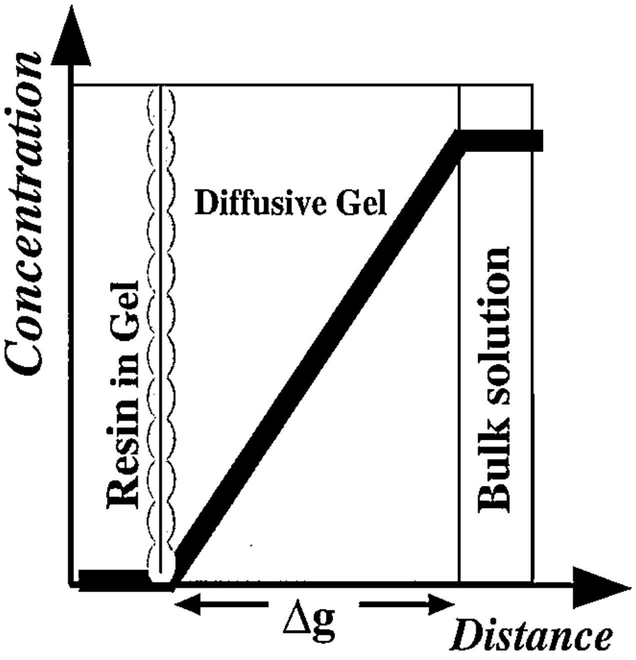
ENVIRONMENTAL CHEMISTRY GROUP

Bulletin

January 2003

Diffusive Gradients in Thin Films (DGT)

DGT, invented in 1994, uses a passive sensor for monitoring metals *in situ*. Trace metals are measured by accumulating them on a selective binding resin after passage through an open-pore gel. The simple plastic assembly can be deployed *in situ* in rivers and effluents where it automatically separates metal ions from solution. Metals are subsequently analysed conveniently and accurately in the laboratory. DGT has been an important technique for the work described in this year's **DISTINGUISHED GUEST LECTURE** (5th March 2003): "Does Biology or Chemistry Determine the Availability of Toxic Metals in Soils and Sediments?"



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The ECG Bulletin may be seen on the Internet at http://www.rsc.org/lap/rsccom/dab/scaf003.htm

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Chairman's report for 2002

Happy New Year to all members of the Environmental Chemistry Group! The last year has been a time of reflection for the Environmental Chemistry Group. One reason for this has been the development of the new 'Environmental Forum' at the Royal Society of Chemistry. The aim of this new Forum is to co-ordinate the Society's activities in the areas of **Environment, Energy and Sustainability**. We wanted to ensure that the ECG would be in a good position to make a valuable contribution to the Forum when it starts up in early 2003. Among the ways we have achieved this is by reviewing the activities of the ECG Committee, which was one of the reasons for my advertisement for new Committee members in the previous *ECG Bulletin*.

Thank you to all those of you who replied to the advert. We had a good response and we have spent the last couple of Committee meetings reviewing those applications. Unfortunately we couldn't invite everyone to join us but I hope you will all continue to support our activities in the future, whether it is by contributions to the *Bulletin* and the Web site, or attendance at meetings and lectures. Incidentally, the new Forum is still unnamed, so please feel free to e-mail me with your suggestions, before February 14th.

In 2003 we hope to be making improvements to our Web site, as we know this is an important form of communication for many of our members and we welcome your suggestions for content. For those of you who use e-mail, the Royal Society of Chemistry is asking you to let them know your e-mail address, if you haven't done so already. For those of you who do not use e-mail or the Web, please don't worry; you will still receive a newsletter from us with lots of the latest news in environmental chemistry.

I hope to see many of you at our **Distinguished Guest Lecture and Annual General Meeting** on March 5th 2003 at the Linnean Society, London. Full details of this year's DGL may be found in this issue of the *ECG Bulletin*.

We can also look forward to a **Young Environmental Chemists Meeting** later in the year, which will give young researchers the opportunity to display and discuss their work in a friendly environment. We are hoping this will be an annual event that is looked upon favourably by the research community. It is always difficult for students to find funds to attend such events and we are therefore looking for contributions to enable us to offer travel bursaries. Please contact me if you are able to help.

Please don't hesitate to send me any comments you may have during the year, we are always looking for ways we can improve services to our members. Finally, I would like to thank all of you for your continuing support and I wish you all the best for the year ahead!

Dr ANDREA JACKSON
Chair of the Environmental Chemistry Group
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December 2002

The Royal Society of Chemistry and the environment

The Environment, Sustainability and Energy Forum

Proposed changes to the way the Royal Society of Chemistry (RSC) represents members' interests in the environmental sciences were described in the previous issue of this *Bulletin* (July 2002). The main proposal – to set up an Environmental Forum – was discussed by representatives from RSC Subject Groups and the RSC at a meeting in Burlington House in April 2002. Better co-ordination within the RSC should result in the organisation of more scientific conferences on the environment. Other benefits of the new Forum will be improved interaction between the Subject Groups and RSC scientific journals and books, and better communication with external research-oriented bodies such as the UK's Research Councils.

After broad internal consultation, the new Forum has been given the go-ahead and will start work early in 2003. The Forum has now been tentatively named the **Environment, Sustainability and Energy Forum**, and it will report to the RSC's Science and Technology Board (STB).

The Environment, Health and Safety Committee

The Environment, Health and Safety Committee (EHSC) has recently undertaken a major review of its activities with the aim of tackling fewer issues but in much greater depth. The committee is likely to continue as a policy and legislation unit within the new Forum. In addition to environmental policy and legislation, EHSC will also continue to have responsibilities for health and safety. The EHSC will also continue to be concerned with public image and public understanding issues related to the environment.

Forthcoming symposium

Royal Society of Chemistry Environmental Chemistry Group

Thirtieth Annual General Meeting and 2003 Distinguished Guest Lecture & Symposium: "Assessment of Change in the Aquatic Environment: Chemistry versus Biology"

To be held in the Meeting Room of the Linnean Society of London, Burlington House, Piccadilly, London, W1V 0LQ on Wednesday, March 5th 2003

PROGRAMME

13.30 Chairman's Introduction: Dr Andrea Jackson (Chairman, RSC Environmental Chemistry Group)

13.35 Professor Brian Moss, Liverpool University: "Chemists pushed out of bed by biologists? The new needs of the Water Framework Directive"

14.20 Professor Mike Depledge, Environment Agency: "Has biological monitoring superseded the need for chemical analysis? The case of developing countries"

15.05 Tea and **RSC Environmental Chemistry Group Annual General Meeting**

15.30 Introduction to the 2003 RSC ECG Distinguished Guest Lecture

15.35 **2003 RSC Environmental Chemistry Group Distinguished Guest Lecture:** Professor Bill Davison, Lancaster University: "Does biology or chemistry determine the availability of toxic metals in soils and sediments?"

16.35 Open Forum

17.00 Close

There are no registration formalities associated with this meeting and guests are welcome, but in order to assist the organisers it would be appreciated if those intending to be present would notify the Hon. Secretary by means of the slip below, or by e-mail. There will be a charge of £5 for non-members of the Environmental Chemistry Group, which should be returned with the slip (cheques made payable to *RSC Environmental Chemistry Group*).

The nearest underground stations to The Linnean Society are Green Park and Piccadilly Circus.

"Progress in understanding the role of soils in determining the uptake of metals by biota has been limited by our failure to appreciate simultaneously the three major controlling factors: pool size; kinetics; and transport. By mimicking the highly localised processes that determine uptake at a biological membrane, realistic chemical surrogates for bioavailability can be developed. They predict remarkably well the metals potentially available to biota, such as plants, and allow simple and rapid assessment of risk. They can also provide fundamental understanding about controlling processes, such as kinetic mechanisms of supply and the role of bacteria in releasing metals."

Excerpted and adapted from Prof. Davison's abstract for his 2003 Distinguished Guest Lecture.

"**The Water Framework Directive** was passed in 2000 and is potentially the most revolutionary environmental legislation ever to be enacted. It will mean not only that a much greater range of chemical variables will have to be monitored and managed (jobs for chemists!) but also a much wider range of biological variables. The world of water chemists has always been complex. For those in the regulatory agencies it is about to become even more so... but life will also become more interesting and the ultimate, tangible consequences of their work much more satisfying. Some of the problems to be faced in forwarding the spirit of the Directive will be technical, but equally many will be political and social."

Excerpted and adapted from Prof. Moss' abstract for his Supporting Lecture.

Royal Society of Chemistry Environmental Chemistry Group Annual General Meeting

Meeting Room, The Linnean Society of London, 5th March 2003, 15.05 pm

AGENDA

1. Apologies for absence
2. Minutes of the 29th AGM held on 6th March 2002, at the Linnean Society of London
3. Report on Group activities
4. Election of officers and members of the Committee
5. Any other business

The composition of the present Committee is given below, with an indication of members who will be retiring under the rules of the Group.

Chairman	Dr Andrea Jackson (University of Leeds)	Dr A. Jackson remains as Chair
Vice-Chairman	Dr Leo Salter (Cornwall College)	Dr L. Salter retires as Vice-Chairman
Hon. Treasurer	Dr Brendan Keely (University of York)	B. Keely to remain as Honorary Treasurer
Hon. Secretary	Dr Rob MacKenzie* (Lancaster University)	R. MacKenzie retires as Honorary Secretary

Members:
Mr B. Hazell (Royal Society of Chemistry)
Prof. S. Hill (University of Plymouth)
Dr J. Holder* (Consultant)
Dr J. Hoskins* (Consultant)
Dr R. Purchase (Consultant)
Dr B. Smith* (British Geological Survey)

* Retiring committee members

Standing for election:

Dr K. Cooke (Sira Ltd)
Dr C. Harrington (De Montfort University)

ROYAL SOCIETY OF CHEMISTRY ENVIRONMENTAL CHEMISTRY GROUP

Thirtieth Annual General Meeting and 2003 Distinguished Guest Lecture & Symposium: "Assessment of Change in the Aquatic Environment: Chemistry versus Biology".

To be held in the Meeting Room of the Linnean Society of London, Burlington House, Piccadilly, London, W1V 0LQ on Wednesday, March 5th 2003

Please tick the item(s) below as appropriate.

I would like to attend:

The AGM ☐

The Symposium ☐

I enclose a cheque for: £5 (registration fee for non-members of the ECG only) ☐

Name: ....

Address: ....
....
....

Please send to: Dr Rob. MacKenzie (r.mackenzie@lancaster.ac.uk), Environmental Science Department,
Lancaster University, LA1 4YQ

More from Bangladesh

The repercussions of a combination of unfavourable geological conditions and a thwarted attempt to provide uncontaminated drinking water *via* tubewells continue to unfold in parts of Bangladesh. Three recent reports, which appeared on reliable American Chemical Society-linked Web sites in the weeks just prior to Christmas 2002, provide a timely reminder of the effects of arsenic contaminated drinking water on this population.

Arsenic field tests may lead to mislabelled wells

Thousands of people in Bangladesh and India may be drinking arsenic contaminated water from wells that are falsely labelled safe, warn researchers from Jadavpur University in Calcutta, India. Inaccurate arsenic test kits are leading villagers to avoid safe water and drink from unsafe wells in countries where untainted water is among the most precious of commodities.

The study of wells in Bangladesh and West Bengal, India, suggests the arsenic test kits used by field workers are often inaccurate, producing scores of mis-labelled wells. Researchers analysed 2,866 water samples from wells that had been tested and labelled by field workers. They found that a large percentage of the wells were mislabelled, marked safe when they contained dangerous levels of arsenic, or marked as contaminated when more sensitive analyses showed them to be safe.

Shallow wells, known as tubewells, are used in Bangladesh and India to avoid the region's surface water, much of which contains bacteria that can cause waterborne diseases like cholera. Starting in the 1970s, international aid organizations dug 'millions' of tubewells to provide bacteria free water. But officials soon found that the tubewells were reaching groundwater containing high levels of arsenic. Long-term arsenic exposure can lead to skin lesions and keratosis, a hardening of the skin.

Numerous studies have linked long term exposure to arsenic with several types of cancer, according to the U.S. Environmental Protection Agency (EPA). The World Health Organization advocates a maximum arsenic level in water of 10 micrograms per litre – the standard recently adopted used by the EPA – but many developing countries still use a standard of 50 micrograms per litre. By 1993, the Bangladesh Department of Public Health Engineering had reported widespread signs of arsenic poisoning, and blamed water from tubewells. Similar problems have also surfaced in other countries in the region, including India, Vietnam, Cambodia, Nepal and Myanmar (formerly Burma).

In 1997, the World Bank, WHO, UNICEF and other international organizations undertook a massive project to test every tubewell in Bangladesh and the surrounding area using field kits. Many wells were labelled with paint to indicate their viability: green for safe water, containing under 50 micrograms per litre of arsenic, and red for unsafe water.

Using flow injection hydride generation atomic absorption spectrometry to recheck the results from field kits, the researchers from Jadavpur University found that almost 50 percent of the wells painted red by field workers contained safe drinking water, while just 7.5 percent of the green painted wells, which had been dubbed safe, turned out to be unsafe. Given the scarcity of uncontaminated water, the mislabelling of 50% of safe wells is of concern.

Field kits do not appear to provide accurate enough results for large scale testing initiatives with such important health, economic and environmental impacts. The field kits are difficult to read with precision, and the majority of the analyses carried out in Bangladesh were performed before 2000, using a test kit with a minimum detection level of 100 micrograms per litre.

Irrigation may produce arsenic-tainted rice in Bangladesh

The arsenic that has contaminated much of Bangladesh's drinking water supply is also getting into its rice, according to a new study. Irrigating rice fields with tainted well water could be jeopardizing the country's staple food, which provides more than 70 percent of the population's daily intake of calories.

"There has been a considerable research effort on the effects of drinking arsenic contaminated water in Bangladesh," says Andrew Meharg, Ph.D., a biogeochemist at the University of Aberdeen in Scotland and lead author on the paper to be published in *Environmental Science & Technology*, 2003. "However, the tubewell water is not just used for drinking water, it is also used for irrigation."

Farmers in Bangladesh use tubewell water for irrigation so that rice can be grown during all six months of the dry season. If the arsenic that is building up in the soil from irrigation moves into rice crops, Meharg says, the exposure of people to arsenic in Bangladesh will be much greater than previously thought.

Meharg and his colleagues took 71 soil samples from 27 districts throughout Bangladesh and collected rice grains from various regions. "We've shown that rice collected from the areas of Bangladesh with the most contaminated fields have arsenic levels 10-fold higher than rice from uncontaminated areas," Meharg says. They calculated that rice could be the main source of arsenic for people in these highly contaminated areas. Three of the Bangladesh rice samples contained more than 1.7 milligrams of arsenic per kilogram of rice.

"These findings cause considerable concern and suggest that ingestion of rice is a major source of arsenic exposure in Bangladesh and elsewhere in regions with subsistence rice diets," the researchers write. A number of countries in the region have similar problems with tubewell contamination. Two areas – Vietnam and West Bengal, India – are particularly likely candidates for finding arsenic in rice, Meharg says.

Meharg, A. A. & Rahman, Md. M. Arsenic contamination of Bangladeshi paddy field soils: implications for rice contribution to arsenic consumption. *Environmental Science and Technology*, Published online doi:10.1021/es0259842, (2002).

International help for Bangladesh

An international team of volunteer scientists from Canada, the U.S., and France has prepared detailed maps of the levels of arsenic and 29 other metals in the drinking water of Bangladesh. Their study suggests that the wide-scale arsenic poisoning that has been devastating much of Bangladesh for the past decade may be exacerbated by the presence of metals besides arsenic in well water used for drinking. Ironically, the poisoning may be exacerbated, as well, by the lack of certain other metals in the drinking water, which, if present, might mitigate some of arsenic's ill effects.

"Our results may allow scientists, policymakers, and aid workers to initiate programs to assist the areas most affected by the toxic metals documented by these studies," says Bibudhendra Sarkar, leader of the team. Professor Sarkar, well known for his work on the biochemistry and treatment of two copper storage disorders, Wilson's disease and Menkes syndrome, is a senior scientist at the Hospital for Sick Children in Toronto and professor of biochemistry at the University of Toronto.

Although a great deal of information about arsenic in the water in Bangladesh is available on Internet sites and from international organizations such as WHO and UNICEF, much of these data are little more than guesses, Sarkar says. Too often, he says, the information being reported is based on limited sampling or has not undergone careful peer review. It was to address this need for solid scientific data on the extent and nature of the water contamination that he and his colleagues conducted their study.

The project began in 1998 when Sarkar, teamed up with Seth H. Frisbie, an environmental scientist. Previously, in 1997, Sarkar had travelled to Bangladesh, accompanied by a film crew from Canadian Television, to make a documentary on the health crisis there. What Sarkar saw in Bangladesh made a profound impression on him. "I have never seen so many sick people as were in many of these villages," he recounts. "There are no doctors, no clinics. They don't even know what is happening to them." Sarkar was struck, in particular, by the fact that "even small children were coming down with metal-connected sickness. They had the dark spots on their bodies associated with arsenic poisoning." That observation was puzzling, he explains, because arsenic is a slow poison. Ordinarily, physical symptoms of toxicity take at least 10 years to develop. "When I saw these small children, I started wondering what is happening to them." Sarkar recalls. "Naturally, with my background in bioinorganic chemistry, I started wondering if there were other toxic metals coming to them in the water."

Meanwhile, quite independently, Frisbie and another scientist who would later join the project, hydrogeologist Donald M. Maynard, were in Bangladesh analysing water from tubewells for arsenic and several other metals in a project funded by the U.S. Agency for International Development. When Frisbie saw the Canadian Television documentary, he contacted Sarkar. The two began to put together a follow-up project to find out whether there were other potentially toxic metals in Bangladeshi drinking water and whether some of them might be contributing to the toxic effects Sarkar was seeing in children.

The two researchers returned to Bangladesh in December 1998. Over a period of about a month, they interviewed villagers and collected water samples from 112 tubewells throughout the country. After doing preliminary work on the water samples in Bangladesh, they sent them to Richard Ortega, a former postdoc of Sarkar's, who is now an environmental analytical chemist at the French National Center for Scientific Research (CNRS) laboratory at the University of Bordeaux. Ortega analysed the samples using CNRS's inductively coupled plasma/mass spectrometers and Maynard mapped the resulting data.

The study found that although the most significant health risk from drinking Bangladesh's tubewell water is chronic arsenic poisoning, other metals may be contributing to the problem as well. The team found 48% of the samples contained arsenic above the 10-ppb level recommended by WHO. That means about 60 million people may be drinking this water, the researchers say. Furthermore, 97% of the water samples that contained detectable levels of arsenic also contained detectable levels of antimony, a metal known to magnify arsenic toxicity.

In addition, the team's data suggest that tens of millions of Bangladeshis are drinking water that exceeds WHO guidelines for manganese, a mutagen that has also been associated with neurological damage; lead, a possible carcinogen that also causes other health problems in humans; and nickel and chromium, both carcinogens.

The severity of chronic arsenic poisoning in Bangladesh might be magnified by the lack of selenium, zinc, or both in much of the drinking water, the team suggests. Selenium can inhibit arsenic toxicity, Sarkar points out, but 92% of the water samples that contained detectable levels of arsenic did not have detectable levels of selenium. Less frequently, zinc was also absent. This element promotes the repair of tissues damaged by arsenic. The team could not detect it in 18% of the samples containing arsenic.

The new findings by Sarkar and his colleagues parallel the results of a much larger study of some 3,500 wells conducted by the British Geological Survey (BGS) and published in 2000. The BGS study looked at water from both deep (more than about 300 metres) and shallower wells. Among the shallower wells, the study found 27% had water that contained more than 50 ppb of arsenic and 46% had more than 10 ppb. "Arsenic is not the only groundwater problem," the study concluded, "but it is undoubtedly the most serious." Manganese is the next biggest cause of concern, according to this study, in terms of both the number of wells affected and the degree to which wells exceeded drinking water standards. The study also noted boron and uranium as potentially toxic metals sometimes present at levels high enough to cause health concerns.

Seth H. Frisbie, Richard Ortega, Donald M. Maynard, and Bibudhendra Sarkar. The Concentrations of Arsenic and Other Toxic Elements in Bangladesh's Drinking Water. *Environmental Health Perspectives*, 2002, 110, 1147, published online Sept. 20, http://ehpnet1.niehs.nih.gov/docs/2002/110p1147-1153frisbie/abstract.html

BGS arsenic Web link: http://www.bgs.ac.uk/arsenic/home.html

Current research at the UK's De Montfort University into the environmental chemistry of arsenic

Dr Chris Harrington, a prospective committee member of the Environmental Chemistry Group, describes the work of De Montfort University's, Metal Speciation and Biotransformation Research Group into arsenic speciation and remediation.

Introduction

Arsenic contamination has been described as the most significant environmental problem facing the developing world in the 21st century. It is estimated that arsenic contaminated water currently affects 80 million people worldwide, mostly in the Indian sub-continent, but also in Vietnam and parts of the United States. In light of the health concerns associated with arsenic, the US EPA and WHO have reduced the limits in potable water to 10 micrograms per litre. In general, the impact of arsenic in these situations is not due to anthropogenic sources, but naturally occurring mineralogy in these locations, it therefore has the possibility to exert an effect over a considerable time period unless action is taken to remove it from the water supply.

The environmental chemistry of arsenic is extremely complex, with a large number of arsenic containing compounds currently known. Arsenic readily bonds with carbon to form organometallic compounds and unlike other metal(loid)s such as mercury, lead or tin this **reduces** its toxicity. Organometallic compounds such as monomethylarsinic acid (MMA), arsenobetaine (AsBet), the wide range of arsenic sugars, or the arsenic containing lipids, are all less toxic than the two inorganic forms of arsenic (As(III) and As(V)). For this reason, it is imperative that the actual chemical form of arsenic is measured in environmental, toxicological and health situations. The most abundant arsenic containing compound in seafood, arsenobetaine, was first identified by Edmonds and Francesconi in 1977. Their work was instigated by the uncertainty associated with the high levels of total arsenic measured in lobsters, edible crabs and shellfish. The fact that arsenobetaine is not metabolised by humans means that the high concentration of arsenic found in seafood is non-toxic. However, the biogeochemical cycle of arsenic in the marine environment is still not understood enough to demonstrate how arsenobetaine, the most ubiquitous arsenic containing compound in the environment, is formed, although a number of mechanisms have been postulated, none to-date have been proven.

Current research projects

The Metal Speciation and Biotransformation Research Group at De Montfort University is currently involved in a number of collaborative projects focused on different aspects of the biogeochemistry, analysis and microbiology of arsenic. The main elements of this research include: the role of microbes in the transformation of arsenic and arsenic containing compounds in the environmental; the remediation of arsenic in water; the assessment of arsenic levels in the diet of specific ethnic groups in the UK; the diagenetic arsenic uptake into hair; and the high accuracy measurement of arsenic biomarkers in biological fluids.

Microbiological research

The group has worked on the identification of bacteria capable of the dissimilatory reduction of As(V) to As(III). This could lead to a method for the remediation of arsenic contaminated soil because As(III) is more mobile and so more readily leached into the liquid phase, where it is available to be removed. This research stems from collaboration with Huelva University, Spain which focused on the 1998 contamination of the River Guadimar by arsenic contaminated sludge resulting from a dam collapse which released tonnes of toxic waste from a mine tailings pond.

Arsenic remediation

Studies on methods to remove arsenic from potable water have focused on the use of modified zeolites. Although this type of technology has been available since the late 1990's, it has not been applied to the current problems in Bangladesh. Our work has shown that the removal of high concentrations of arsenic from potable water can be achieved in less than 2 minutes using naturally occurring zeolites modified by simple methods and materials.

By using the available resources in the locality of the Bangladesh problem and basic chemistry, it may be possible to develop a water filtration system capable of reducing the high concentrations of arsenic in drinking water to levels below the WHO limit of 10 micrograms per litre. This approach is both cost-effective and simple to implement in a developing country.

Arsenic and archaeology

Archaeology reconstructs the lives of people in the past from their material remains. Trace elements in hair can provide a record of an individual's diet, health and environment. Collaboration with Bradford University has investigated how human hair can be used to evaluate whether arsenic uptake into hair can happen after burial.

Acknowledgements

The following have contributed to the research described above: Dr R. O. Jenkins, Dr A. Wilson, Dr P. Haris, Dr K. Huddersman, Dr M. Atli, A. Ritchie, O. Afulabi. Funding from British Council and De Montfort University is gratefully acknowledged.

CHRIS HARRINGTON
December 2002

Air quality in Cornwall

"... the air
Nimbly and sweetly recommends itself
Unto our gentle senses."

(Macbeth, Act 1, Scene 6)

Shakespeare was describing the machinations in Inverness. At the other end of the UK, **Leo Salter** is concerned with air quality in Cornwall.

Under National Air Quality Strategy (NAQS) guidelines extensive monitoring of air pollution is necessary to examine the linkage of ambient air quality to traffic flow (and other sources). In many UK urban areas state-of-the-art monitoring stations provide data for use in sophisticated computer modelling programmes. These programmes provide an interpretative and predictive picture of air pollution in an area, and the values are used by the National Environment Technology Centre (NETCEN, http://www.airquality.co.uk) to predict background concentration levels of pollutants across the UK.

NETCEN predictions for Cornwall of background concentrations for of all monitored pollutants (except boundary-layer ozone) are low. NETCEN predictions do not however provide insight into pollutant concentrations in Cornwall for areas where local inputs may influence air quality. Although the extent of air quality problems in Cornwall is different to that in most other areas of the UK there is the potential for air pollution problems to occur.

Unlike many counties Cornwall does not now have a large industrial base and consequently has little industry-related air pollution. However, like many other counties Cornwall does have areas where air quality is poor due to traffic-related pollution. This is particularly true of the summer months when traffic in Cornwall increases significantly. There is particular concern about the effects on air quality of slow-moving traffic under still weather conditions in narrow streets that trap pollutants.

Over the past three years this scenario has been examined in several towns and villages in Cornwall, (CAQF, 2002). A variety of pollutants have been monitored using both real-time equipment and passive diffusion tubes and the results have been examined with particular reference to the influence of traffic-flow and topography on the pollutant concentrations recorded (Parsons, 2002a).

These studies found that not only did sites of high traffic density generate levels of pollutants, which exceeded NAQS objectives, but that topography also hampered the dispersion of these pollutants leading to high concentrations in areas with very low traffic values. In some situations these conditions were found to lead to concentrations of pollutants (especially benzene and PAHs), which were comparable to much larger urban conurbations where traffic-flow levels were up to 20 times higher.

Cornwall is also home to the largest opencast mineral mining operation in Europe. In co-operation with Cardiff University, Cornwall College has monitored ambient air quality in the St Austell china clay area of Cornwall with particular reference to respirable mineral particles (Parsons, 2002b). Studies found high ambient levels of particulate matter (less than 5 micrometres), which could be attributed to china clay sites. The concentrations of particulate matter recorded and the particle size and type have potential health implications for the resident population.

Not all air pollution in Cornwall is locally sourced. Cornwall has been described as being '... exposed to high concentrations of particulate matter' (Salter et al 1999) which, it is thought, originate from distant sources (PORG, 1997).

This is partly evidenced by nation-wide "air quality events" during which transboundary air movements have deposited large quantities of PM_{10} across the UK. On several occasions (March 1998, March 2000) the UK has experienced high concentrations of particulate matter which have originated from sources such as the Sahara desert. These events can give PM_{10} values 6 times the NAQS objective level (50 micrograms m^{-3}) but are totally outside of the control of the local authorities who are responsible for ambient air quality. It is important to be able to recognise when these events occur so as not to attribute their effects to local sources. This can be done by reference to air quality data from other UK sources (NETCEN) or by examination of the particulate matter collected.

In common with all the south coast of England Cornwall has also been described as being exposed to '... damagingly high concentrations of low-level ozone' (Salter et al 1999) which arrive via incoming air masses from the continent. UK tropospheric ozone levels can be strongly affected by long range transport of pollutants and although low-level ozone is not covered by the NAQS objectives it is still a matter of concern both for human health and for the ecology. This is especially true for Cornwall which is not only largely agricultural but also has many areas of unique ecology. Monitoring of ozone levels in Cornwall both by continuous and passive diffusion tube techniques has revealed that ozone concentrations can vary considerably over small (2 km) areas. Thus tropospheric ozone concentrations in rural areas are not only influenced by long-range transportation of ozone but also by localised microclimates.

In the future Cornwall is liable to undergo many demographically-linked changes, both to its road systems, its population levels and its industrial infrastructure. By careful and rigorous monitoring a picture of air quality in Cornwall is being built which doesn't depend on extrapolations from out-of-county data, but will allow any future traffic and planning changes to be clearly assessed in detail with regard to the potential impact on air quality.

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LEO SALTER
November 2002

What is FECS?

The Federation of European Chemical Societies (FECS) represents – albeit indirectly through the national chemical societies – the largest possible number of chemists from almost all European countries. Its activities are numerous and serve the individual members mainly through the organisation of scientific conferences. The chemists in Europe, however, now expect more from FECS. They want FECS to help them gain professional recognition, to lend social prestige to chemistry as a science and a profession, and to pave the way towards easier accessibility of research funds. To this end the FECS General Assembly approved in October 2001 an Action Plan to enhance the visibility of FECS among chemists in its member states (see http://www.chemsoc.org/fecs).

This article, by Dr John Holder, Secretary General of the **FECS Division of Chemistry and the Environment** since 1997 and member of the RSC Environmental Chemistry Group, is written with the intent of raising the profile of FECS among ECG Members.

FECS is constituted as a non-profit-making organisation representing the views of national scientific and technical societies in Europe whose interests include the science and/or practice of chemistry. Its object is: 'to promote the advancement of chemical sciences and the practice of chemistry in Europe taking account, where appropriate, of issues of particular relevance to the European Union'.

At present there are about 50 national chemical societies in membership. There are significant differences in the operation, role and memberships of these societies. For example, the RSC and the GDCh rely, albeit in different ways, on income from publications in order to maintain their level of services to their members. Other societies rely on income from conferences or on governmental support.

FECS exists to serve national chemical societies and it provides a valuable forum to exchange information at the European level and to promote ideas emanating from national societies. It aims to be active in areas where, by working through the member societies, it can provide added value for chemists and chemistry in Europe. The larger societies such as those of Britain, France, Germany and Italy are taking the opportunity to transfer skills to the smaller and often newer societies in other states. Current member societies are as follows:

Albania	Society of Albanian Chemists
Austria	Gesellschaft Österreichischer Chemiker, The Austrian Society for Analytical Chemistry (ASAC)
Belgium	Koninklijke Vlaamse Chemische Vereniging, Société Royale de Chimie
Bulgaria	Union of Chemists in Bulgaria
Croatia	Croatian Chemical Society
Cyprus	Pancyprian Union of Chemists
Czech Republic	Czech Chemical Society
Denmark	Danish Chemical Society
Estonia	Estonian Chemical Society
Finland	Association of Finnish Chemical Societies
France	Société Française de Chimie
Germany	Gesellschaft Deutscher Chemiker; Deutsche Bunsen-Gesellschaft fur Physikalische Chemie; Deutsche Gesellschaft fur Klinische Chemie
Greece	Association of Greek Chemists
Hungary	Hungarian Chemical Society
Republic of Ireland	Institute of Chemistry of Ireland
Israel	The Israel Chemical Society
Italy	Societa Chimica Italiana
Latvia	Latvian Chemical Society
Lithuania	Lithuanian Chemical Society
Luxembourg	Association des Chimistes Luxembourgeois (ACHIL)
Former Yugoslav	Republic of Macedonia, Society of Chemists and Technologists
The Netherlands	Royal Netherlands Chemical Society
Norway	Norwegian Chemical Society
Poland	Polish Chemical Society
Portugal	Portuguese Electrochemical Society, Sociedade Portuguesa de Quimica
Romania	Romanian Society of Analytical Chemistry, Romanian Chemical Society
Russia	Mendeleev Chemical Society
Slovak Republic	Slovak Chemical Society
Slovenia	Slovenian Chemical Society
Spain	Real Sociedad Espanola de Quimica, Spanish Society for Analytical Chemistry
Sweden	Swedish Chemical Society
Switzerland	Swiss Chemical Society
Turkey	Chemical Society of Turkey
Ukraine	Ukrainian Chemical Society
United Kingdom	Royal Society of Chemistry
Yugoslavia	Serbian Chemical Society

Web links to all these national societies are available through: http://www.chemsoc.org/networks/enc/fecs/fecsmembers.htm

The **roles of FECS** are various, serving a variety of purposes, and can be seen primarily as follows:

- Lobbying
- Networking
- Advancement of the chemical sciences
- Dissemination of scientific knowledge
- Promotion of standards of education and competence

Academic and industrial communities in Europe concerned with chemistry and chemical engineering came together in 1995 under the banner of the AllChemE alliance (Alliance for Chemical Sciences and Technologies in Europe; Web link http://www.chemsoc.org/networks/enc/AllChemE.htm) to share common concerns and to develop mechanisms to allow them to deliver better what society expects of them in the 21st Century. AllChemE embraces and represents the interests of CEFIC (the European Chemical Industry Council), CERC3 (the Chairmen of the European Research

Council's Chemistry Committee), COST Chemistry (the European Commissions Chemistry Research Programme), FECS and EFCE (the European Federation of Chemical Engineering).

FECS works through the following Divisions and Groups:

- Division of Analytical Chemistry
- Division of Chemical Education
- Division of Food Chemistry
- Division of Chemistry and the Environment
- Division of Organometallic Chemistry
- Working Party on Computational Chemistry
- Working Party on the History of Chemistry
- Division of Electrochemistry
- Working Party on the Conservation of the Cultural Heritage
- Working Party on Nuclear and Radiochemistry
- European Communities Chemistry Council
- European Chemist Registration Board

The objectives and mission of the **FECS Division of Chemistry and the Environment** are:

- To represent FECS in matters concerning chemistry and the environment, including green/sustainable chemistry;
- To contribute to the advancement of environmental chemistry and chemistry and the environment in the countries of the national member societies of the Federation of European Chemical Societies;
- To promote and support the co-operation about chemistry and the environment issues between the national chemical societies in Europe and their members;
- To identify important areas in science, technology and other human activities relevant to chemistry and the environment, and to stimulate actions in such fields;
- To address aspects of importance in or to chemistry and the environment, which need regulation, harmonisation, standardisation or codification, and to make recommendations as appropriate;
- To promote and support the sound application of chemistry for assessing and solving environmental issues;
- To enhance knowledge and awareness of the chemistry of the natural environment;
- To encourage and inform the responsible management of the impact of anthropogenic chemicals on the environment;
- To encourage co-operation between environmental chemists, in particular within the countries of the member societies of FECS and other international organisations such as IUPAC, ACS, ECTN and ISO;
- To liaise with other FECS bodies and chemical societies in other parts of the World concerning chemistry and the environment;
- To foster close contacts and co-operation of DCE with the European Commission and other relevant institutions;
- To use its best endeavours to promote the status of environmental chemists in general and in the countries of FECS member societies in particular;
- To safeguard the interests of the chemistry and the environment community, especially concerning recognition and legitimisation in matters of regulation and legislation as well as decision making in economic and in social areas;
- To assist and strengthen quality in teaching and training of environmental chemistry in education and in daily practice;
- To support the transfer and exchange of knowledge in the areas of DCE expertise both within Europe and in non-European countries;
- To hold Chemistry and the Environment Conferences and other conferences, symposia and workshops;
- To assume a general promotion and co-ordination functions for conferences, Euro-courses and other events related to chemistry and the environment, and to advocate FECS support or grant DCE support as appropriate in agreement with the Constitution of FECS;
- To disseminate information to the wider scientific community and general public about chemistry and the environment and its achievements.

The idea of forming a Working Party dealing with environmental chemistry was adopted by FECS at its General Assembly in Helsinki on 11 June 1976. The initiative came from Professor Dr. Clément Troyanowsky, then Secrétaire Général of Société de Chimie Physique in Paris. He convened the first meeting held on 8 December 1976 in Paris.

The substantially increased activity in recent years is doubtless due to the great effort, personal engagement and involvement of the present chairman, Allan Astrup Jensen form Denmark, who has served from 1997: six years which have seen the group increase in size threefold to include thirty-two countries, achieve FECS Divisional status, run three highly successful international conferences, and establish five specialist sub-committees devoted to various aspects of environmental chemistry.

Sub-committees have been formed on:

Soil Chemistry and Pollution, headed by Toomas Tenno, University of Tartu, Estonia
Water Chemistry and Pollution, headed by Fritz Frimmel, University of Karlsruhe, Germany
Education in Environmental Chemistry, headed by Uri Zoller, University of Haifa, Israel
Green and Sustainable Chemistry, headed by Allan Astrup Jensen, dk-TEKNIK Energy & Environment, Copenhagen , Denmark
Atmospheric Chemistry and Pollution, headed by Hartmut Frank, University of Bayreuth, Germany
Chemical Toxicology, headed by Valery Petrosyan, University of Moscow, Russia.

One of the most important achievements of the Division has been the arrangement and sponsoring of international conferences dealing with environmental chemistry, of which there have been eight to date (see below).

Conference venue	Conference title
Paris/Palaiseau, France, 1980	Chemical pathways in the environment
Lindau/Lake Constance, Germany, 1984	Air pollutants affecting plants
Guildford, UK, 1988	Risk assessment of chemicals in the environment
Vienna, Austria, 1993	The challenge of waste
Budapest, Hungary, 1995	Pesticide chemistry for sustainable agriculture
Copenhagen, Denmark, 1998	Atmospheric chemistry and air pollution
Porto, Portugal, 2000	Metal speciation in the aquatic environment
Athens, Greece, 2002	Chemistry for a sustaining world

A most fruitful collaboration between the Division and the journal *Environmental Science and Pollution Research* (ESPR) was established in 1997. When the Working Party was promoted to a FECS Division at the General Assembly of FECS in Istanbul in September 1998, ESPR became the official organ for the Division. Apart from the Special Issues of ESPR, which have published the abstracts of the various conferences, a number of papers originated from FECS DCE have been published in ESPR. The publishers of ESPR, ecomed, also host the Division website (www.scientificjournals.com/espr/fecs).

What of the future? Allan Astrup Jensen relinquishes the Chair in 2003 to Philippe Garrigues from the University of Bordeaux. International conferences are planned for 2004 in Moscow and 2005 in Rimini. In 2006 it is proposed to hold the first FECS General Chemistry Conference in which there will be sessions on Chemistry and the Environment and Green Chemistry.

JOHN HOLDER
December 2002

Meeting report: Sixth European symposium on stratospheric ozone

The Sixth European Symposium on Stratospheric Ozone, supported by EC and Swedish agencies, was held in Göteborg, Sweden between the 2nd and 6th September 2002. More than 220 participants from 21 countries were involved in a week of stimulating discussion. Twenty-eight talks and 230 posters were presented, most of which are being prepared for publication as extended abstracts in the proceedings. The posters were a major part of the meeting, and were displayed throughout the week. The main sessions were based on work in the European research clusters – ATUV (Atmospheric UV Radiation), CORSAIRE (Coordination of Research for the Study of Aircraft Impact on the Environment), GATO (Global Atmospheric Observations), OCLI (Ozone-Climate Interactions), and SOLO (Stratospheric Ozone Loss). Further analyses of measurements made during THESEO (The European Commission's Third European Stratospheric Experiment on Ozone) were presented. On the final day, there were discussions about the scientific interests in the next few years during European Environment and Climate Framework Programme 6.

Hot topics at the meeting

Recovery of the ozone layer

The Montreal Protocol and subsequent amendments have significantly reduced the emissions of industrial gases known to be harmful to the ozone layer. One would hope, therefore, to see an improvement in the state of the ozone layer as a result. It is important to see the recovery in ozone not just so that we can all feel better about the health of the planet, but also so that policy makers are convinced that heeding scientists' warnings, at the expense of industry, leads to tangible improvements. And indeed, long-term observations of CFCs in the ozone layer do suggest that many CFC concentrations have reached a peak. Due to the long chemical lifetime of these compounds it will be many years, however, before the CFCs are completely removed from the system. And over these many years, climate may be changing, in such a way as to make each chlorine atom more effective at destroying ozone, particularly in polar winter/spring. For these reasons, the consensus of the meeting was that it was too early to identify recovery of the ozone layer unambiguously.

Predicting future ozone amounts

Because the predicted direction of man-made climate change is such that it makes chlorine more efficient in destroying ozone at certain times of the year, predictions of future ozone for the coming decades are very sensitive to the prediction of climate over that period. And predicting the stratospheric climate decades ahead is not something the meteorologists can do well yet. Crucially, it is not known whether climate change will result in a colder, more stable stratospheric circulation around polar regions, especially the North Pole, or whether the climate change will bring more heat and disturbed flow to the region. The more the climate tends towards a cold stable circulation around the poles, the longer "ozone hole" situations will occur, postponing the recovery of ozone until well into this century, long after the CFC emissions have been curtailed.

Understanding the removal of nitrogen compounds from the wintertime polar ozone layer

One of the most important reasons why cold, stable circulations produce lots of ozone destruction and ultimately "ozone holes", is that nitrogen compounds are efficiently removed under such conditions. Nitrogen compounds, when present, mop up the chlorine radicals derived from CFCs, making ozone destruction less efficient. The mechanism for the removal of nitrogen compounds has been elusive, but recent results are beginning to constrain theories a little more tightly. It has been shown that the particles responsible for removal of nitrogen need several days of cold temperatures to grow, a situation occurring only occasionally in the Arctic, but much more frequently in the Antarctic. If, in the future, climate change results in the Arctic becoming more like the Antarctic, then increasingly efficient removal of nitrogen compounds is one of the reasons why future ozone amounts in the Arctic may not really improve even when the CFCs return to the concentrations at which ozone destruction was first observed (i.e. there will be a climate-induced hysteresis).

Determining the composition of air entering the ozone layer

It is a curious fact, known for more than half a century but now receiving attention again, that air travelling to the upper reaches of the ozone layer, and above, begins its upward journey in the tropics. Determining the composition of this air is straightforward for long-lived and well-mixed gases - nitrogen and oxygen, of course, but also the CFCs – since the composition is the same as that measured at the ground. But for other gases – locally produced nitrogen and bromine compounds, for example, and especially water – the only way to know for sure how much is going in is to measure it at the point of entry, the tropical tropopause. Recent results of such measurements were presented at the meeting. A new picture of the tropical tropopause region is forming. In this picture, air is rapidly lifted two-thirds of the way to the ozone layer, by the towering cumulonimbus clouds that are responsible for tropical downpours. The rest of the journey is accomplished by much slower ascent, sometimes through clouds wispier than the wispiest mare's tails seen in the mid-latitude sky. The changes that both the cumulonimbus and the thinner cirrus clouds make to the composition of the air entering the ozone layer was identified by the meeting as one of the most important outstanding issues in ozone science.

Overall, the feeling was one of a science reaching maturity, though still with important questions to answer.

Web links:

Details of the Research clusters (ATUV, CORSAIRE, etc.), and further information on the Coordinating Unit itself, can be found at http://www.ozone-sec.ch.cam.ac.uk/

Articles on ozone science aimed at teachers and senior school pupils, can be reached from http://www.es.lancs.ac.uk/casestud/case13.htm

REBECCA PENKETT, European Ozone Research Coordinating Unit, Cambridge, U.K.
ROB MACKENZIE, Environmental Science Department, Lancaster University, U.K.

October 2002

Meeting report: Microscopy and chemistry of airborne particles – current research

On Tuesday September 10th 2002 the University of the West of England (UWE) hosted a meeting entitled "Microscopy and chemistry of airborne particles – current research." The meeting was intended as an open forum for researchers to discuss work in progress and the potential applications of their techniques. It was designed to attract academics and researchers with an interest in PM_{10}, local authority air quality officers, equipment suppliers and regulators. **Professor Jim Longhurst**, of the Air Quality Management Resource Centre, UWE, (http://www.uwe.ac.uk/aqm/centre), opened the meeting and also chaired the sessions.

The first speaker, **Bob Odle**, Natural Resources Institute, University of Greenwich at Medway, reviewed the "Characterisation of particulate matter using microanalysis". The presentation discussed his experiences of using a modified Burkard Volumetric Spore Trap for time-resolved collection of PM_{10}s on a constant velocity adhesive tape and the difficulties associated with attempting SEM of the particles captured by this carbon rich adhesive matrix. It became apparent that the use of such a tape as a collection device presented problems for subsequent analysis by electron microscopy and that special attention needed to be given to sample preparation, instrument geometry, particle morphology and software use.

John Watt (Middlesex University) described "A new sampler for airborne particulate matter" where the focus was again to develop a device which enabled the time-resolution of PM_{10} deposition to be examined. In this case the research was targeted at investigating the deterioration and soiling of culturally valued buildings – in terms of damage to buildings and other artefacts, ozone, nitrogen dioxide and particulate matter are as important now as sulphur dioxide was in the past. A 'streaker sampler' was used where a constant velocity rotating filter exposed to a small orifice of continuously sampled air produces a record of the time profile of ambient PM_{10} deposition for subsequent analysis by SEM.

Kirsty Smallbone (University of Brighton) spoke on "Particulate monitoring and characterisation on the South Coast". The essence of the presentation was a further examination of the problem for Local Authorities of distinguishing between the contribution to the measured PM_{10} concentrations in their areas from local sources (which they can abate) and the contribution from long-range sources (which they can't). This was being tackled by examining ratios of $PM_{2.5}$ to PM_{10} particulate matter together with ICP-MS/AAS and SEM analysis. In general the variation in observed airborne particulate matter concentrations was not associated with changes in traffic flow but rather with meteorology. For instance, low $PM_{2.5}$ / PM_{10} ratios were associated with SW winds (probably due to a high coarse sea salt contribution) and high $PM_{2.5}$ / PM_{10} ratios were associated with E and W winds.

Tim Chatterton (UWE) gave a talk on "Particulate modelling and monitoring in East Anglia" in which he summarised his NERC-funded PhD work at the University of East Anglia. This study compared urban sites (Norwich and Belfast) and rural sites (Lough Novar, N. Ireland and Stoke Ferry, Norfolk) in order to gain insight into the contribution from extraneous sources of PM_{10} to the measured values in Norwich. Interestingly although Norwich and Belfast had similar annual average PM_{10} values (19 micrograms m^{-3}), Stoke Ferry experienced much higher values than isolated rural Lough Novar (17 micrograms m^{-3} as compared with 9 micrograms m^{-3}). The comparison between concentrations measured at Norwich and Stoke Ferry suggested that little of the annual average burden experienced in Norwich was due to traffic or other sources that could be influenced by Local Authority abatement processes. Modelling of the data on a regional, national and continental scale indicated that sulphate species were of great importance for the understanding of long-term rural PM_{10} data.

The afternoon session began with a presentation from **Peter Hollingsworth** (Neath and Port Talbot County Borough Council) entitled "Source apportionment studies in Neath, Port Talbot". Particulate emissions from the Corus blast furnace operations were thought to be responsible for locally high levels of PM_{10}. In order to investigate this further, continuous PM_{10} monitoring as a function of wind direction (8 sectors) was used together with SEM and chemical analysis. The direction of the particulate matter plume was identified as being associated with blast furnace operations, and the chemical composition and morphology of the PM_{10} matter were also consistent with it being sourced from blast furnace fume. Having identified the source of the PM_{10} exceedances, the Corus Air Quality Management Working Group confirmed the findings by modelling the fugitive emissions from the blast furnace. Changes in working practices and technical processes are now being initiated.

Barbara Parsons (Cornwall College) reviewed her team's work in Cornwall – "Airborne particulate matter (PM_{10}) in the china clay area, Cornwall". This project began in 1997 as part of a UK government programme to monitor air quality in the Cornwall china clay area and showed that although concentrations of PM_{10} did not exceed National Air Quality Strategy (NAQS, 1995) guidelines, they were greater than those normally associated with rural areas. Subsequently, in the summer of 2000, airborne dust sampling was conducted with the University of Cardiff at three sites around the IMERYS (ex-ECCI) owned Kernick mica dam, a potential source of re-suspended airborne particulates from china clay waste minerals. Results showed the presence of substantial percentages of respirable kaolinite, muscovite and quartz; the major components of china clay waste.

In a discussion on the origins of PM_{10} during pollution episodes, **David Muir** (Senior Scientific Officer, Bristol City Council) considered several episodes of elevated airborne particulate matter that had occurred recently in the UK (e.g. the photochemical events July/August 1995 & 1999 and Saharan sand deposition in

March 2000), and examined them in relation to other air pollutants. The Saharan dust event did not have associated increases of nitrogen dioxide and ozone, but the 1995 and 1999 photochemical events did. Measurements of $PM_{2.5}$ / PM_{10} ratios for these events also reflected the sources of the elevated particulate concentrations with high ratios for the photochemical events and low ratios for Saharan sand sources and similar.

The meeting closed with a presentation from **Ian Stone** (Advance Environmental) "Resolving particulate characterisation and apportionment". This presentation reviewed data from 12 particulate monitoring programmes performed over the last three years. The process involved separating collected particulate matter into water soluble (i.e. aqueous soluble salts analysed via IC and ICP) and insoluble (SEM examination) fractions. Overall the aqueous soluble fraction accounted for 25% to greater than 60% of the total mass and was typically a third. Nitrate concentrations were highly variable (0 to 26 micrograms m^{-3}) and nitrate was generally associated with ammonium or sodium cations. Chloride ranged from (0 to 21 micrograms m^{-3}) and was always associated with sodium or (occasionally) potassium cations (i.e. 0 to 30 micrograms m^{-3} sodium chloride). Irrespective of the location of the monitoring site in the UK, high concentrations of sea salt were nearly always associated with a SW wind. As with so many of the previous studies an assessment of the contribution of long-range transport to measured PM_{10} concentrations was identified as a difficult but important task for any assessment of local sources.
(SEM: scanning electron microscopy)

New RSC publications on the environment

The laws relating to the environment and health and safety have become so closely interrelated that the previous edition of the Pocket Guide to Environmental Law has been completely revised, updated and enlarged to include health and safety law.

The resulting **Health, Safety and Environment Legislation: A Pocket Guide** is divided into 17 sections, each of which is subdivided, with the relevant legislation easily identified within the sections. A list of contents and an index are also included. All material is current as of November 2002, and includes recently introduced legislation such as CHIP 3, GMOs (Deliberate Release), Control of Asbestos at Work, COSHH and Control of Lead at Work.

This guide will be useful to all employers and employees, but especially so to those employed to advise their colleagues on health, safety and environmental law. It is therefore designed to be a first port-of-call for quick and easy access to reference information, which can readily be carried to meetings or taken out on site.

ISBN 0 85404 497 3, approx 320 pages, £49.50 (RSC members' price £32.00)

Other titles of interest

Environmental and Health Impact of Solid Waste Management Activities (*Issues in Environmental Science & Technology* series). This book, written by international experts, discusses the various waste disposal options that are available (landfill, incineration, composting, recycling) and then reviews their impact on the environment, and particularly on human health. ISBN 0 85404 285 7, xii + 214 pages, £32.50 (RSC members' price £21.25)

UV Effects in Aquatic Organisms and Ecosystems is the first of the ***Comprehensive Series in Photochemical & Photobiological Sciences*** titles. This book offers extensive coverage of the most important aspects of UVR effects on all aquatic (not just freshwater and marine) ecosystems, encompassing UV physics, chemistry, biology and ecology. ISBN 0 85404 301 2, xxii + 574 pages, £169.50 (RSC members price £99.00)

RSC Journal and Bulletin News

Subscribers to **Laboratory Hazards Bulletin** or **Chemical Hazards in Industry** can now benefit from free site-wide access to a searchable database, containing all the information included in the relevant title since1981. Full details can be found on the web pages at http://www.rsc.org/lhb and http://www.rsc.org/chi

Green Chemistry continues to stimulate and publish cutting-edge research that reduces the environmental impact of the chemical enterprise by developing alternative, sustainable technologies that are inherently non-toxic to living things and the environment. It is accessible to a wide audience, including undergraduates, scientists and technologists. http://www.rsc.org/greenchem

The ***Journal of Environmental Monitoring*** (JEM) has a new Editorial Board Chairman: Professor James Vincent, from the University of Michigan, USA. JEM is dedicated to assessing exposure and health risks through the latest developments in measurement science and contains multidisciplinary research and information that is essential in helping to safeguard the environment. JEM is a must-have journal for environmental and health professionals http://www.rsc.org/jem

Full details on all RSC titles can be obtained from the Sales and Customer Care Department, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF. Tel: +44 (0)1223 432360 Fax: +44 (0)1223 426017 Email: sales@rsc.org. Alternatively the fully searchable online catalogue can be found at http://www.rsc.org/pubcat

BSc Earth System Science: An innovative new degree programme at the University of Leeds

The decline in A-level students taking science subjects is affecting all science and engineering degree courses in the UK. With this in mind, the School of the Environment and the School of Earth Sciences at the University of Leeds have developed a new degree programme, **BSc Earth System Science**, which takes a more practical, hands-on approach to teaching and allows more flexible entry requirements. **Andrea Jackson** explains.

Some funding bodies already identify Earth System Science as an area of growth and the subject provides an excellent vehicle for teaching fundamental skills in physics, chemistry, biology and mathematics. At the same time, there is a growing trend in the earth and the environmental sciences towards treating the Earth as a complete system and studying the interactions between its component parts, rather than regarding the Earth as a collection of separate and unrelated systems. The new BSc at Leeds therefore provides a broad training in the science of the entire Earth system, including the solid earth, the atmosphere, the oceans and the biosphere.

In order to address the needs of science students with less quantitative backgrounds, the new degree is heavily practically based and the primary learning approach is via practical laboratory, field and computer-based teaching courses. Traditional lecturing methods are used to draw subject material together and set it in context, rather than leading the teaching, as has become the norm in science areas.

The programme aims to equip students with the range of scientific and related skills to understand the natural environment and to give them an in-depth appreciation of the complex interactions between the atmosphere, oceans, solid earth and biosphere. At the same time it aims to enable students to understand the human, social and economic factors affecting the environment, in the past, present and future. This is achieved by means of students acquiring a range of technical, scientific and practical skills required to monitor and investigate the environment and by development of their scientific and technical communication skills.

The School of the Environment and the School of Earth Sciences at Leeds both provide modules for the programme. The first year is composed of compulsory modules, although some of these have component parts which are tailored to meet individual students' backgrounds. In particular, core science areas such as physics, chemistry and mathematics are introduced for students without previous qualifications in these subjects. In each of the 2nd and 3rd years, approximately half of the modules are optional. Some modules are shared with other degree programmes in Environmental Science or Earth Science. In the 3rd year students are required to undertake a large-scale research project on an Earth System Science topic formulated jointly by students and tutors. There is the option to extend the degree programme to four years and to take the 3rd year abroad in a department in North America, or students may apply to undertake a full year's work placement between years 2 and 3. The programme aims to produce students well qualified for employment in environmental or geophysical organisations, both in the private and public sectors.

This is a new degree programme with first entry in September 2003. We hope that next year you will be reading an article about the success of this hands-on approach to science teaching at undergraduate level.

Further details of the BSc Earth System Science degree, as well as other degree programmes in the School of the Environment can be found at the following Web site http://www.env.leeds.ac.uk/admissions/admisug1.html or you can contact the degree programme co-ordinator, Dr Andrea Jackson (andrea@env.leeds.ac.uk).

Dr ANDREA JACKSON,
School of the Environment,
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Recent books on the environment and on toxicology at the RSC library

The following books and monographs on environmental topics, toxicology, and health and safety have been acquired by the Royal Society of Chemistry library, Burlington House, during the period August to December 2002.

Acrylonitrile

World Health Organisation, Geneva, 2002, ISBN/ISSN: 9241530391, 51 pp., Accession No: 20020369, West Gallery 628.5

Approved Supply List Information Approved for the Classification and Labelling of Substances and Preparations Dangerous for Supply Chemicals (Hazard Information and Packaging for Supply) Regulations 2002: 7th Edition.

HSE, 2002, ISBN/ISSN:0717623688, 445 pp., Accession No: 20020501, Reference Shelves REF 614.8 R

Awards for Green Products and Processes, 1999 - 2000 - 2001

Tundo, P. (ed), INCA, Mestre, 2002, ISBN/ISSN: 8888214004, 120 pp., Accession No: 20020480, West Gallery 628.5:54

Cancer: The Outlaw Cell

LaFond, R.E. (ed), Oxford University Press, Oxford, 2001, ISBN/ISSN:0841214204, 274 pp., Accession No: 20020098, West Gallery 616-006.6

Chlorine Dioxide (gas)

World Health Organisation, Geneva, 2002, ISBN/ISSN: 9241530375, 26 pp., Accession No: 20020367, West Gallery 628.5

Collection of Lectures of the Summer Schools on Green Chemistry, Venice, 1998 - 1999 - 2000

Tundo, P. (ed), INCA, Mestre, 2001, ISBN/ISSN: 8888214003, 236 pp., Accession No: 20020479,
West Gallery 628.5:54

Control of Substances Hazardous to Health Regulations, 1999

Stationery Office, London, 1999, ISBN/ISSN:0110820878, 41 pp., Accession No: 20020347,
Reference Shelves REF 614.8 R

Diethylene Glycol Dimethyl Ether

World Health Organisation, Geneva, 2002, ISBN/ISSN: 9241530413, 33 pp., Accession No: 20020371, West Gallery 628.5

Environmental Law: 4th Edition

Hughes, D., Butterworths, London, 2002, ISBN/ISSN:0406942919, 725 pp., Accession No: 20020323,
Reference Shelves 628.5 R

Environmental Organic Chemistry: 2nd Edition.

Schwarzenbach, R.P., John Wiley & Sons, New Jersey 2003, ISBN/ISSN:0471350532, 1313 pp., Accession No: 20020523, Reading Room 547:628.5

Environment: The Truth

Potter, N.M., N.M. Potter, Nottingham, 2002, 37 pp., Accession No: 20020484, West Gallery 628.5

Formaldehyde

World Health Organisation, Geneva, 2002, ISBN/ISSN: 9241530405, 75 pp., Accession No: 20020370, West Gallery 628.5

Guidelines for Quality and/or Environmental Management Systems Auditing

British Standards Institution, London, 2002, ISBN/ISSN:0580405567, 31 pp., Accession No: 20020471, West Gallery 628.5:658

Handbook of Chemical Health and Safety

Alaimo, R.J. (ed), Oxford University Press, Oxford, 2001, ISBN/ISSN:0841236704, 652 pp., Accession No: 20020532, West Gallery 614.8

Handbook of Food Toxicology

Deshpande, S.S. (ed), Marcel Dekker, New York 2002, ISBN/ISSN:0824707605, 903 pp., Accession No: 20020506, West Gallery 664:615.9

Health and Safety at Work etc. Act 1974 (Application to Environmentally Hazardous Substances) Regulations 2002

Stationery Office, London, 2002, ISBN/ISSN:0110393104, 5 pp., Accession No: 20020357,
Reference Shelves REF 331.823:342.924 R

Heavy Metals in the Environment

Sarkar, B. (ed), Marcel Dekker, New York, 2002, ISBN/ISSN:0824706307, 725 pp., Accession No: 20020324, West Gallery 628

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Some Thyrotropic Agents: Volume 79

International Agency for Research on Cancer (IARC), Lyon, 2001, ISBN/ISSN: 9283212797, 763 pp., Accession No: 20020106, West Gallery 616-006.6:061.3

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Non-ionizing Radiation, Part 1: Static and Extremely Low-frequency Electric and Magnetic Fields: Volume 80

International Agency for Research on Cancer (IARC), Lyon, 2002, ISBN/ISSN: 9283212800, 429 pp., Accession No: 20020311, West Gallery 616-006.6:061.3

IUPAC Workshop on Green Chemistry Education: September 2001, Venice, Italy

Tundo, P. (ed), INCA, Mestre, 2002, ISBN/ISSN: 8888214005, 127 pp., Accession No: 20020481,
West Gallery 628.5:54

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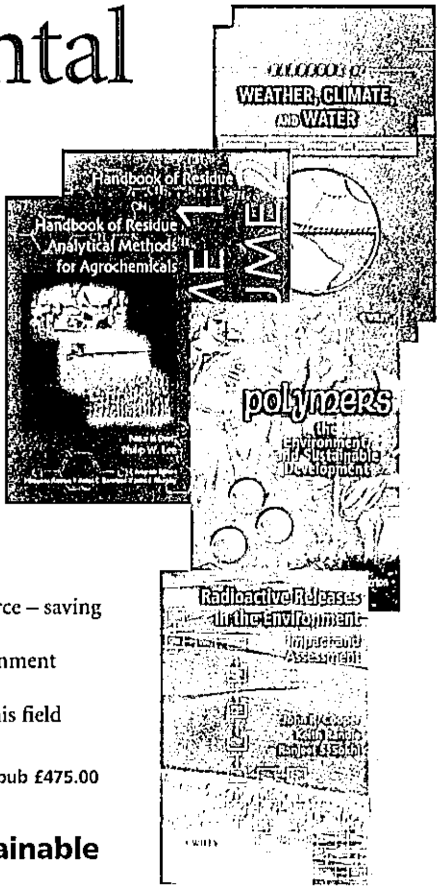

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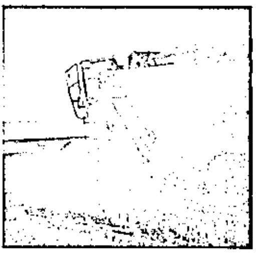

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