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New Year—New Team

For all of us, the new year is a time for new resolutions. For me, it is a time to assume new responsibilities as managing editor of *Chemistry International.* As part of this transition, I would like to ask you, the reader, to remember that without your input, *CI* has no reason for being. I urge you—members, fellows, affiliates, organizational representatives—to share your stories, send your points of view, and communicate news to your peers and IUPAC colleagues.

With this new year, also comes a new biennium, which is for IUPAC a significant event. It is the time for the new officers to take charge, relaying former efforts and new initiatives, and ensuring continuation. In this issue, Prof. Steyn, the new President presents his views of the Union and the task before him. Chemical industry and education, preservation of historical records, and involvement of young scientists are among the subjects covered in other articles.

A brand new feature of this issue is the web reference (or pointer) that prominently follows all of the newsletter articles. These pointers refer you to the exact spot on the web—on the IUPAC web site or another site—where you can find more information on the subject at hand.

Enjoy this first issue of the new year and remember—give your input!

Fabienne Meyers <fabienne@iupac.org>

President's Column

IUPAC Sails into New Waters

I'm grateful for this opportunity to wish members of IUPAC bodies, fellows, affiliate members, and our corporate associates a fruitful and satisfying 2002. I am also grateful to you, the IUPAC family, for your extraordinary commitment to the chemical sciences. As chemists we naturally believe that chemistry is the core science; thus, we're particularly open to expanding its borders to embrace exciting new areas such as molecular biology, post-genomic chemistry, chemical biology, supramolecular chemistry, quantum chemistry, nanochemistry, and advanced materials. And as students of this core science, we pride ourselves on understanding the challenges of related disciplines.

IUPAC's Mission Statement and its goals guide our actions. We remain committed to constant renewal, critical self-evaluation, and the optimal utilization of our resources. Thus, a task group headed by our Finance Committee Chairman, Dr. Ed Przybylowicz (USA), was appointed to make a SWOT (**s**trengths, **w**eaknesses, **o**pportunities, and **t**hreats/challenges) analysis of IUPAC's strategic plan. All National Adhering Organizations were invited to contribute.

In my critical assessment in Brisbane last July, I said "IUPAC is sailing into new waters." We're in them now, and to continue the nautical metaphor, we may even experience some white water in 2002. But we will emerge wet, perhaps, but alive and well. IUPAC has been modernized and democratized in many ways, the most notable of which is the formal transition from a commission-driven organization to one driven primarily by the inception of individual projects. The challenge now is to spark ideas for projects that are appropriate for IUPAC and of broad international interest, and we invite all chemists to make such project proposals.

I'm firmly committed to broadening the geographical base of the Union, so as to contribute to the globalization of the scientific endeavor and to recruit "human capital" from all segments of the world chemical community. An *ad hoc* committee of the Union, headed by Prof. Hitoshi Ohtaki (Japan), has been appointed to develop the IUPAC membership in Africa, South America, Eastern Europe, and Asia. A warm welcome to new members Mexico and Uruguay, joining the ranks of IUPAC as Associate National Adhering Organizations. As part of our efforts to involve chemists from all parts of the globe in the work of IUPAC, we continue to support high-quality conferences in economically disadvantaged countries as a means of promoting chemistry in those places.

Pieter S. Steyn
IUPAC President
2002-2003

We are acutely aware that some of our member and potential member countries experience problems affording membership fees, exacerbated by an unstable world economy and currency fluctuations. Dr. Chris Buxtorf (Switzerland), IUPAC's treasurer, has been asked, along with a task group, to take a hard look at the structure of our membership fees.

I regard chemistry education as a top priority for the Union. The newly reconstituted Committee on Chemistry Education (CCE), led by the distinguished chemistry educator Prof. Peter Atkins (Oxford), will focus on the teaching of chemistry at the school and tertiary leveld, as well as on the public appreciation of chemistry, including "chemical literacy" in developing countries. This activity is aimed at ensuring that chemistry flourishes as a discipline at our universities, our research institutions, and in industry. I applaud the success achieved by the Committee on Chemistry and Industry in distributing and utilizing DIDAC visual educational materials (see *CI*, Vol. 22, No. 4, pp.103-105, July 2000). These activities are subsidized by UNESCO and effectively complement those of CCE.

Since its establishment, IUPAC has been noted for its significant contributions to the language of chemistry. A new Division of Chemical Nomenclature and Structural Representation has been established in Brisbane under the able leadership of Dr. Alan McNaught (UK). I endorse the development and consolidation of our nomenclature functions in this era of computer-based structures and nomenclature.

Dr. Alan Hayes (IUPAC past president) is playing a key role in the preparations for a workshop, at the

request of the Organization for the Prohibition of Chemical Weapons (OPCW), that will provide objective scientific advice on scientific advances that may impact the enforcement of the Chemical Weapons Convention. I strongly favor this particularly relevant role of IUPAC in acting as an independent, nongovernmental scientific organization.

As part of its mission to provide independent, scientific information to policy makers, IUPAC has produced over the past few years a number of special issues of its journal *Pure and Applied Chemistry* devoted to scientific issues of global public interest. A current example is the extensive IUPAC-ICSU-SCOPE project on Endocrine Active Substances, managed by Dr. Junshi Miyamoto (past president of the IUPAC Division on Chemistry and the Environment). This joint project will result in not only the publication in *PAC* of authoritative reviews of the current scientific understanding of this complex issue, but also in an International Conference, to be held in Yokohama 11-17 November 2002. This milestone unambiguously confirms IUPAC's commitment to the "customer" needs of chemical industries and concerned countries.

The IUPAC Prize for Young Chemists gives me particular joy. It was established to encourage outstanding young research scientists at the beginning of their careers. Nine of the future leaders of chemistry were recognized at the Brisbane IUPAC Congress. I look forward to meeting the next group of superb young chemists at the Ottawa Congress in 2003. (The deadline for the 2002 Prize is 1 February 2002. Details can be found at <http://www.iupac.org/news/prize.html>.) I appeal to young chemists worldwide to get involved in the *new* IUPAC and to make a difference to the international world of the chemical sciences. We need your dedication and enthusiasm for chemistry. My association with IUPAC has resulted in research collaboration with eminent chemists all over the world, and, especially in my studies on mycotoxins, has been the most gratifying part of my career in chemistry.

I again appeal to all chemists to support the strategic changes in IUPAC and to provide feedback on our activities. The *new* IUPAC is changing for the better, and I, with all the other Union leaders, have a nonnegotiable commitment to serving the needs of our stakeholders.

Pieter S. Steyn is the current IUPAC president and has been involved with the Union since 1973. He is director of the Division of Research Development of the University of Stellenbosch in South Africa.

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Catalyst—the Museum of the Chemical Industry

A museum in northern England makes chemistry a fun learning experience

by Christine Allison

Tucked away in northern England is a museum unlike any other in the world. Catalyst: the Museum of the Chemical Industry in Widnes, Cheshire, is a unique attraction, the only museum of its kind — focusing on chemistry and the chemical industry and the vital role they play in our everyday lives.

The location of this hands-on science center is no coincidence. Widnes is the birthplace of the modern chemical industry. Its roots date back in the mid-19th century.

The building itself is from the 1860s, and it too has close ties to the chemical industry, being the headquarters of Gossages Soap Works. The River Mersey and the St. Helens/Sankey Canal—at one time the hub of industrial activity—flow nearby.

I remember vividly my first visit to Catalyst. Not only am I a museum professional, but a Widnesian, born and bred, so climbing the four flights of stairs leading to the observatory has always held special significance for me. Today, most people make the journey to the top of the building in a scenic glass lift rising over 100 feet above the ground. Even after climbing all the stairs, the views are quite spectacular—and the elevator certainly makes the view easier to appreciate as you rise above the trees around the building.

How It All Began

The inspiration for Catalyst came from the Society of Chemical Industry, the Halton Borough Council, and interest in the chemical industry. The idea was first put forth in 1983. Five years later, shortly after the building had been acquired, the first exhibition opened in the glass observatory on the top floor.

The Exhibits

Catalyst is a place where science fuses with fun, and of course, chemistry is most fun when it is hands on. There are over 100 interactive exhibits, computers, and puzzles—as well as text and film clips—helping to relay the message throughout its four galleries.

Scientrific, which opened in 1991 as one of the first exhibits, is a ground floor gallery containing over 30 interactive exhibits. I call this our "play station," because everyone who passes through learns something new by playing with the hands-on science activities and computers.

Upstairs from *Scientrific* are two additional galleries: *Birth of an Industry* and *Chemicals for Life*. *Birth of an Industry* provides some historic background to the chemical industry. The exhibit traces developments in the field of chemistry, from the ancient Egyptians and Greeks through alchemy, to the beginnings of the chemical industry in Widnes and up to advances in the 1940s.

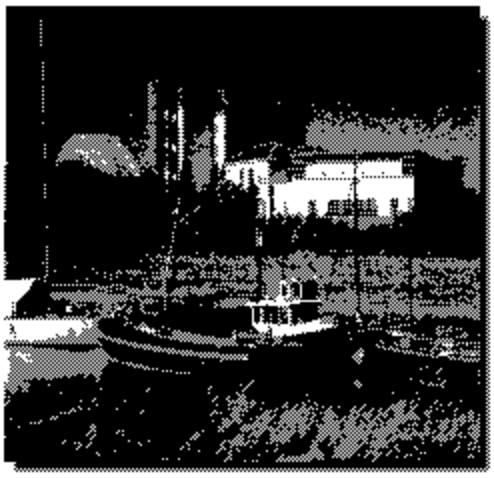
The story of the industry leads into *Chemicals for Life*, which looks at the effects of the chemical industry on our everyday lives. Visitors to the center are often surprised to learn that items such as x-ray film, medicines, textiles, CDs, toy Lego blocks, and many more products were made possible by the chemical industry.

In the *Enviroforum*, visitors can watch a film that answers questions often raised by the general public about safety, pollution, water and air quality, and other issues involving the chemical industry.

Ecoquest is housed in the glass, observatory gallery on the top floor. This innovative exhibition explores the links between the built and the natural environment. The layout of the gallery, punctuated by the stunning views, encourages visitors to find out more about the "green" environment through the hands-on activities.

A Well-Kept Secret

Visitors say that Catalyst is a well-kept secret. We host approximately 40,000 visitors each year, 18,000 of whom are school-children on organized visits. The Education Service, having its own suite, is the jewel in the crown of Catalyst. The well-qualified education staff



Catalyst overlooks the banks of the River Mersey and the St. Helens/Sankey Canal.

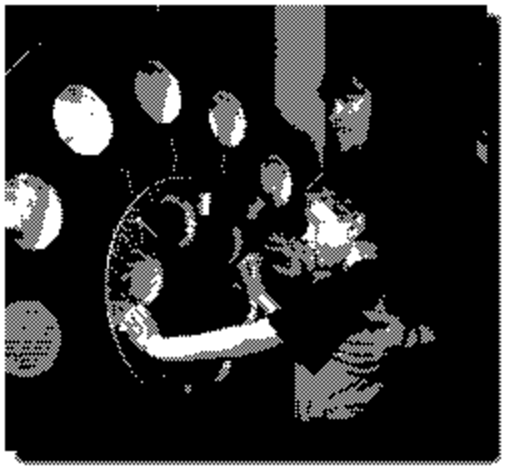
provides sessions on a variety of subjects. Eminent professors and specialists are often brought in to enhance the program. All key stages of science/chemistry within the National Curriculum are covered by the service.

Families account for the majority of the more than 20,000 general visitors. During holiday periods, we offer week-long activities on a wide variety of topics. Recently activities have included *Bubble Trouble* (learning how to make magnificent, *huge* bubbles), *Creepy Crawly Show* (with live spiders, snakes, tree frogs, and lizards), *Music Mayhem* (making and playing musical instruments), and *Junk Beach Buggy Challenge* (a recycling workshop with a difference).

Catalyst's funding is through the admission price paid by visitors and school groups, shop and café income, and sponsorship from industry, without which it would not be able to continue. In the current economic climate, however, sponsorship is becoming more difficult to find. Yet Catalyst is playing an important role in challenging people's perceptions of the chemical industry, in opening their eyes to the vital role that the industry plays and how different and difficult their lives would be without the products that are so often taken for granted. Catalyst provides a superb communication platform for industry and a center of excellence for education.

Come and see us and have a visit full of fascination and fun. We have so much to offer.

For more information; details of opening times, events, and activities; and sponsorship opportunities, contact Christine Allison, Director, Catalyst, Mersey Road, Widnes, Cheshire, WA8 7HP (tel: +44 151 420 1121, fax.+44 151 495 2030).



Many hands-on exhibits make learning about science fun.

Christine Allison is director of Catalyst—The Museum of the Chemical Industry.

http://www.catalyst.org.uk

Preserving Records of Modern Science

Scientific organizations are urged to preserve their historical records

by R. Joseph Anderson, Fabienne Meyers, and Giovanni Paoloni

Preserving historical records remains important for scientific organizations. Toward this end, the Commission on Bibliography and Documentation of the International Union of History and Philosophy of Science (IUHPS) has discussed with other scientific unions, including IUPAC, the need to preserve permanently the historically valuable paper and electronic records of modern science and make them accessible to researchers. Based on a discussion held in December 2000, the Commission planned to formulate guidelines to assist scientific unions and to ensure that their records will be available to researchers. These guidelines, which are supported by IUHPS, are now being considered by the International Council for Science for recommendation to its members.

The recommended guidelines call for scientific organizations to make an effort to archive the papers of leading scientists as well as their own historical documentation, including electronic and inactive records that might be difficult to track down and organize. Among the details is a recommendation that budgets of all significant scientific projects include a small margin to cover the cost of such archiving. As well, the group suggested that the unpublished papers of scientists who have made significant contributions to modern science should be preserved at the institution with which they were most closely associated.

A number of scientific unions have already signed formal agreements with major science archives to maintain their records. IUPAC's records are held by the

Beckman Center of the Chemical Heritage Foundation, Philadelphia, PA, USA. The records of the International Union of Pure and Applied Physics are held by the Center for History of Science, Royal Swedish Academy of Sciences, Stockholm, Sweden, and those of the International Union of Geodesy and Geophysics are held by the Center of History of Physics, at the American Institute of Physics, College Park, MD, USA.

Electronic records are proving to be a particular challenge to the archival process, and several national archives and international bodies are currently working to develop solutions to the preservation problems that these records present. It seems likely that effective long-term systems will be available within the next few years. In the meantime, it is recommended that electronic records along with their accompanying metadata be preserved on a server or, if storage space is a problem, downloaded to optical disk or magnetic tape. Saving only paper printouts of electronic records destroys contextual information and is not adequate for the historical record.

IUPAC has been working for some time with the Chemical Heritage Foundation, and like the Commission, CHF can offer advice. An excellent resource for those who embark on these efforts is the Othmer Library's web site <http://www.chemheritage.org/Publications/personal.htm>. It provides a brief and informative overview of the importance of archiving. Why save? Who should save? What, when, and where to save? are questions whose answers will help scientists to lay the groundwork for their own archival efforts.

The American Institute of Physics (AIP) has it own Center for History of Physics, whose goal, in its own words, is "to preserve and make known the history of modern physics and allied fields." In addition to keeping the records of the International Union of Geodesy and Geophysics, the Center's contributions to the field include the Emilio Segrè Visual Archive, (a collection of some 25,000 historical photographs, slides, lithographs, engravings, and other visual materials) and the Niels Bohr Library. Additional information about the center and its documentation programs and archival efforts can be found at <http://www.aip.org/history>.

Joseph Anderson is assistant director at the Center for History of Physics, College Park, Maryland, USA; Fabienne Meyers is electronic publishing manager at the IUPAC Secretariat; and Giovanni Paoloni is from the School for Archivists and Librarians of the Universita degli Studi de Roma 'La Sapienza', Roma, Italy.

Science and the Public: Learning for the Future

What hinders the public from appreciating science more? Is the way that science is taught today helping or making it harder for young people to evaluate science-based issues?

by John Johnston

In January 2000, the Royal Society of Chemistry (RSC) set out to address these important questions. The Society put in place a two-year initiative—*Science and the Public*—to take a careful look at the schools and colleges. RSC designed the initiative to bring about collaboration among scientific societies and other agencies, with the ultimate goal of promoting a long-term strategy for highlighting the role of science in everyday life.

Project leaders aimed to accomplish the following:

- to find new ways of providing young people with the background information and confidence to evaluate science-based issues that are affecting society;
- to consider how best to provide continuing professional development opportunities for teachers to achieve the above objective; and
- to provide support for adults who go into schools to support teachers.

Initially, the RSC developed a range of evaluation criteria to help measure the effectiveness of current activities in promoting science to the public—in this case pre-higher education—in as objective a way as possible. By drawing on these criteria and examples of successful public outreach activities and curriculum

resources, the RSC sought to concentrate efforts on supporting those activities that are proved to work, and to sustain a long-term program of activities with common messages about the role of science.

Finding Activities That Work

The evaluation criteria needed to be workable in real-life situations. Three general measures to help target specific student activities have been used:

- Objective feedback (from evaluations), produced by organizations creating the initiatives, on the successes and failures of initiatives.
- Worldwide published sociological and psychological research on the perception of science and scientists (5-19 year olds as well as the general public) supported by unpublished surveys from learned societies within the United Kingdom.
- Theories on the nature of learning—considering students' cognitive development at different ages (preschool to post-16). For example, the project took into consideration issues such as the ability to learn abstract theories as well as gender differences in learning.

Key findings

A number of key issues were identified as a result of the research. The following is a summary of some of the main issues.

- Aside from monitoring, very little independent evaluation of projects and activities exists.
- A lack of coordination has created some duplication among a large number of diverse projects and resources available to schools and colleges.
- The majority of resources are linked to mandatory parts of the curriculum.
- Let them talk! Discussion activities are important to students.
- There is a dearth of resources covering science and societal issues available at the correct level for use in schools and colleges.
- Any materials should provide more than information. Teachers need help developing strategies for preparing students to deal with controversial science and society issues that require evaluation of data.

Conclusion

The study highlights the need to develop a consensus approach with other learned societies, industry, and government agencies that are involved in science and society issues. It is critical to take the project forward across as many fronts as possible in science engineering and technology. The RSC hopes that a consensus approach will give the project more impact.

The full report was published by the RSC in May 2001. To request a copy of the report or if you would like more information about the project, contact John Johnston, Manager, Education Communications, Royal Society of Chemistry, Burlington House, Piccadilly, London W1J 0BA (tel: +44 020-7437 8656; e-mail: johnstonj@rsc.org).

John Johnston is manager of education communications for the Royal Society of Chemistry in London, United Kingdom.

The report can be downloaded from the RSC website at http://www.chemsoc.org/networks/learnnet/science-public.htm

IUPAC Forum

Young Observer Programs: Getting New Experts Involved in IUPAC

by E. P. Przybylowicz

Any scientific discipline, if it plans to remain vibrant and innovative, must explore ways to renew itself as it expands into new areas and develops new techniques. Traditionally, IUPAC has depended on its commission structure to bring new talent into the fold. Because commissions had relatively long lifetimes, they could include new experts on their commission projects either as observers or working members.

Given the recent changes in organizational structure, however, the process of bringing new expertise into IUPAC will, itself, face new challenges. In the true spirit of experimentation, the organization must try different approaches to involve new experts in IUPAC.

E. P. Przybylowicz

An Innovative Way to Seek Innovative Scientists

In the past, several countries have made use of what is called the Young Observer program. It is typically structured at the country level by the National Adhering Organization and differs somewhat from country to country. Believed to have been first intro-

duced in the United Kingdom some years ago, it has most recently been actively used by Japan and the United States.

At the recent General Assembly in Brisbane, Japan had four scientists under the age of 45 who were selected by the Japan National Committee for Chemistry of the Science Council of Japan. This program has been in existence for ten years and operates with a fund provided by the Japanese Company Associates. This fund provided approximately USD 2000 toward travel and subsistence expenses for the Japanese scientists.

IUPAC and its National Adhering Organizations should be challenged by how best to shape successful programs that also involve new expertise in the organization.

For the United States, the 2001 Young Observer program was supported through grants from the National Science Foundation, Research Corporation (a nonprofit organization), the American Chemical Society, and the U.S. industrial companies that constitute IUPAC's Company Associates.

The U.S. Young Observers and IUPAC

A total of 13 Young Observers (four women and nine men) were selected from the United States to participate at the most recent General Assembly in Brisbane in July 2001, and to experience the global efforts undertaken by the Union. They represented a broad array of expertise and professional backgrounds: macromolecules, analytical, environmental, teaching of chemistry, inorganic, colloidal, physical, medicinal, organic, and nomenclature. Two were from industry, two from government laboratories, and the remainder from academia.

The Young Observers indicated general satisfaction with their experience. Perhaps more importantly, these Young Observers gained awareness of the important role that IUPAC plays (and *must continue* to play) as an international organization for the worldwide chemistry enterprise. Generally, they were pleased with the structure of the program (see sidebar). Many pointed out the value of the orientation program as well as the "mentors" that were assigned to them as being particularly helpful in their getting the most out of the meetings they attended.

Overall, the Young Observers were impressed with the operations of IUPAC. As with any meeting there were good and not-so-good experiences. A number of useful observations were suggested to help IUPAC improve its operations. These points will be summarized in a report that will be sent to U.S. National Committee members, the sponsors of the U.S. Young Observer Program, and the Executive Committee of IUPAC. The report will also be used for soliciting funds to support a similar program at the General Assembly in Ottawa.

A number of the Young Observers indicated a willingness and an interest to continue their participation in IUPAC. Several were assigned to task groups in Brisbane and will be working with these IUPAC bodies as a followup to the General Assembly.

What the Young Observers Have to Say

A sample of quotes from some of the Young Observers reports gives a flavor of their impressions and experiences:

"Overall, I was favorably impressed with the things that I saw and participated in while at the IUPAC meeting. The most significant impression was that IUPAC provides a vehicle to collaborate with scientists from other countries on projects important to chemistry. Most collaborative efforts by chemists are research-based projects with few collaborators; however, the IUPAC projects provide the opportunity to interact with a number of chemists on issues that have the potential for impacting larger areas of chemistry and science in general."

"IUPAC should narrow its mission to reflect its limited financial resources. The IUPAC goals (list) is unrealistically long and can never be fulfilled with IUPAC's current funds. Unless IUPAC can dramatically increasing its funding level, it should focus on a subset of those goals and de-emphasize the others."

"This was one of the most interesting and invigorating scientific experiences of my career. I really enjoyed the opportunity to meet and interact with other scientists from all over the world, and the discussions that I became involved in were among the most intellectually stimulating I have experienced."

"The program for the young observers was very well organized, and the communications prior to the meeting were quite effective as were the introductory meeting and reception. I was very fortunate to have been assigned a really terrific mentor. . . ."

"There can be no question of the value of these meetings both from the technical and the international cooperation perspective. IUPAC offers a unique forum for the exchange of views on issues of concern to chemists around the world. The mix of participants on the Medicinal Chemistry Section Committee represented most regions of the world and a good mix of participants from both industrial and developing nations. While I have attended several international meetings the mix of people I encountered here was far more nation-

The Structure of the U.S. Young Observer Program

The program consists of the following discrete steps:

1. The decision by the U.S. NAO Committee for IUPAC, i.e. the U.S. National Committee for IUPAC-USNC under the auspices of the National Academy of Sciences, to have a Young Observer program was taken about 18 months prior to the upcoming General Assembly.
2. The program is intended to provide several things:
   - Selection of chemists or chemical engineers under 45 who were leaders in their field and showed an interest in establishing international connections and involvement in IUPAC.
   - Partial financial support to attend the General Assembly (USD 2000). (This figure varied for past General Assemblies, depending on support availability and the General Assembly location.)
   - Contact with appropriate IUPAC chairpersons to introduce the Young Observers and request permission to attend their meeting.
   - Identification of a mentor for the Young Observers who works with them before the General Assembly, sends them material relevant to their interests, and generally meets with the Young Observers several times during the General Assembly.
   - Orientation for the Young Observers as a group by members of the USNC at the meeting site prior to their attending meetings.
3. The program requires that each applicant:
   - Provide a rationale of why the applicant wishes to attend an IUPAC General Assembly and an indication of interest areas among the specific meetings being held at the General Assembly.
   - File a report after attending the General Assembly giving their candid impressions of the meeting. These reports have been very useful in pointing out areas of strengths and weaknesses of the Young Observer program, as well as some observations about IUPAC and its operations.
4. A subcommittee of the USNC handles the funding and publicity, receives and judges applications, and makes the selection of Young Observers to be recommended to the full USNC for approval.
5. Since the selection process is competitive, decisions are made on the basis of the written application.
6. Funding for the program is raised in parallel to the publicity and application steps. The level of funding obtained determines how many Young Observers can be selected. Funding is raised from industry, foundations, and government agencies. Summary reports of previous Young Observer programs are used to "sell" the program to the funding agencies.
7. Final selection of the Young Observers for the General Assembly is made about six months prior to the General Assembly. This allows time for the contacts to be made with committee chairpersons to ensure that the selection of meetings to attend will work out. Also during this six-month period, mentors are identified and contacted. Much of this work is done through the staff office for the USNC.

http://www4.nationalacademies.org/oia/iupac.nsf/

ally diverse than I had previously encountered at ACS meetings, or other smaller special interest meetings."

Maintaining the Enthusiasm

The enthusiasm for the work of IUPAC demonstrated by the Young Observers is something that we need to channel into effective work for IUPAC on meaningful projects. With the new organizational structure of IUPAC, we must find ways to involve these new experts.

The Young Observers program has been run largely by national organizations. Mechanisms need to be considered that will encourage involvement from *all* member countries of IUPAC, not just the larger countries. Additionally, Division Committees need to consider how best to involve these enthusiastic young scientists, should the program continue to increase. Perhaps Young Observers should be given an opportunity to participate in more than General Assembly meetings.

In summary, where the program has been used in the past, it has been successful in involving new experts in IUPAC. The Union and the National Adhering Organizations should be challenged now by how best to shape this successful program to serve its continuing need to involve new experts in the organization.

E. P. Przybylowicz is Chairman of the U.S. National Committee for IUPAC.

IUPAC Divisions and Education: A Case for Joint Projects

by Bob Bucat

Is Chemistry Education merely a subfield of the discipline of chemistry? This article contends that chemistry is a complex and ill-defined field that requires considerable skill and effort to teach and learn, and requires the joint efforts of chemistry education specialists and content specialists in all fields working together to analyze the demands of learning chemistry to find better ways forward.

There is a syndrome pervading our discipline that "people interested in chemical education" occupy a specific compartment, in a corresponding way to those who we label polymer chemists, or organic chemists, or thermo-dynamicists or surface chemists. This, I believe, does a disservice to both the chemistry-related education enterprise and the discipline of chemistry in general.

There is minimal value in chemical educationists restricting their reflections and research findings within their own community. The people who wear this label make up a very small fraction of those engaged in teaching chemistry.

Chemistry education should not comprise one compartment of the discipline of chemistry, because it transcends all such compartments. I have been to myriads of conferences on chemistry education, and invariably I find chemistry educationists talking with chemistry educationists—but nary an organic chemist, a polymer chemist, a synthetic macromolecular chemist, or an NMR spectroscopist listening to their significant findings. And then they (the chemistry educationists) publish their work in chemistry education research articles, which are read by so few outside of that community. Such a waste of talent and effort!

To prove the point, let me ask how many chemists intend to go to the International Conference on Chemical Education to be held August 2002 in Beijing?

Conversely, I'd love to hear from those organizing international conferences on, say, carbohydrates, calixarene chemistry, ESR spectroscopy, computational chemistry, environmental chemistry, analytical chemistry, or any other specialty. What fraction of time do they expect to devote to education about their field of chemistry? Experience tells me not much—but how I'd love to be wrong!

Of course, I don't question the value of chemists talking among their own kind. This communication is one of the ways that the field advances. Another way is the development of new generations of practicing chemists, as well as the development of more knowledgeable engineers, lawyers, biologists, and agricultural and environmental scientists.

Still another, commonly overlooked, way that barriers to advancement are removed is an increase of the level of appreciation of the science enterprise by the public, including politicians, who give us the go-ahead to spend their money as an investment in the quality of life of our children and grandchildren.

Bob Bucat

Let's Hear It for the Teachers

Chemistry is a complex and ill-defined field that requires considerable skill and effort to teach, except perhaps for those students who are so talented and motivated as to go on to postgraduate work in chemistry. This fact is being borne out by myriad research studies that diagnose chemistry students' less-than-adequate understanding of a wide range of topics, at all levels of chemistry—with the same misconceptions common among the students of many countries.

Dimensions of Understanding Chemistry

To demonstrate the complexity of chemistry, and the challenges involved in educating the public about the field, it might be helpful to distinguish some of the ways, which I call dimensions, involved in an understanding of chemistry.

- **Propositional (knowing that . . .) knowledge**: the "facts" of chemistry, which might include, for example, knowing that fluorine is the most *electronegative* element (and presumes that the meaning of *electronegative* is known).
- **Procedural (knowing how . . .) knowledge**: the skills and techniques of chemistry, which might include, for example, knowing how to purify by recrystallization, or how to calculate an equilibrium vapor pressure at a given temperature from that at another temperature.
- **Understanding the role of modeling** in the progress of chemistry, and recognizing that chemistry concerns people and their imagination and ideas as much as it does the behavior of substances. This concept includes progression to a degree of comfortableness with various models in place of a dualistic right/wrong approach to theories.

IUPAC and Chemistry Education

Following the report of the ad hoc Education Strategy Development Committee, the educational role of IUPAC has been enhanced and considerable responsibility assigned to a new Committee on Chemistry Education (CCE), whose terms of reference include addressing matters related to the public appreciation of chemistry. CCE includes in its membership one Associate Member from each of the IUPAC Divisions; a policy designed to improve the engagement of each Division with educational issues.

- **The ability to switch between the macro world of bulk properties and their continuous variation,** the discontinuous submicroscopic world of atoms, molecules and ions, and the intramolecular world of bonds and electron distributions. And at the submicroscopic level, we sometimes use a single-particle picture (when we consider symmetry and polarity) and sometimes we need to use a many-particle picture (when we consider diffusion and competing reaction pathways).
- **The nature and quality of images one might have at the submicroscopic level.** To take an elementary example, I would claim that a three-dimensional dynamic crowded image of liquid water with implied intermolecular interactions is preferable to the typical textbook two-dimensional, static picture with gross misrepresentations of the spacing between molecules.
- **The ability to understand the language of chemistry.** This idea includes the massive demands of our symbolic representations: chemical equations, numerous different types of structural representation, reaction mechanisms etc. And then there is technical jargon used only in chemistry, as well as everyday terms that have different meanings when used in the chemistry context (such as spontaneous, saturated, property, and dispersion). If you need convincing about the problems faced by a novice in communicating through the language of chemistry, I refer you to almost any entry in the IUPAC "Gold Book" in which the glossary definitions are written for the practicing chemist (as indeed they should be), but are unintelligible to all others except advanced chemistry students.
- **The ability to operate at multiple levels of explanation, rationalization, and prediction.** For example, the bonding in a molecule can be considered at a number of different levels—all perhaps useful for various purposes. Similarly, acid-base theory and prediction of the outcomes of perturbing systems at chemical equilibrium can be modeled at different levels.
- **The richness of one's memory bank of episodes;** i.e., images of phenomena that have been experienced. Examples might include demonstration of the critical point of diethyl ether, a measurement of optical rotation, or seeing electrolysis of acidified water. All of these can make our understandings richer than a memory of words transmitted from lecturer or textbook.
- **The ability to distinguish between demonstrable knowledge and arbitrary knowledge.** For example the "insolubility" of calcium carbonate is demonstrable, while the value given to the standard reduction potential of $Fe^{3+}(aq)$ to $Fe^{2+}(aq)$ is arbitrary.
- **Appreciation of the sources of our knowledge.** Put another way, I would claim that we are richer for knowing why we should believe what we believe; i.e., the experimental evidence on which it is based. Try asking your students, even the advanced ones, why they believe that all matter is constituted of atoms.
- **Knowing what we do not know.** This is perhaps an underestimated factor in the business of knowing, contradictory as it may sound.
- **Appreciation of the role and place of chemistry in society, at the local and international levels.**
- **Understanding what chemists do.**
- **Interlinking of one's learning, rather than compartmentalized knowledge.** Chemical education research is increasingly pointing to the importance of links between knowledge "bits" in the same topic (including between theory and practical experience), to knowledge in other chemistry topics, to knowledge in other disciplines such as physics or biochemistry, and to real-world applications.

Pervading these dimensions of knowing chemistry, there are myriad concepts that are not easy to grasp, and whose understanding can be expected to grow only with experience. For example, there is the all-pervasive (and evasive) concept of energy, ranging all the way from calorimetry, through notions such as bond energy, vibrational and rotational excitation, stability of reaction mixtures, equilibrium, entropy as probabilistic distribution of energy among possible states, to prediction of structures by energy minimization calculations.

Challenge your students to explain where the energy has gone when we put a Bunsen burner under a beaker of water (or turn on the electric kettle). Challenge your students to explain why the average temperature of the earth is about 35° C warmer than it

would be in the absence of our atmosphere, even though the net energy flux is zero. If they resort to notions such as carbon dioxide molecules "trapping" energy, how do they explain that the temperature is not continuously rising (at fixed greenhouse gas concentrations)?

Learning Chemistry is Not a Linear Process

Textbooks, of course, must arrange their content in a linear fashion, but has this seduced us into thinking that students learn in the same sequence? My view of learning is that it is a rather sporadic process with leaps of learning along one or more of the above-mentioned dimensions in sometimes unpredictable ways.

Some of the dimensions listed above are unique to chemistry, making learning chemistry different from learning about other disciplines. As well, the extent to which the subject matter depends on each of these dimensions presumably varies from topic to topic. For example, the demands of learning about thermodynamics are different from those of learning about stereoisomerism.

There is a growing awareness that effective teaching about any one topic requires reflective analysis, and perhaps classroom research, to analyze the topic in terms of the particular demands that it puts on the student. And when we understand these demands, we can transform our expert knowledge (perhaps expressible in the language we use to communicate with other experts) into forms of knowledge that the student can make sense of. Knowing ways of doing this is referred to as *pedagogical content knowledge*; the label recognizes the interaction between the expert's content knowledge and generalizable pedagogical knowledge to arrive at this sort of knowing.

There is currently a tendency to cope with the difficulties of learning (and teaching) topics in chemistry by simplifying and idealizing the chemistry and its situations. I invite readers to find a raft of articles in the *Journal of Chemical Education* by Stephen J. Hawkes in which he points out how this strategy can, and does, lead to wrong chemistry. For example if we use concentrations rather than activities, and ignore speciation complexities, as we do at the introductory college level of education, we can predict solubilities of salts which are wrong by several orders of magnitude. But, at least so far as textbooks indicate, we continue to teach this wrong chemistry because it is too difficult otherwise. One challenge for educational researchers and developers, working in concert with practicing chemists, is to devise and prove ways of teaching the "truth," with all of its complications in real situations. Perhaps we should be more strategic in our design of teaching, recognizing that each topic has its special demands?

Which leads me to a suggestion concerning IUPAC projects that demand joint consideration by the subject-matter experts and education experts with a sound understanding of the subject matter. What about, for example, a project entitled "The challenges of teaching about physical chemistry"?

One challenge for educational researchers and developers, working in concert with practicing chemists, is to devise and prove ways of teaching the "truth," with all of its complications in real situations.

But this is in two senses contrary to what I have been saying: firstly, it covers such a broad area, and might imply that the challenges of teaching quantum chemistry are the same as the challenges of teaching, say, about phase diagrams; and secondly, it implies that the challenge is on the teaching component of the teaching-learning process only. The challenges for teaching and learning in a particular field are, of course, closely related: What presents the greatest challenge for learning also presents the greatest challenge for teaching. So let me make some other suggestions with regard to the challenges of teaching and learning about:

- computational quantum chemistry
- phase diagrams
- entropy
- speciation in aqueous solution
- reaction mechanisms in organic chemistry
- molecular modeling of pharmaceuticals

The list, of course, is endless. And the case is made for only one type of joint proposal involving people from the various IUPAC divisions and others whose particular concern is the education process.

Different challenges arise when we consider the task of raising the public appreciation of chemistry, which has been given enhanced status in IUPAC's mission.

Let me conclude by saying that this article represents my personal thoughts as an individual, and although I was a titular member of the Committee on Teaching of Chemistry for eight years, I do not claim to be representing the views of that former committee.

Robert (Bob) Bucat is associate professor in the Department of Chemistry at the University of Western Australia, in Perth.

New Paid Affiliate Members Mean More Sponsored Affiliates in Developing Countries

As a step in expanding and revitalizing the Affiliate Membership Program, IUPAC will support one new Sponsored Affiliate in a developing country for each new paid Affiliate membership. Secretary General Ted Becker announced the new policy by saying:

"Most chemists are concerned about the enhancement of our profession in developing countries and recognize that IUPAC affiliation is often a lifeline for chemists who are well trained and who are trying to pursue chemistry under adverse conditions. With the present base of 4000 paid Affiliates, we have determined that with economies of scale, we can afford to sponsor one additional Affiliate in a developing country for each additional paid Affiliate above 4000. We shall welcome proposals of specific names from new Affiliates, but otherwise IUPAC will work with chemical societies and other groups in developing countries to identify deserving chemists as sponsored Affiliates."

Currently there are about 4200 paid Affiliate Members and about 500 Sponsored Affiliates.

Becker pointed out in his presentation to the Council in Brisbane that "We are dependent on our National Adhering Organizations and national chemical societies in all major countries for running the Affiliate Membership Program." He said that IUPAC Officers will help and encourage the national organizations to increase their Affiliate membership. He cited the flexibility of the new project system as one additional incentive for chemists to become Affiliates and to participate actively in IUPAC activities.

Whither Green Chemistry?

A Look at CHEMRAWN XIV

What are the latest advances in green chemistry? How can green chemical processes be implemented for the benefit of all? What are the prospects for green chemical research and policies promoting such research to advance sustainable development around the globe? How is green chemistry best taught?

These questions were explored last June at a World Congress on Green Chemistry—*CHEMRAWN XIV: Toward Environmentally Benign Processes and Products.* More than 200 scientists, students, and policymakers—from more than two dozen countries—met in Boulder, Colorado. They learned that green chemistry is attracting more scientists to the discipline, that significant advances have been made in the use of alternate reaction media such as supercritical carbon dioxide, that high-yield bioprocesses offer a wealth of opportunities while avoiding the use of hazardous reactants, and that a number of new catalysts are powerful tools for advancing green chemistry.

The welcoming session included remarks by Organizing Committee Chairman J. Michael Fitzpatrick, President and Chief Operating Officer of Rohm and Haas; ACS Past-Presidents Attila E. Pavlath and Daryle H. Busch; Local Arrangements Chairman Professor Robert E. Sievers; IUPAC CHEMRAWN Committee Chairman Parry M. Norling; and Green Chemistry Institute Director Dennis L. Hjeresen.

Conference lecturers included Mary L. Good, President of the American Association for the Advancement of Science; Nobel Laureate Paul J. Crutzen, Professor Emeritus at the Max Planck Institute, Mainz, Germany; Rosina Bierbaum, Acting Director of the U.S. Office of Science and Technology Policy; Joseph M. DeSimone, chemical engineering Professor at the University of North Carolina; Joseph A. Miller, former Chief Science and Technology Officer at the DuPont Company; and Martin Poliakoff, Professor at the University of Nottingham, England.

While scientific papers, lively poster sessions, controversy, and debate were the center of the conference, a three-day pre-conference workshop was essential for 25 young scientists from 16 countries. The workshop provided training in concepts, fundamentals, methods of green chemistry, and a base for communication net-

Reducing harmful emissions is a focus of green chemistry.

works for participants. Expenses for the workshop were covered by the sponsors of the conference—IUPAC, national chemical societies such as the American Chemical Society and the Royal Society of Chemistry, the University of Colorado, a number of chemical companies including Rohm and Haas, and UNESCO.

Key lectures are published in the August 2001 issue of *Pure and Applied Chemistry*. Prefaced by Dennis L. Hjeresen and Paul T. Anastas, the series of manuscripts covers the following topics: global issues on chemistry and the environment, education and international programs, industrial processes and practices, and scientific advances in green chemistry.

An essential feature of all CHEMRAWN (CHEMical Research Applied to World Needs) conferences is the development of a set of actionable recommendations based on findings during the sessions. This task at CHEMRAWN XIV was carried out by a Future Actions Committee headed by Paul T. Anastas of the U.S. Office of Science and Technology Policy. The findings and proposed actions are summarized to in the box below.

As the recommendations are implemented and as the young scientists continue their research and collaboration, the lasting impact of CHEMRAWN XIV will be realized.

http://www.iupac.org/publications/pac/2001/7308/index.html

CHEMRAWN XIV Future Actions Committee

FINDINGS

- Green chemistry and enabling approaches result in the protection of human health and the environment and help preserve sustainability in a manner that is economically profitable and increases competitiveness.
- The incorporation of green chemistry and related approaches into the training of current and potential science students increases the effectiveness of recruitment and retention efforts in this crucial field.
- Research investments are needed by both government and industry beyond current "pilot program" levels to empower and enable the development and utilization of green chemistry technologies by the broad spectrum of private-sector interests.
- Many technologies that meet green chemistry objectives already exist and offer immediate opportunities to reduce environmental burdens and enhance economic performance.
- Markets for next-generation innovative environmental technologies such as green chemistry need to be developed through international engagement and commercial promotion.
- Incentives are necessary to catalyze the implementation of green chemistry innovations by industry to overcome barriers, especially for small- and medium-sized enterprises.

ACTION ITEMS

- National centers for green chemistry should be established or expanded, and these centers should be linked to create an effective worldwide network.
- Basic research funding in green chemistry needs to be significantly increased.
- Educational initiative funding in green chemistry needs to focus on curriculum materials development, faculty training centers, fellowships, and recruitment and retention activities
- Increased incentives are needed for the initial implementation of green chemistry technologies by industry to offset investment, policy, and regulatory barriers that may exist.
- A green chemistry and next-generation environmental technology market development project is needed to build market position for commercial opportunities in international trade.
- An international scientist exchange and research collaboration funding should be established.
- Informational outreach is needed to educate industry, the public, and environmental groups on the benefits of green chemistry adoption.

Dr. Dennis L. Hjeresen is director of The Green Chemistry Institute. He is ACS and Chair, CHEMRAWN XIV Organizing Committee.

Dr. Paul T. Anastas is from the White House Office of Science and Technology Policy and is chair of CHEMRAWN XIV Future Actions Committee.

The full conference report can be read at <http://www.iupac.org/standing/chemrawn/crXIVfac.html>

Awards and Honors

Chunli Bai Awarded SCI's International Medal

The Society of Chemical Industry (SCI) recently bestowed one its highest honors, the International Medal, to Professor Chunli Bai. The medal recognizes an individual's major contribution to international cooperation in any of the fields within SCI's sphere of interest. Bai is vice president of the Chinese Academy of Sciences.

Chunli Bai, recipient of SCI's International Medal

An authority in the field of scanning tunnelling microscopes, Bai initiated and promoted the development of scaning probe microscopy in China. Leading the research, he successfully achieved many firsts for China—atomic force microscope and ballistic electron emission microscope. Using these techniques, his laboratory has studied a wide variety of materials. Bai also holds five patents and is the author of over 200 papers and ten books.

Bai is a newly elected member of the IUPAC Bureau. As a National Representative of IUPAC, he twice (in 1995 and 1997) attended the General Assembly. He also served as a Member of the Organizing committee of various academic conferences.

Allen Bard Awarded the ACS' Priestley Medal

The American Chemical Society awarded its highest honor, the 2002 Priestley Medal, to Professor Allen J. Bard of the University of Texas, Austin. Many IUPAC members know Al Bard personally, especially those who were active between 1991-93, when he was President and deeply involved in restructuring the organization. While the Priestley Medal recognizes his distinguished service to chemistry, Dr. Bard is also best know for his research in electrochemistry, from fundamental understanding to the devolpment of unique techniques, such as scanning electrochemical microscopy. More than having a "pure and applied" approach to science, Bard also promotes the teaching of the field. During his outstanding service as editor in chief of the *Journal of the American Chemical Society*, he served the community by meticulously screening the best scientific reports for publication in this journal of broad interest. It is not surprising, therefore, that Bard is also well known as an elder statesman of the profession who has done much to advance its global influence. *CI* spoke with him about what he would like today's IUPAC leaders to accomplish.

CI: What are some of the greatest opportunities for IUPAC?

AB: I think there are a lot of problems in the fundamental and applied sciences . . . and political problems . . . that IUPAC can play a role in solving. IUPAC can address such global problems as the environment, energy, and water resources on a more international scale than even large countries can by themselves. In fundamental chemistry, IUPAC is poised now to make important and widely recognized contributions in nanoscience, molecular electronics, materials science, and other areas.

CI: What about recognition for IUPAC itself?

AB: If IUPAC does important work and addresses problems significant to industries and governments, it will be recognized. The key issue is, how important is IUPAC and what it's doing? If members come out with good reports that back up their views on important issues, I think they will be publicized.

CI: As President of IUPAC, you strongly encouraged restructuring in order to focus resources on high-priority projects. Does the current structure achieve what you had hoped for?

Allen J. Bard, recipient of the Priestley Medal

AB: It's a question of timing and the speed of getting things out. The tradition of

IUPAC had been to do very careful, very good work at a leisurely pace. So it spent four or six or even eight years to address fairly non-critical problems. Clearly, in today's faster-paced world, that's not good enough for addressing problems people care about. The new structure is better. It's attuned to identifying a problem through, let's say, the divisional structure, rapidly getting together a group that can address that problem, and giving them the support to complete the study in a relatively short time. The key issue is to identify an important project and get the best people who are willing to work on it – and I think good people will be willing to work on an important project. Give them the resources to meet a few times—not just once every two years—and let them publish their report in a timely manner.

CI: Speaking of resources, what can IUPAC do to address disparities in resources and standards among member countries?

AB: In terms of resources, I don't think IUPAC can make a very big difference, but it can – and does – play a role in establishing world-wide standards and making these standards clear to developing countries. IUPAC could perhaps try to leverage its funding by doing collaborative studies with other international organizations.

CI: With so many multidisciplinary issues in the sciences, would your suggestion to collaborate with other organizations possibly broaden IUPAC's professional base as well?

AB: That's right. Various organizations—UNESCO and others—are concerned with interdisciplinary problems that are within the broad scope of IUPAC. We ought to be working more closely and more frequently with them on a wide range of cross-cutting issues.

Thomas Tidwell Receives CCA's Killam Fellowship

The Canadian Council for the Arts (CCA) announced the results of the 33rd annual competition of the Killam research fellowships. The fellowship enables its recipients to devote two years to full-time research and writing. Recipients were chosen by a selection committee comprised of 15 eminent scientists and scholors who represent a broad range of disciplines.

Thomas Tidwell, recipient of a Killam Fellowship

Included among those chosen from the field of chemistry were Thomas Tidwell, professor at the University of Toronto, Ontario, Canada. Tidwell is recognized for his work on hightly reactive intermediates, including mechanistic studies by fast reaction techniques and synthetic applications.

As of January 2002, Tidwell is president of the IUPAC Organic and Biomolecular Chemistry Division. Following last year's restructuring, the Division activities will focus on areas of organic synthesis, structural and mechanistic organic chemistry, photochemistry, biomolecular chemistry, green chemistry, and biotechnology.

IUPAC on the Trail of Advanced Materials

The 2nd IUPAC Workshop on New Directions in Chemistry—Workshop on Advanced Materials: **Nanostructured Advanced Materials** (IUPAC WAM II) will convene in Bangalore, India, 13-16 February 2002 <http://www.jncasr.ac.in/wam/>.

A special issue of *Pure and Applied Chemistry* devoted to this subject is planned for later this year. This follows the precedent of the publication of WAM I, which appeared as the January 2000 issue. <http://www.iupac.org/publications/pac/2000/7201/index.html>.

IUPAC Projects

Evaluated Kinetic Data for Atmospheric Chemistry

Evaluated data are essential not only for atmospheric modellers, but also for experimental scientists studying kinetics and mechanisms of atmospheric reactions. Over the last 20 years, and in response to the emerging problem of the depletion of atmospheric ozone due to man made pollutants, a group was tasked to produce evaluations of the existing chemical kinetics data. These evaluations continuously updated and augmented results in a series of nine peer reviewed publications in *J. Phys. Chem. Ref. Data.* As the accessibility of these data appears equally important, a new task group is now engaged in assembling, compiling, and indexing the materials on an interactive web site.

The published evaluations contain two elements. Firstly, they contain a summary table containing a list of recommended rate parameters giving the best available values for rate coefficients, for use in models representing atmospheric chemistry/explicitly as a system of elementary chemical reactions. Secondly each reaction is discussed in a separate data sheet, in which the key experimental data are summarized and the basis of the recommendation together with its uncertainty is given.

An initial database has been created by the former IUPAC Subcommittee for Gas Kinetic Data Evaluation for Atmospheric Chemistry and developed at the Centre for Atmospheric Science in the Department of Chemistry, at the University of Cambridge <http://www.iupac-kinetic.ch.cam.ac.uk>. The current task group, lead by Dr. R. A. Cox, will substantially expand the content of the web site to include not only the most current summary sheets, but also the data for photochemical reactions (absorption cross sections, quantum yields), heterogeneous reactions (kinetic uptake coefficients for atmospheric gases on a range of surfaces) and the individual data sheets for each of the (600) gas phase reactions evaluated in the past 20 years. The current "passive" site will be converted into an interactive interphase, including search and hyperlinks between the summary table and the data sheets. As new data are reported, a more effective way of updating and extending the portfolio of recommended rate coefficients will be developed; this will be necessary to maintain an effective and ongoing communication between laboratory scientists and atmospheric modellers.

http://www.iupac.org/projects/1999/1999-037-2-100.html

New Book Available

The History of IUPAC 1988-1999

by Stanley S. Brown

The *Supplement to The History of IUPAC* continues the story of IUPAC to 1999, the 80th anniversary of the founding of IUPAC. It covers the years in which IUPAC underwent a number of significant changes as it adapted to the changes in the science of chemistry and the globalization of the chemical sciences. This book is a supplement to *The History of IUPAC 1919-1987*.

The supplement is available for USD 20, ISBN 0-967-85501-2.

A two-volume boxed set of both history books is available for USD 41, ISBN 0-967-85502-0.

Orders can be placed at <orderdesk@iupac.org>.

Educating Chemists and the Public About Risk Assessment

IUPAC's Chemistry and Human Health Division recently oversaw the production of educational material that addresses a void much in need of filling. Risk assessment involving chemical use is now mandatory in many countries, and although much has been written about it, there is still no broad agreement on best practices. In particular, discussions about toxicology have not always been ground in reliable science. In response to this situation, the group, led by John Duffus, of the Edinburgh Centre for Toxicology, has published a technical report and prepared educational resources in the form of a visual presentation package.

Risk assessment involving chemical use is now mandatory in many countries, and although much has been written about it, there is still no broad agreement on best practices.

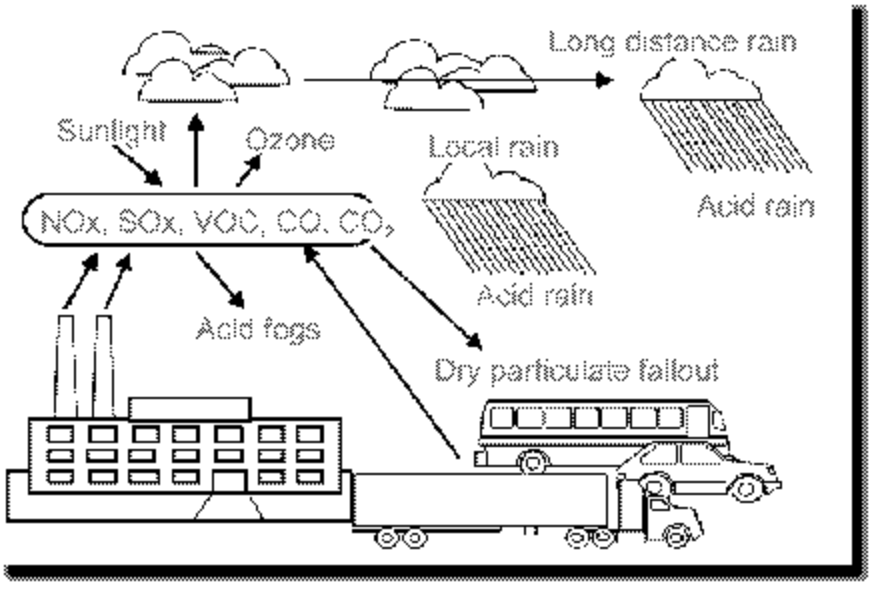
The technical report, titled "Risk Assessment for Occupational Exposure to Chemicals. A Review of Current Methodology," appears in *Pure and Applied Chemistry*, Vol. 73, No. 6 (2001). By examining the ways in which chemicals can pose a threat in various workplace and environmental settings, the authors offer strategies for monitoring and quantifying risk.

The presentation consists of a series of Adobe Acrobat PDF files that can be used as slides or handouts. It is intended to provide educators with a resource for teaching and learning the fundamentals of toxicology. As well, the presentation attempts to explain fundamental ideas in toxicology clearly so that students can understand the hazards and risks associated with chemicals.

The topics covered range from fundamental principles of toxicology through environmental toxicology and risk management to consideration of ethics. To complement the units and help with self-guided study, a series of self-assessment questions are provided.

This educational material is the result of a collaborative project between the former IUPAC Commission on Toxicology and the former Committee on the Teaching of Chemistry. It follows the successful production of an undergraduate level textbook, *Fundamental Toxicology for Chemists*, published by the U.K. Royal Society for Chemistry.

http://www.iupac.org/projects/1995/720_8_95.html



What is the chemical foundation of acid rain?

This illustration of the formation and distribution of acid precipitation is part of a presentation on Environmental Toxicology that will help educators to introduce air pollution as a problem in toxicology.

Impact of Scientific Developments on the Chemical Weapons Convention

A workshop titled the *Impact of Scientific Developments on the Chemical Weapons Convention* will be the focal point for the development of advice by IUPAC to the Organization for the Prohibition of Chemical Weapons (OPCW). The workshop, to be held in Bergen, Norway, 1-3 July 2002, is expected to bring together about 80-100 experts to discuss novel methods of organic synthesis and chemical processing, new analytical chemistry technology, and other areas relevant to the production and detection of chemical weapons.

The Chemical Weapons Convention (CWC) entered into force in 1997 and has been ratified by 143 nations. This treaty prohibits the use of chemicals as weapons of war and requires the destruction of existing stockpiles of such weapons. This treaty is implemented by the OPCW, which is responsible for monitoring the destruction of weapons, monitoring international transfers of chemicals that are recognized as weapons or their immediate precursors, and inspecting chemical production facilities in member countries.

The operation of the CWC is to be reviewed at a conference of all Member States in October 2003. In recognition of the many scientific developments since the drafting of the treaty, OPCW has arranged with IUPAC to provide advice on such topics as new methods of synthesis, changes in chemical processing that could significantly affect the design and appearance of chemical production facilities, new analytical methods (currently available and on the horizon) that may facilitate OPCW inspections, newer methods of destruction of chemical weapons, etc. In addition, IUPAC will consider aspects that may be relevant to the prevention of the use of chemical weapons by terrorists.

An International Advisory Board, chaired by IUPAC Past-President Alan Hayes, with representation from 17 countries, has been formed to aid the Program Committee in formulating the program and obtaining the best international scientific input. Following the workshop, proceedings will be published, and a report provided to OPCW.

With support from the U.S. National Academy of Sciences [IUPAC's NAO in the USA], IUPAC held a planning meeting at OPCW headquarters in The Hague in July. In opening remarks, John Gee, Deputy Director-General of OPCW, pointed out that "IUPAC, through its constituent national chemical societies and science academies, is well placed to draw to the attention of the OPCW, developments in scientific knowledge, understanding, and methodology that have a direct bearing on

the Convention. As a truly independent international association with an indisputable scientific reputation and a history of accomplishments in the furthering of chemistry and chemical technology, your contribution to the CWC review process will be of great value indeed."

Mr. Gee went on to say, "Perhaps more than any other international legal instrument in the field of international security and disarmament, the Chemical Weapons Convention has strong scientific foundations. It reaches into such activities as scientific research and development, and the use of chemicals for peaceful purposes. The Convention therefore needs to mirror accurately the capabilities of chemistry, technology, and manufacturing. At the same time, governments and the international community as a whole, need to be reassured that new scientific developments are not going to undermine the prohibitions in the Convention."

http://www.iupac.org/projects/2001/2001-057-1-020.html

Highlights from Pure and Applied Chemistry

Presenting abstracts of selected articles from IUPAC's journal

Use of Legendre Transforms in Chemical Thermodynamics (IUPAC Technical Report)

by Robert A. Alberty
Pure and Applied Chemistry, Vol. 73, No. 8, pp. 1349–1380 (2001)

The fundamental equation of thermodynamics for the internal energy μ may include terms for various types of work and involves only differentials of extensive variables. The fundamental equation for μ yields intensive variables as partial derivatives of the internal energy with respect to other extensive properties. In addition to the terms from the combined first and second laws for a system involving *PV* work, the fundamental equation for the internal energy may involve terms for chemical work, gravitational work, work of electric transport, elongation work, surface work, work of electric and magnetic polarization, and other kinds of work.

Fundamental equations for other thermodynamic potentials can be obtained by use of Legendre transforms that define these other thermodynamic potentials in terms of μ minus conjugate pairs of intensive and extensive variables involved in one or more work terms. The independent variables represented by differentials in a fundamental equation are referred to as natural variables. The natural variables of a thermodynamic potential are important because if a thermodynamic potential can be determined as a function of its natural variables, all of the thermodynamic properties of the system can be obtained by taking partial derivatives of the thermodynamic potential with respect to the natural variables. The natural variables are also important because they are held constant in the criterion for spontaneous change and equilibrium based on that thermodynamic potential. By use of Legendre transforms any desired set of natural variables can be obtained. The enthalpy *H*, Helmholtz energy *A*, and Gibbs energy *G* are defined by Legendre transforms that introduce *P*, *T*, and *P* and *T* together as natural variables, respectively.

Further Legendre transforms can be used to introduce the chemical potential of any species, the gravitational potential, the electric potentials of phases, surface tension, force of elongation, electric field strength, magnetic field strength, and other intensive variables as natural variables. The large number of transformed thermodynamic potentials that can be defined raises serious nomenclature problems. Some of the transforms of the internal energy can also be regarded as transforms of *H*, *A*, or *G*. Since transforms of *U*, *H*, *A*, and *G* are useful, they can be referred to as the transformed internal energy *U´*, transformed enthalpy *H´*, transformed Helmholtz energy *A´*, and transformed Gibbs energy *G´* in a context where it is clear what additional intensive natural variables have been introduced. The chemical potential μ_i of a species is an especially important intensive property because its value is uniform throughout a multiphase system at equilibrium even though the phases may be different states of matter or be at different pressures, gravitational potentials, or electric potentials. When the chemical potential of a species is held constant, a Legendre transform can be used to define a transformed Gibbs energy, which is minimized at equilibrium at a specified chemical potential of that species. For example, transformed chemical potentials are useful in biochemistry because it is convenient to use pH as an independent variable. Recommendations are made to clarify the use of transformed thermodynamic potentials of systems and transformed chemical potentials of species.

http://www.iupac.org/publications/pac/2001/7308/7308x1349.html

Modeling Lifetime and Degradability of Organic Compounds in Air, Soil, and Water Systems (IUPAC Technical Report)

by A. Sabljic and W. Peijnenburg
Pure and Applied Chemistry, Vol. 73, No. 8, pp. 1331–1348 (2001)

Degradability of organic compounds in air, soil and water is the most important factor for evaluating possible adverse effects to humans and the environment. The primary degradation process in the troposphere is the reaction with the hydroxyl radical. For water and soil compartments, the primary degradation process is biodegradation.

The objectives of this report are (i) to review published models and their evaluation studies, (ii) to perform an in-house evaluation of general models for estimating tropospheric degradation and biodegradation of organic compounds, and (iii) to recommend reliable procedures for estimating degradability of organic compounds in the environment.

The extensive evaluation procedure has shown that the most accurate method for estimating tropospheric degradation is Atkinson's group contribution method. Although this method has some limitations, it seems to be the method of choice. A viable alternative to Atkinson's method is a direct calculation, performed today almost routinely, of the reaction rate constants with hydroxyl radicals. Recently, a methodology based on reliable semi-empirical potential energy surfaces was developed that enables the calculation of reaction rate constants within a factor of 2 of their measured values. A PLS model and a set of 7 biodegradation rules have been found to be the most reliable in estimating complete biodegradation of organic compounds. However, it is recommended to use all four evaluated methods to estimate biodegradation in the environment. If their results agree, such estimates are very reliable.

http://www.iupac.org/publications/pac/2001/7308/7308x1331.html

Selectivity in Analytical Chemistry (IUPAC Recommendations 2001)

by J. Vessman, R.I. Stefan, J.F. van Staden, K. Danzer, W. Lindner, D.T. Burns, A. Fajgelj, and H. Müller
Pure and Applied Chemistry, Vol. 73, No. 8, pp. 1381–1386 (2001)

Selectivity is one of the key properties in analytical chemistry. However, definitions within the framework of IUPAC have been rather vague. In the analytical chemical community there has also been an unfortunate overlap between the terms *selectivity* and *specificity*, which has been confusing. As a remedy a project was started in the Analytical Chemistry Division within IUPAC in 1999, which was finalized in Brisbane 2001.

The resulting document states that the term *selectivity* has evolved in parallel with the development of more sensitive and discriminating methods and that several kinds of interactions are used in the discrimination process.

Selectivity in a method is obtained by the combination of several *selectivity* generating steps as exemplified by LC-MS-MS (with separation and detection *selectivity*) and by arrays of sensors, where computational *selectivity* is introduced.

Selectivity can be expressed in a qualitative manner in many ways, but most importantly, *selectivity* is something that can be graded in contrast to *specificity*, which is absolute. On the other hand, a calculation of degree of *selectivity* is not easy and many attempts have been made. A calculation approach useful to the practicing analyst is therefore still to be desired.

The IUPAC recommendation 2001 states that *selectivity* should be promoted and *specificity* discour-

PAC Online

Pure and Applied Chemistry, the scientific journal published by IUPAC, includes recommendations on nomenclature, symbols and units, technical reports on standardization, recommended procedures, collaborative studies, data compilations, critically evaluated state-of-the-art commissioned review articles on important topics in chemistry, and main invited lectures presented at IUPAC-sponsored symposia and conferences.

Over the last two years, numerous changes occurred for the journal, as the production of its hard copy edition was transferred from a professional publisher, Blackwell, to a self-publishing venture, with IUPAC working directly with a copy-editor and a printer. With these changes also came the development of an online version, which is available from the IUPAC web site. **<http://www.iupac.org/publications/pac/index.html>** The site includes tables of contents given, free access to every abstract, and full text Adobe Acrobat PDFs of all IUPAC reports and recommendations.

To ensure wide-spread availability of all documents published in the journal, IUPAC has made arrangements with other portals and distributors that allow pay per view and/or subscription to the entire contents of the journals. These include OCLC, EBSCO, ChemWeb, The Scientific World, and PubScience. For specific information about each of these outfits, visit their websites or contact the following individuals:

OCLC Online Computer Library Center
<http://www.oclc.org>
or contact Chris Brown,
e-mail: <christina_brown@oclc.org>

EBSCO
<http://www.ebsco.com/>
or contact Leigh Marie Lunn,
e-mail: <lmlunn@ebsco.com>

ChemWeb
<http://www.chemweb.com>
or contact Jan Kuras,
e-mail: <jan.kuras@chemweb.com>

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or contact Anita Crafts-Lighty,
e-mail: <acraftslighty@thescientificworld.com>

PubScience
<http://pubsci.osti.gov/>
or contact Mary E. Beasley,
e-mail: < beasleym@osti.gov>

aged as the latter is incorrect. A method is either *specific* or not, Few, if any methods are *specific*. From a semantic point of view, the expression that "*selectivity* is the state or quality of choosing carefully" has been derived.

The recommended definition of *Selectivity* is: *Selectivity* refers to the extent to which the method can be used to determine particular analytes in mixtures or matrices without interferences from other components of similar behavior.

http://www.iupac.org/publications/pac/2001/7308/7308x1381.html

New Books and Publications

Polymer Networks

H. Galina (Ed.)
Macromolecular Symposia, Vol. 171,
Wiley-VCH, 2001, pp. 1-263, ISBN 3-527-30333-2

This volume contains selected papers presented at Polymer Networks 2000, the 15th Polymer Networks Group Meeting, held in Cracow, Poland, from 17 - 21 July 2000. The conference was organized jointly by the Rzeszów University of Technology and the Jagellonian University, Cracow, under the sponsorship of IUPAC and the Polymer Division of the Polish Chemical Society. It was a satellite meeting of the IUPAC World Polymer Congress, held the previous week in Warsaw.

In addition to theoretical papers, this volume presents papers on the formation, structure and properties of interpenetrating polymer networks, and heterogeneous, filled and hybrid networks. The properties and characterization of hydrophilic and hydrophobic gels and swollen networks are also covered and there are contributions on calorimetric and dielectric studies of thermoset formation and on the structure of amorphous sulfur.

http://www.iupac.org/publications/macro/2001/171_preface.html

Polymers in Medicine

J. Kahovec (Ed.)
Macromolecular Symposia, Vol. 172
Wiley-VCH, 2001, pp. 1-165, ISBN 3-527-30334-0

The 40th microsymposium in the series of the Prague Meetings on Macromolecules, organized by the Institute of Macromolecular Chemistry in Prague since 1967, was devoted to polymers in medicine. All the lectures presented at the microsymposium appear in this special volume. Various aspects of development, structure and properties of diverse polymeric drug delivery systems are discussed in papers of Bae, Einmahl, Heller, Kataoka, Kennedy and Lloyd. Specific aspects of polymer systems designed for cancer therapy are presented, e.g., in the papers of Neuse, Minko or Kabanov, immunological aspects of the use of water-soluble polymer-drug conjugates in cancer therapy are discussed by Ríhiová. The reader will also find papers dealing with other topics of application of polymers, such as cell encapsulation (Lukás), polymer vaccines (Kissel), gene therapy (Hoffman) and collagen-based fibres for blood vessel replacements (Feijen).

http://www.iupac.org/publications/macro/2001/172_preface.html

Metal and Ammonium Formate Systems

C. Balarew, T.P. Dirskse, O.A. Golubchikov, M. Salomon, S. Trendafilova, S. Tepavitcharova, T. Ageyeva, P. Baldini, and G. D'Andrea
IUPAC-NIST Solubility Data Series. 73.
Journal of Physical and Chemical Reference Data,
Vol. 30, No. 1 pp. 1-163, 2001

This volume reviews the metal and ammonium formate solubility data published up to 1995. As far as the editors are aware, all the solubility data published during this period have been reviewed. Preference has been given to data published in numerical form. Data that appeared only in graphical form may not appear in this volume. In each section the metal atoms are arranged in the order (group) in which they appear in the Periodic Table. Metal formates are crystalline solids having some interesting chemical and physical properties. Several of these salts are important because they have nonlinear optical properties. Specific examples are: $LiCHO_2 \cdot H_2O$ (3), $NaCHO_2$ (4), $Sr(CHO_2)_2$, and $Sr(CHO_2)_2 \cdot 2H_2O$, $Ba(CHO_2)_2$, formates of Sc, Y and the rare earth elements having the general formula $Me(CHO_2)_3 \cdot nH2O$ (where Me = Sc, Y, La, Ce, Pr, Nd, Sm . . . Lu) and some double salts and mixed salts such as $NaCd(CHO_2)_3$, $BaCd(CHO_2)_4 \cdot 2H_2O$ and $Li_{0.9}Na_{0.1}CHO_2$. Some metal formates have useful electric or magnetic characteristics. Thus, $Cu(CHO_2)_2 \cdot 4H_2O$ has ferroelectric properties, $Cu(CHO_2)_2$ is ferromagnetic, $Mn(CHO_2)_2 \cdot 2H_2O$ is antiferromagnetic, $CuBa_2(CHO_2)_6 \cdot 4H_2O$ is paramagnetic,

and the formates of Ca, Cd, and Sr have elastic and thermoplastic properties. Bivalent metal formates could be used as precursors for the production of catalysts because they show excellent miscibility in the solid state, i.e., they form mixed crystals that dissociate at relatively low temperatures (about 300 °C) to form the respective oxides and mixed oxides. There are also additional smaller-scale uses of metal formates. The wide interest in the applications and uses of metal formates will lead to an interest in seeking methods for the preparation of these materials. Solubility data for the metal formates will be helpful in devising the methods of preparation. Therefore, this volume has been prepared to present and evaluate solubility data for the binary, ternary and multicomponent systems containing metal formates in aqueous and in nonaqueous solutions.


http://www.iupac.org/projects/2001/2001-032-1-500.html

Actinide Carbon Compounds

Jiri Hála and James D. Navratil
IUPAC-NIST Solubility Data Series. 74.
Journal of Physical and Chemical Reference Data, Vol. 30, No. 2, pp. 531-698, 2001

This volume presents solubility data of the carbonates, salts of carboxylic acids, and other carbon containing compounds of actinides. Covered are compounds of thorium, uranium, neptunium, plutonium, americium, and one system for curium. No solubility data on carbonates or other carbon containing compounds have been found for other actinide elements. The literature has been covered up to the end of 1999, and there was a great effort to have the literature survey as complete as possible. Only those published results that report meaningful data were considered for the volume. Papers that reported qualitative results with statements like "sparingly soluble" or "insoluble," etc. were not considered. In addition to papers that published numerical data, some papers that presented data in graphical form only were considered as well. They were considered for the volume either if no other data were available for the system, if the data were published in difficult to obtain older literature, or if the data were considered to be of importance for other reasons. For many compounds it was not possible to provide the Chemical Abstracts Registry Numbers since these have not yet been assigned. For this reason, the Registry Number index is incomplete.


http://www.iupac.org/projects/2001/2001-033-1-500.html

Mycotoxins and Phycotoxins in Perspective at the Turn of the Millennium

Willem J. de Koe, Robert A. Samson, Hans P. van Egmond, John Gilbert and Myrna Sabino, (eds.) W.J. de Koe, 2001 (ISBN 9-090-14801-9)

This book contains symposium keynote lecture, plenary lectures which introduce each topic area, and contributed oral papers presented at the Xth International IUPAC Symposium on Mycotoxins and Phycotoxins, held from 21-25 May 2000 in Guarujá, Brazil.

Brazil made history in the mycotoxin area when aflatoxin was detected for the first time in Brazilian peanut meal exported to England, explained M. Sabino. From that time, a new field of research was created: mycotoxicology. After 40 years, the opportunity emerged to gather the renowned authorities in the area to discuss the problem in where this contaminant was first detected. Being a country with continental dimensions, Brazil is subject to climatic diversities, consequently, the possibility of producing mycotoxins other then the aflatoxins. Fortunately, various research groups, governmental agencies, universities and industries are working together to minimize the problem and today the level of contamination is no longer what is was used to get together and discuss various topics such as control and/or prevention, new methods of detection, decontamination, etc.


http://www.iupac.org/publications/books/author/dekoe.html

Nomenclature of Organic Compounds. Principles and Practice. 2nd edition

Robert B. Fox and Warren H. Powell
American Chemical Society and Oxford University Press, New York. Hardcover, 2001, xvii and pp. 1-437. (ISBN 0-841-23648-8).

The authors served for many years as members of and consultants to the American Chemical Society Nomenclature Committee and to several IUPAC Nomenclature Commissions. They stress the need for unambiguous communication among organic chemists and for understanding of names for chemical structures and chemical substances.

The book focuses on the methods and their application in the naming of organic compounds, stressing the relationship between structure and name. The first part is a general overview of organic nomenclature. It includes origin and evolution, conventions, and methods of organic nomenclature, and a very useful chapter on common errors, pitfalls, and misunderstandings. The second part uses the concepts from the first part to answer the question “how do I name this compound?”.

Every common class of organic compounds is covered, from simple hydrocarbons, hetero compounds, acids, aldehydes, alcohols, amides, and amines to nitrogen, sulfur, phosphorus, silicon, boron, and organometallic compounds, polymers, natural products, stereoisomers, isotopically modified compounds, radicals, and ions. Throughout the book, the concepts and methods of the IUPAC recommendations are compared with rules used by Chemical Abstracts Service and other sources. Appendices contain most useful lists of substituent prefixes and common endings, and a glossary of terms.

http://www.oup-usa.org/isbn/0841236488.html

Reports from Conferences

Plasma Chemistry

by Steven L. Girshick

The 15th International Symposium on Plasma Chemistry, ISPC-15, was held in Orléans, France, from 9-13 July 2001. The Symposium was hosted by the laboratory GREMI (Groupe de Recherche sur l'Énergetique des Milieux Ionisés) at the University of Orléans, and was organized by an International Organizing Committee and a Local Organizing Committee, chaired respectively by A. Bouchoule and J. M. Pouvesle, both of GREMI. The 610 registered attendees came from 40 countries. Countries with the highest number of attendees included France (218), Japan (90), Germany (48), Russia (32), the United States (32), Czech Republic (31), Canada (26), Italy (20), Poland (16) and the Netherlands (12). The Symposium was preceded by the biennial International Summer School on Plasma Chemistry, held 4-6 July, and a Workshop on Industrial Applications of Plasma Processing, on 7 July, both of which were well attended.

The high quality of the presentations and the range of topics demonstrated the extraordinary vitality of the field of plasma chemistry. Over 550 papers were presented at the symposium, including 133 oral presentations and 420 posters. Presentations were grouped into major topical areas, which included fundamentals of and basic processes in each of thermal plasmas and non-equilibrium plasmas; sources, diagnostics and modeling in each of atmospheric pressure non-equilibrium plasmas, thermal plasmas, and low-pressure plasmas; plasma chemical vapor deposition of silicon-based compounds; inorganic films and hard coatings; plasma deposition and treatment of polymers; etching and microtechnology; plasma sprays and thermal plasma material processing; clusters, particles and powders; environmental applications of each of thermal plasmas and non-equilibrium plasmas; plasma chemical synthesis/engineering; and laser-based technologies and plasma light sources. The full conference proceedings, edited by A. Bouchoule, J. M. Pouvesle, A. L. Thomann, J. M. Bauchire and E. Robert, comprise eight volumes and more than 3000 pages.

There were seven plenary lectures, given by C. H. Kruger, Stanford University, US, on non-equilibrium discharges in air at atmospheric pressure; D. C. Schram, Eindhoven University of Technology, the Netherlands, on plasma processing and chemistry; M. Sekine, Association of Super Advanced Electronics Technologies, Japan, on future plasma technologies in ULSI processing; J. Heberlein, University of Minnesota, US, on new approaches in thermal plasma technology; S. De Benedictis, University of Bari, Italy, on energy transfers by long-lived species in glows and afterglows; P. Roca i Cabarrocas, École Polytechnique, France, on plasma production of polymorphous silicon thin films; and M. Moisan, University of Montreal, Canada, on plasma sterilization. The plenary and invited papers will be published in *Pure and Applied Chemistry,* edited by A. Bouchoule.

The conference banquet was held at the magnificent Chateau de Blois. At the banquet the Plasma Chemistry Award was presented to Prof. Pierre Fauchais, of the University of Limoges, France. The Plasma Chemistry Award is the major award of the plasma chemistry community for career achievement. Prof. Fauchais was recognized for his outstanding contributions in the areas of thermal plasmas, plasma spraying, optical diagnostics, and modeling. In 1968 Prof. Fauchais founded the group on "Procédés de traitements de surface," which is part of the CNRS laboratory SPCTS at the University of Limoges. Prof. Fauchais continues to direct this group, which has educated a large number of plasma scientists and engineers. In addition he has a distinguished recored of service to the plasma chemistry community, having organized a number of conferences and having served on the IUPAC Subcommittee on Plasma Chemistry.

Best Paper Awards were presented to three young plasma scientists: Nicolas Gherardi, Université Paul Sabatier, Toulouse, France, for his paper on light emission in a glow dielectric barrier discharge in nitrogen; Matthias Meier, Max Planck

Institute for Plasma Physics, Garching, Germany, for his paper on formation of polymer-like hydrocarbon films from beams of methyl radicals and hydrogen atoms; and Masako Shindo, Kyushu University, Japan, for her work on the role of negative ions in an oxygen-argon electron cyclotron resonance plasma.

A major event at the Symposium was the founding of a new society, the International Plasma Chemistry Society (IPCS). The first meeting of the General Assembly of the IPCS, consisting of all attendees of IPSC-15, was held during the Symposium on 11 July 2001. At this meeting the Statutes of Foundation and Rules of Governance of the new Society were adopted. I was elected for a two-year term as President of the IPCS and Chair of the Board of Directors. J. Winter, of the University of Böchum, Germany, was elected as Vice-Chair.

The next International Symposium on Plasma Chemistry, ISPC-16, is planned for Taormina, Italy, 22-27 June 2003. The Symposium will be hosted by R. d'Agostino, P. Capezzuto, and colleagues at the University of Bari, Italy.

Steven L. Girshick is a professor in the High Temperature and Plasma Laboratory, Department of Mechanical Engineering at the University of Minnesota.

Safety in Chemical Production

by Mike Booth

The IUPAC Committee on Chemistry and Industry (COCI) has run a number of successful workshops with the theme Safety in Chemical Production over many years. The first of these was in Basel, Switzerland in 1990 and subsequent ones have been held in Yokohama, Japan 1993 and San Francisco, USA 1997. The fourth and last of these workshops was held 30 July-4 August 2001 in Dakar, Senegal as part of the 8th International Chemical Conference in Africa, under the auspices of the African Association of Pure and Applied Chemistry (AAPAC). Almost all of the 150 participants at the conference attended the workshop, which was presented by Daniel Rademeyer from ISHECON, a group of safety, health and environmental consultants. As the COCI member from South Africa, I organized the workshop, which centred on aspects of responsible care, hazard identification, and risk assessment in chemical production.

In the first part of the session Daniel dealt with the safety, health, and environmental (SHE) risks presented by chemical processes, in which a series of systematic reviews are conducted, in parallel and integrated with the process development activities.

The first review is done at an early stage of the development as a broad overview of SHE issues. Consideration is given to the hazards of the chemical materials involved in the process, the interactions between these, means of handling, suitability of the materials of construction and their implications for site selection, plant layout, process control, employee protection, effluent treatment, waste disposal, legal requirements, and design codes or standards. From this review enough information will usually be available to carry out an environmental impact assessment (EIA).

Once the conceptual design has been completed and major processing steps have been selected, the second review is undertaken. The major hazards are identified (e.g., fire, explosion, toxic release, pollution, and violent releases of energy) and preventative and protective measures are incorporated into the basic design phase. From this review enough information will be available to carry out formal risk assessments to establish whether adequate resources have been allocated to meet SHE targets.

Finally, a third review in the form of the traditional Hazard and Operability study (Hazop) is performed once the basic design has been completed. This is a thorough examination of the operability of the process in terms of dealing with deviations in operating conditions; e.g., pressure, temperature, concentration, and failures etc.

The above three reviews can be applied to the set-up in the research laboratory, the pilot plant, and the full-scale plant. Once the construction is almost complete, and before commissioning and introducing hazardous materials, a practical review is carried out to check whether all the requirements of the first, second, and third reviews have been incorporated. This may take the form of an audit.

Often, once hazards have been identified in chemical processes, various protective devices or systems are installed, which involve high costs. This can make a process uneconomical and in some cases lead to the closure of the plant with accompanying loss in revenue and jobs. In order to decide the optimum amount of money that must be spent on safety, it is necessary to assess the risk. This aspect was covered in the second half of the session.

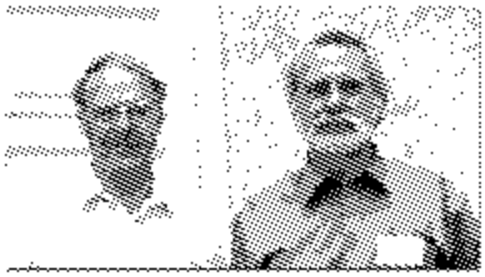
Risk is the combination of the *likelihood* of occurrence of the hazard and the *severity* of the consequences. A release of chlorine from storage may be very serious (people may be gassed, so the *severity* is high), but the tank may be so secure that a leak is almost impossible (therefore, the *likelihood* is very small) and hence the risk will be low.

Likelihood of an event may be determined by using the so-called Fault Tree technique, where the event is broken down into its root causes. One may for example not know the likelihood of a release via the relief valve on a chlorine vessel. However, this may be simply bro-

ken down into the root causes of overfilling and heating in the sun. One may know how often the operator overfills the vessel, as well as the duration of sunshine, which with the aid of the fault tree will reveal how often the relief valve may be expected to blow.

Consequence may be determined by calculation of the effect of the hazard (i.e., whether a person will suffer injuries). A chlorine release will be carried away by the wind and dispersed to lower concentrations, so that some distance away a person may suffer respiratory effects. In the case of a fire at some distance a person may suffer a certain degree of burns, or with an explosion, some blast injuries. The effects are usually related to the amount of chemical material in containment or the rate of release.

Combining *likelihood* and *severity* gives an estimate of the risk e.g. injuries per year. This is then compared to a target. If the target is exceeded, the risk is unacceptable and more money needs to be spent to make the system safer; i.e., reduce the risk. On the other hand, if the risk is below the target, no further action needs to be taken to improve the system.



Dr. Mike Booth (left) and Mr. Daniel Rademeyer

Assessing the risk allows money to be spent, which is in relation to the risk. Thus if the risk is high the cost will be high and visa versa. This will ensure that unnecessary money is not spent on a chemical plant where the risk is low.

Some lively discussion took place at the end of the presentation and generally the content of the workshop was well received and thought provoking. We can all learn from the use of these techniques, either in the research and development environment or at a full-scale plant. COCI is in the process of organizing the next workshop to take place in China in 2002.

Dr. M. D. Booth is Director of Information Resources for the Chemical & Allied Industries' Association.

Web Reviews

Spare Parts on the Web

by John Joyce

Many a time you may feel hostage to your instrument vendor for spare parts. Indeed, some vendors go out of their way to hide the generic identity of the parts used in their systems. With access to the World Wide Web, dependence on specific vendors has been greatly decreased. Whether you are attempting to locate full backup units or just a part, the web offers many resources.

Using a search engine and performing a search on "spare parts" and the vendor or instrument name will often provide you with promising leads. If you want to start with something more focused, you might want to try performing your search within a site such as ChemIndustry.com <http://www.ChemIndustry.com>. There are other sites, such as Used-line <http://www.used-line.com> and labX <http://www.labx.com> that specialize in locating spare equipment, primarily full systems, but some spare parts as well. You can also locate vendors, such as Thorn Scientific Services Ltd. <http://www.thornta.com>, that specialize in spare parts for a particular class of instruments - in this case thermal analyzers. Of most general interest are firms such as MediBix <http://www.medibix.com> that specialize in providing spare parts for laboratory equipment, be it centrifuges, ovens or spectrometers. This site can even display schematic drawings to ensure you have specified the correct part. If MediBix does not have the part in its databases, it has a technical service department, mandated to locate the part within four hours.

John Joyce <jrjoyce@briefcase.com.> is a contributing writer to Inside Laboratory Management. *Reprinted with permission from AOAC International.*

http://www.ChemIndustry.com
http://www.used-line.com
http://www.labx.com
http://www.thornta.com
http://www.medibix.com

Valid Analytical Measurement

The VAM (Valid Analytical Measurement) website has been developed by LGC under contract with the UK Department of Trade and Industry (DTI) as part of the National Measurement System. This site provides communication channels through which the UK analytical community and industry can access expert advice, information and products to help diagnose and solve measurement related problems.

Users of the site have access to a range of information and services including:

- about VAM: find out more about VAM, learn how to implement the VAM principles and find out about the technical projects being undertaken
- news and events: read the latest news, review the VAM Bulletin online and find out about forthcoming events
- advice and information: seek technical advice online, review frequently asked questions, find help on a particular topic and use the interactive guidance on buying analytical services and selecting laboratories
- publications: search the library of reports, papers, books and audio visual aids, download many reports & papers for free and buy books and other products online
- training and education: find a suitable training course or seminar and book online, get guidance on laboratory skills and competencies, obtain training and teaching resources and find the latest events for universities, colleges and schools
- communities: give your views on the bulletin boards and find out the latest from any VAM programme clubs or networks that you belong to.

http://www.vam.org.uk

Send your submissions of no more than 250 words to edit.ci@iupac.org.

Sites that are reviewed will be added to our links of interest page at http://www.iupac.org/links/index.html.

Conference Announcements

International Congress on Process Technologies

From 18-20 March 2002, the 1st International Congress on Process Technologies will be taking place at the same time as AchemAmerica in the World Trade Center in Mexico City. This event is jointly organized by AIChE (American Institute of Chemical Engineers), IMIQ (Instituto Mexicano de Ingenieros Quimicos) and DECHEMA (Society for Chemical Engineering and Biotechnology). Big names from the field of chemical engineering in Mexico and the United States and numerous lecturers from Europe have already promised their participation. Focal topics of the congress are: Novel reactors; Separation technologies; Multipurpose batch processing; Solids handling and particle technology; Bioprocess engineering; High-throughput screening; Environmental issues; Energy; Supply chain management and e-commerce.

Contact: DECHEMA e.V.
Ausstellungskongresse
Postfach 15 01 04
D-60061 Frankfurt am Main
Tel.: +49/(0)69/7564

http://www.achemamerica.de/

Advances in Emulsion Polymerization and Latex Technology

The 33rd annual one-week short course, "Advances in Emulsion Polymerization and Latex Technology," will be offered at Lehigh University during the week of 3-7 June 2002. This course is designed for engineers, chemists, other scientists and managers who are actively involved in emulson work and for those who wish to develop expertise in the area.

The course is an in-depth study of the synthesis and properties of high polymer latexes. The subject matter includes a balance of theory and applications as well as a balance between chemical and physical problems. Lectures, given by leading academic and industrial workers, begin with introductory material and review, and progress through recent research results.

Contact: Debra H. Nyby, Administrative Associate
Emulsion Polymers Institute, Lehigh University
111 Research Drive
Bethlehem, PA 18015-4732 USA
Tel.: +1 610 758 3607

http://www.lehigh.edu/~esd0/luscbroc.htm

Joint Meetings on Pharmacognosy

American Society of Pharmacognosy (ASP) members, spouses, friends and professionals interested in botanicals, folklore medicines, traditional Chinese medicines, Ayurvedic indian medicines and other herbal preparations are invided to join us for the Joint Monroe Wall Symposium and 43rd Annual meeting of the American Society of Pharmacognosy, 27-31 July 2002 at the Hyatt Regency Hote, New Brunswick New Jersey. We have arranged an interesting program featuring Nutraceuticals: Update and the Monroe Wall Symposium focusing on "Targeted Cancer Drug Discovery from natural products" with a list of exceptional symposium speakers, as well as fun filled social activities including an excursion Boat Trip around the Statue of Liberty and many optional tours.

Contact: Dr. Ramesh C. Pandey, General-Chair, or Mrs. Linda Aymes
Xechem International, Inc.
100 Jersey Avenue, B-310
New Brunswick, NJ 08901 USA
Tel.: +1 732 247 3300

http://www.phcog.org

International Symposia on Organosilicon Chemistry

The XIIIth International Symposium on Organosilicon Chemistry & 35th Organosilicon Symposium will be hosted simultaneously by the Chemistry Department of the University of Guanajuato from 25-30 August 2002.

ISOS is the premier international forum for the sharing of scientific and technological advances and research findings among practitioners of organosilicon chemistry. Major themes to be covered at the symposium include materials science, sol-gel chemistry, silicones in coatings, silicon in organic and organometallic synthesis, theoretical aspects of organosilicon compounds, silicon and applications to specific topics of industrial interest, biological aspects of organosilicon chemistry, coordination chemistry of silicon species, advances in direct process, silicon production and organosilicon precursors.

The program is not yet complete. For frequent updates, please refer to the official congress web pages.

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Tel.: +52-473-26885, ext. 8113 and 8111

http://www.int.com.mx/congreso
http://www.ugto.mx/Eventos/ISOSXIII/index.html

European Conference on Rheology

The 6th European Conference on Rheology (eurheo 2002) will be held 1-6 September 2002 in Erlangen, Germany. The conference, organised by the Institute of Polymer Materials (LSP) in collaboration with the German Society of Rheology (DRG), is held in the tradition of the International Conferences on Rheology and is intended to be a meeting place for everybody working in the different fields of rheology. We would like to invite you to discuss recent results and exchange ideas with your colleagues from different countries at University Erlangen-Nürnberg.

The conference will cover the follwoing topics:

- Molecular modelling, numerical simulations and micro-structural modelling
- Pharmaceuticals, cosmetics and food
- Colloidal and noncolloidal suspensions
- Polymer melts and solutions
- Extensional rheology
- Metallocene polymers and lnog-chain branching
- Rheology of solids and composits
- Rheometry
- Experimental studies and numerical simulations of flow instabilities
- Rheology and processing
- Foams, emulsions, and surfactants
- NonNewtonian fluid mechanics

Contact: Prof. Dr. H. Münstedt, Dr. J. Kaschta, or Dipl.-Ing. A. Merten
Department of Materials Science
Institute of Polymer Materials
Martensstr. 7
D-91058 Erlangen
E-mail: erc2002@ww.uni-erlangen.de
Fax: +49 9131 8528321

http://www.lsp.uni-erlangen.de/eurheo2002/

Discussion Meeting on Thermodynamics of Alloys

This conference, 8-13 September 2002 in Rome, Italy is the last of a series and will be hosted by the University of Roma "La Sapienza." Its scope is to survey recent advances, undertake stimulating discussions and indicate future directions in the area of the thermodynamics of alloys. The meeting will focus on the following topics:

- experimental and theoretical thermodynamics
- phase diagrams
- thermodynamic aspect of reactivity of metallic systems (hydrogen absorptio, oxidation)
- modelling and databases
- thermochemistry of metallurgical processes
- metallic clusters and nanoparticles
- surface and interfacial phenomena

Contact: Prof. G. Balducci, Prof. D. Gozzi
Dipartimento di Chimica, Università di Roma "La Sapienza", P. le A. Moro, 5-00185 Roma, Italy
Tel.: +39 06 4991 3943

http://j.uniromal.it/tofa2002

The 3rd World Congress on Emulsion

In the field of emulsions there is a strong partnership between university and industrial research. The 3rd World Congress on Emulsion, to be held 24-27 September 2002 in Lyons, France, will once again showcase this partnership.

The World Congresses on Emulsions have known an international success, bringing together in Paris in 1993 and in Bordeaux in 1997 more than 1000 participants from over 60 countries and 250 papers selected and published.

The authors of these papers are representing very different backgrounds: the food industry, phytochemical products, plastics, road surfacing, pharmacy, cosmetics, photography, inks, paints, detergents, as well as universityresearchers.

As international forums, these congresses are designed to advance exchanges between researchers, scientists and the engineers from all the different industries around the common theme of emulsion, and to encourage the transfer of technologies and fundamental knowledge in this field.

An innovative undertaking indeed, as it is somewhat unusual to see such diverse professions - cosmetics or bitumenspecialists to cite but these two - focusing on the same centre of scientific interest. As a matter of fact, science progressed a great deal during these past years, and the interaction between the populations of university researchers and those of industrial engineers of research and development became more and more important, moreparticularly due to the sophisticated nature of commercial products.

As in 1993 and in 1997, an exhibition will be organised during the third congress. This exhibition, as well as the poster area will offer the opportunity for the dif-

ferent industries to meet and to demonstrate their most recent developments.

Contact: Congrès Mondial de l'Emulsion
50 Place Marcel Pagnol
92100 Boulogne-Billancourt, France
Tel.: +33 1 47 61 76 89

http://cme-emulsion.com/

World Space Congress 2002

The Second World Space Congress will be a joint meeting between the Committee on Space Research (COSPAR) and the organizations which meet during the International Astronautical Congress: the International Astronautical Federation (IAF), the International Academy of Astronautics (IAA), and the International Institute of Space Law (IISL).

The congress will take place 10-19 October 2002 in Houston, Texas, USA. For those wishing to participate, the COSPAR abstract deadline is 1 May 2002 The deadline for abstracts submitted to the IAC is 1 February 2002.

Approximately 80 events covering the fields of COSPAR scientific commissions and panels will cover a number of topics, including: the Earth's Surface, Meteorology and Climate; the Earth-Moon System, Planets, and Small Bodies of the Solar System; Space Plasmas in the Solar System; Research in Astrophysics from Space; and Life Sciences as Related to Space.

Contact: COSPAR Secretariat
51 bd de Montmorency
75016 Paris, France
Tel.: +33 1 45 25 06 79

http://www.copernicus.org/COSPAR/COSPAR.html
http://www.cosparhq.org
http://www.iafastro.com

Conference Calendar

Visit http://www.iupac.org for complete information and further links

2002

Carotenoids
6–11 January 2002
13th International Symposium on Carotenoids, Honolulu, Hawaii, USA.
Dr. John S. Bertram, Cancer Research Center, University of Hawaii, 1236 Lauhala Street, Honolulu, Hawaii 96813, USA
Tel.: +1 808 586 2757
Fax: +1 808 586 2970
E-mail: John@crch.hawaii.edu

Polymer Characterization
7–11 January 2002
10th International Conference on Polymer Characterization, Denton, Texas, USA.
Dr. Witold Brostow, Department of Materials Science, University of North Texas, Denton, Texas, 76203-5310 USA
Tel.: +1 940 565 4358, -3262, 4337
Fax: +1 940 565 4824
E-mail: brostow@unt.edu or polychar@marta.phys.unt.edu

Bioinformatics
6–8 February 2002
International Conference on Bioinformatics 2002: North–South Networking, Bangkok, Thailand.
Dr. Prasit Palittapongarnpim, BIOTEC, 15th Fl, Gypsum Metropolitan Tower, 539/2 Sri-Ayudhya Road, Ratchadevi, Bangkok, Thailand
Tel.: +66 2 642532231, ext 228
Fax: +66 2 488304
E-mail: incob@biotec.or.th

Heterocycles
6–8 March 2002
3rd Florida Heterocyclic Conference, Gainesville, Florida, USA.
Prof. Alan R. Katritzky, Department of Chemistry, University of Florida, P.O. Box 11720, Gainesville, Florida 32611, USA
Tel.: +1 352 392 0554
Fax: +1 352 392 9199
E-mail: katritzky@chem.ufl.edu

Macromolecules
25–29 March 2002
5th Annual UNESCO School and South African IUPAC Conference on Macromolecules and Materials Science, Stellenbosch, South Africa.
Prof. R. D. Sanderson, UNESCO Associated Centre for Macromolecules and Materials, Institute for Polymer Science, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa
Tel.: +27 21 808 3172
Fax: +27 21 808 4967
E-mail: rds@maties.sun.ac.za

p-Electron Systems
30 May–4 June 2002
5th International Symposium on Functional **p**–Electron Systems (Fπ5), Ulm/Neu-Ulm, Germany
Prof. Dr. Peter Bäuerle, Abteilung Organische Chemie II, Universität Ulm, Albert-Einstein-Allee 11, 89081 Ulm, Germany
Tel.: +49 731 502 2850
Fax: +49 731 502 2840
E-mail: peter.baeuerle@chemie.uni-ulm.de

Polymer Systems
3–7 June 2002
4th International Symposium on Molecular Order and Mobility in Polymer Systems, St. Petersburg, Russia
Prof. T. M. Birshtein, Institute of Macromolecular Compounds, Russian Academy of Sciences, Bolshoi pr. 31, St. Petersburg 199004, Russia
Tel.: +7 812 328 85 42
Fax: +7 812 328 68 69
E-mail: birshtein@imc.macro.ru

Nuclear Analytical Methods
16–21 June 2002
7th International Conference on Nuclear Analytical Methods in the Life Sciences, Antalya, Turkey.
Prof. Namik K. Aras, Bahcesehir University, 34900 Istanbul, Turkey
Tel.: +90 212 669 6523
Fax: +90 212 669 4398

Macromolecules
7–12 July 2002
39th International Symposium on Macromolecules—IUPAC World Polymer Congress 2002, Beijing, China
Prof. Fosong Wang, The Chinese Academy of Sciences, Beijing 100864, China
Tel: +86 10 62563060
Fax: +86 10 62573911
E-mail: fswang@mimi.cnc.ac.cn

Solid-State Chemistry
7–12 July 2002
5th Conference on Solid-State Chemistry, Bratislava, Slovakia.
Prof. P. Sajgalik, Slovak Academy of Sciences, Dubravska c. Bratislava, SK-842 36 Slovakia
Tel.: +421 7 59410400
Fax: +421 7 59410444
E-mail: ssc2002@savba.sk

Organometallic Chemistry
7–12 July 2002
20th International Conference on Organometallic Chemistry, Corfu, Greece.
Dr. Constantinos G. Screttas, National Hellenic Research Foundation, Institute of Organic and Pharmaceutical Chemistry, 48 Vas. Constantinou Avenue, 11635 Athens, Greece
Tel.: +30 1 7273876
Fax: +30 1 7273877
E-mail: kskretas@eie.gr

Carbohydrates
7–12 July 2002
XXIst International Carbohydrate Symposium, Cairns, Queensland, Australia.
Prof. R. V. Stick, University of Western Australia, Department of Chemistry, Nedlands, 6007, Western Australia
Tel.: +61 8 9380 3200
Fax: +61 8 9380 1005
E-mail: rvs@chem.uwa.edu.au

Polymers and Organic Chemistry
14–18 July 2002
Polymers and Organic Chemistry 2002, San Diego, California, USA.
Prof. Spiro Alexandratos, Office of Academic Affairs, City Univer-sity of New York, 535 East 80th St., New York, New York 10021, USA
Tel: +7 095 135 6166 or +7 095 135 7405
Fax: +7 095 135 5085

Organic Synthesis
14–19 July 2002
14th International Conference on Organic Synthesis, Christchurch, New Zealand.
Prof. Margaret A. Brimble, Department of Chemistry, University of Auckland, 23 Symonds St., Auckland, New Zealand
Tel.: +64 9 373 7599, Ext. 8259
Fax: +64 9 373 7422
E-mail: m.brimble@auckland.ac.nz

Photochemistry
14–19 July 2002
XIXth IUPAC Symposium on Photochemistry, Budapest, Hungary.
Prof. H. D. Roth, Rutgers Univer-sity, Department of Chemistry and Chemical Biology, 610 Taylor Road, New Brunswick, NJ 08854-8087 USA
Tel.: +1 732 445 5664
Fax: +1 732 445 5312
E-mail: roth@rutchem.rutgers.edu

Electrical Properties of Polymers
15–18 July 2002
21st Discussion Conference and 9th International ERPOS Confer-ence on Electrical and Related Properties of Polymers and Other Organic Solids, Prague, Czech Republic.
Prof. Dr. Drahomir Vyprachticky, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic,
Heyrovského nám. 2, 162 06 Praha 6, Czech Republic
Tel.: +420 2 20403251 or +420 2 20403332
Fax: +420 2 35357981
E-mail: vyprach@imc.cas.cz or sympo@imc.cas.cz

Visas
It is a condition of sponsorship that organizers of meetings under the auspices of IUPAC, in considering the locations of such meetings, should take all possible steps to ensure the free-dom of all bona fide chemists from throughout the world to attend irrespective of race, religion, or political philosophy. IUPAC sponsorship implies that entry visas will be granted to all bona fide chemists provided applica-tion is made not less than three months in advance. If a visa is not granted one month before the meeting, the IUPAC Secretariat should be notified without delay by the applicant.

Solubility Phenomena
22–26 July 2002
International Symposium on Solubility Phenomena (10th ISSP), Varna, Bulgaria.
Prof. Christo Balarew, Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, BG-Sofia 1040, Bulgaria
Tel.: +359 (2) 9793925
Fax: +359 (2) 705 024
E-mail: balarew@svr.igic.bas.bg

Chemical Thermodynamics
28 July–2 August 2002
17 th IUPAC Conference on Chemical Thermodynamics, Rostock, Germany.
Prof. A. Heintz, FB Chemie, Universitat Rostock, Hermannstr. 14, D-18051 Rostock, Germany
Tel.:+49 381 498 1852
Fax: +49 381 498 1854
E-mail: andreas.heintz@chemie.uni-rostock.de

Natural Products
28 July–2 August 2002
23rd International Symposium on the Chemistry of Natural Products, Florence, Italy.

Prof. B. Botta, Dip. Studi Chimica e Tecnologia Sostanze, Biologicamenta Attive, University "La Sapienza", P.le A. Moro 5, 00185 Roma, Italy
Tel.: +39 06 49912781 or +39 06 49912783
Fax: +39 06 49912780
E-mail: bruno.botta@uniroma1.it

Boron Chemistry
28 July–2 August 2002
XI th International Meeting on Boron Chemistry (IMEBORON XI), Moscow, Russia.
Prof. Yu. N. Bubnov, A. N. Nesmeyanov Institute of Organoelement Compounds of the Russian Academy of Sciences, Vavilov str. 28, Moscow V-334, GSP1, 119991 Russian Federa-tion
Tel.: +7 095 135 6166 or +7 095 135 7405
Fax: +7 095 135 5085
E-mail: imeboron@ineos.ac.ru

Crop Protection
4–9 August 2002
10 th IUPAC International Congress on the Chemistry of Crop Protection (formerly International Congress of Pesticide Chemistry), Basel, Switzerland.
Dr. Bernard Donzel, c/o Novartis CP AG, WRO-1060.3.06, CH-4002 Basel, Switzerland
Tel.: +41 61 697 22 67
Fax : +41 61 697 74 72
E-mail: bernard.donzel@cp.novar-tis.com

Physical Organic Chemistry
4–9 August 2002
16th International Conference on Physical Organic Chemistry: Structure and Mechanism in Organic Chemistry, San Diego, California, USA.
Prof. Charles L. Perrin, Depart-ment of Chemistry, University of California at San Diego, La Jolla, California 92093-0358, USA
Tel.: +1 858 534 2164
Fax: +1 858 822 0386
E-mail: icpoc@ucsd.edu

Chemical Education
6–10 August 2002
17th International Conference on Chemical Education—New Strategies for Chemical Education in the New Century, Beijing, China.
Prof. Xibai QIU, 17 th ICCE c/o Chinese Chemical Society, P.O. Box 2709 Beijing 100080, China
Tel.: +86 10 62568157, 86 10 62564020
Fax: +86 10 62568157
E-mail: qiuxb@infoc3.icas.ac.cn

Bioorganic Chemistry
11–14 August 2002
6th International Symposium on Bioorganic Chemistry (ISBOC-6), Toronto, Canada.
Dr. Ronald Kluger, Department of Chemistry, University of Toronto, Toronto,Canada M5S 3H6
Tel.: +1 416 978 3582
Fax.: +1 416 978 3482
E-mail: rkluger@chem.utoronto.ca

Polymer Networks 2002
2–6 September 2002
Polymer Networks 2002, Autrans, France.
Prof. E. Geissler, Université J. Fourier de Grenoble, Laboratoire de Spectrométrie Physique, B.P. 87, F-38402 St Martin d'Heres cedex, France
Tel: +33 476 635823
Fax: +33 476 514544
E-mail: erik.geissler@ujfgrenoble.fr

Physical Chemistry of Liquids
6–15 September 2002
European Molecular Liquids Group (EMLG) Annual Meeting on the Physical Chemistry of Liquids. Novel Approaches to the Structure and Dynamics of Liquids: Experiments, Theories, and Simulations, Rhodes, Greece
Prof. Dr. Jannis Samios
Tel.: +30 1 7274534 or +30 1 7274751
Fax: +30 1 7274752
E-mail: isamios@cc.uoa.gr

Polymer Science and Technology
2–5 December 2002
IUPAC Polymer Conference on the Mission and Challenges of Polymer Science and Technology, Kyoto, Japan.
Prof. Seiichi Nakahama, Faculty of Engineering, Tokyo Institute of Technology, 2-12-1 Ohokayama, Meguro-ku, Tokyo 152-8552, Japan
Tel.: +81 3 5734 2138
Fax.: +81 3 5734 2887
E-mail: snakaham@polymer.titech.ac.jp

2003

High-Temperature Materials
19–23 May 2003
11th International Conference on High Temperature Materials Chemistry, Tokyo, Japan.
Prof. Michio Yamawaki, Univer-sity of Tokyo, Department of Quantum Engineering and Systems Science, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan
Tel.: +81 3 5841 7422
Fax: +81 3 5841 8633
E-mail: yamawaki@q.t.u-tokyo.ac.jp

IUPAC 42nd General Assembly
8-17 August 2003
Ottawa, Canada.
IUPAC Secretariat
Tel.: +1 919 485 8700
Fax: +1 919 485 8706
E-mail: secretariat@iupac.org

39th IUPAC Congress
10–15 August 2003
39th IUPAC Congress and 86th Conference of The Canadian Society for Chemistry: Chemistry at the Interfaces, Ottawa, Ontario, Canada.
National Research Council Canada (NRC), Conference Services Office, Building M-19, Montreal Road, Ottawa, Ontario, Canada K1A 0R6
Tel.: +1 613 993 0414
Fax: +1 613 993 7250
E-mail: iupac2003@nrc.ca

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