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From the Editor

I am not sure why, but while proofing this issue, I got stuck on the words "function" and "functional."

Read first the echoes of the 7th International Symposium on Biomolecular Chemistry (p. 31), where George Whitesides spoke of the need to understand the fundamental nature of the cell as a system of chemical reactions, and the shift in emphasis in biology from structure to function. The word "function" is not only a keyword in biology, but in chemistry as well. Nowadays, chemists not only design new molecular architectures, they also manage to understand their properties and optimize their functions. As chemists move from studying structure/property relationships to analyzing structure/property/function, it becomes obvious that chemistry will form the foundation for growth in other sciences and technology. The recent MAM-04 and Fπ6 (p. 30) exemplified how progress in chemistry is leading to countless new technologies.

One can also view the idea of function in another context: the growing emphasis on "chemistry at the interfaces." Functional properties have a prominent place in the interdisciplinary aspects of molecular science as reported in a recent double issue of the IUPAC journal *Pure and Applied Chemistry* that is devoted to a selection of papers presented at the 39th IUPAC Congress and 86th Conference (see p. 26). In the three symposia combined for this publication, the emphasis on "function" is in each case particular, but obvious.

Perhaps the best example of the "functional" aspect of chemistry is in a feature story by Josh McIlvain, who reports on the Chemical Heritage Foundation's recent exhibit "Her Lab in Your Life: Women in Chemistry" (see p. 8). The story and the exhibit itself feature a prescient quote from Ellen H. Richards, who in 1879 wrote: "We must show to the girls who are studying science in our schools that it has a very close relation to our everyday life." While expressed in different words, the functional aspects of science were as important then as they are today.

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Cover: Display of the exhibit "Her Lab in Your Life" at the recent meeting of the American Chemical Society in Philadelphia, PA, 22–26 August 2004. Courtesy of Josh McIlvain of the Chemical Heritage Foundation.

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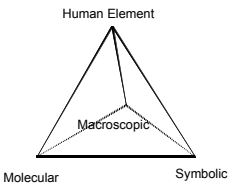

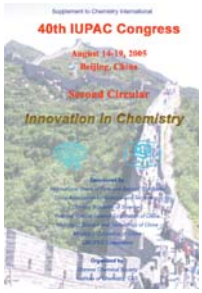

Enclosed with this issue is the second circular for the 40th IUPAC Congress in Beijing.

President's Column

Chemists in a Vulnerable World

by Leiv K. Sydnes

In a recent issue of *Angewandte Chemie* there was an essay by Professor Carl Djerassi, entitled "Chemical Safety in a Vulnerable World—A Manifesto."[1] In this article, Djerassi argues that the "absence of adequate knowledge in many less-developed countries of the extent and nature of their exposure to dangerous chemicals is their greatest vulnerability." In order to overcome this deleterious situation, he calls for the formation of a steering committee to encourage and facilitate North/South interaction on new approaches to chemical safety. Based on his positive experiences with ICIPE (International Center for Insect Physiology and Ecology) in Nairobi in the 1960s, and the USA-Brazil chemistry program of the late 1960s and early 1970s, Djerassi then proposes that a group of chemical societies in developed countries ("the haves") should take on this task in partnership with the chemical communities in less-developed countries ("the have nots").

I find the proposals and ideas outlined by Djerassi certainly commendable and absolutely worthy of the support of the chemical community. However, for several reasons I was surprised that he did not mention a single word about IUPAC. First and foremost, IUPAC has been addressing challenging issues similar to those mentioned in the article. In addition, it is important to acknowledge that IUPAC already has the committee structure Djerassi proposes for collaborative projects. And finally, it is noteworthy that all the chemical societies mentioned specifically in his article have been and are still actively involved in a variety of IUPAC activities.

In essence, IUPAC is based on the partnership between volunteers that forms the basis for Djerassi's proposals. Since IUPAC was founded in 1919 this partnership spirit and the voluntary work performed by thousands of chemists around the world have enabled the Union to make recommendations on chemical nomenclature and terminology, provide and critically evaluate chemical data, set standards for chemical analyses, and promote global cooperation between chemists and with other international organizations. The results of many of these activities have been published in *Pure and Applied Chemistry*, IUPAC's own journal. In addition, IUPAC has supported national and regional workshops and meetings to disseminate knowledge and skills related to specific problems and challenges in troubled countries and regions. These activities are not glamorous and do not usually generate news headlines, but standardization of chemical measurements, terminology, nomenclature, and analytical methods are of crucial importance to commerce and society also in the "have-not" countries.

Several of the projects in the current IUPAC portfolio are of the type Djerassi proposes in his essay (i.e., projects specifically connected to problems in developing countries). Let me illustrate the IUPAC approach to problem solving by describing briefly what is being done with the problem of arsenic contamination of the ground water in Bangladesh,[2] one of the important issues mentioned in the article.

Last year, a task group of volunteers, chaired by Drs. Satinder Ahuja and John M. Malin,[3] was appointed. Based on ideas generated by interaction with chemists and chemical engineers from around the world and by working actively with local chemists and authorities, potential solutions for this serious problem are being considered. Extensive discussions, involving a number of national and foreign volunteers, were held in Dhaka early this year, and a progress report was presented at and discussed during the CHEMRAWN XV conference "Chemistry for Water" held in Paris in June.[4] The issue will be further developed and scrutinized by the task group, and a regional workshop with input from all parties involved will be held in Bangladesh next year. The purpose of this conference is

1) to promote collaboration between "researchers [..] from the 'industrial superpowers'"[1] and "local counterparts in the host country,"[1] who are actively addressing the problem, and
2) to evaluate how local government agencies can assist in implementation of the solutions proposed.

Another project—based almost completely on voluntary work and performed in cooperation with the International Organization for Chemical Sciences in Development (IOCD)[5]—addresses the "Standardization of Analytical Approaches and Analytical Capacity-Building in Africa." The project, chaired by Dr. Walter R. Benson, aims "to upgrade selected laboratories in Africa, thereby enabling them to produce reliable and internationally accepted analytical results

for farmers and enterprises in the private sector that seek to export commodities to markets in the USA, EU, and Japan, where compliance with international standards is required."[6] In order to reach this goal the following working strategy has been adopted: make teams of experienced chemists and local staff members, facilitate interaction, and organize working sessions with practical work both within and outside Africa. As pointed out by Djerassi, close cooperation with instrumental people in the African countries is required for success. This aspect of the project is therefore taken very seriously.

Space does not allow me to present other examples involving IUPAC projects in developing countries, such as those addressing contamination from mining in some African countries, improvement of chemistry education in many countries around the world, management of biodiversity in several Asian countries, or development of sustainable agriculture in Sub-Saharan Africa. However, the IUPAC experience is the same: successful volunteer work requires an attitude of mutual respect, willingness to work persistently, and strong coordination with the people in charge. Careful selection of the task group is therefore a crucial part of the planning of IUPAC projects, and that is not easy if the volunteers of the right calibre are not available. I therefore appreciate very much that Professor Djerassi so wholeheartedly urges Ph.D. students or postdoctoral researchers (or even advanced graduate students) from the industrial superpowers to go out and work in collaboration with their younger local counterparts in developing countries.[1]

More involvement by young chemists in voluntary work is definitely needed, and involvement in an IUPAC project may be a place to start. Welcome as an IUPAC volunteer! IUPAC involvement and effort not only provides personal satisfaction, but also contributes significantly to the application of chemistry in the service of Mankind.

References

1 Carl Djerassi, *Angew. Chem. Int. Ed.* 2004, **43**, 2330–2332; reprinted in *Chemistry International* 2004, **26** (5), 12–14.

2 The problem has been described in an article by Rebecca L. Rawls in *Chem. & Eng. News* 2002, **80**, 42–45.

3 A description of the project and information about the task group members are available through the IUPAC Web site at www.iupac.org/projects/2003/2003-050-1-021.html.

4 Mike Freemantle, *Chem. & Eng. News* 2004, **80**, 42–45; Alan Smith, *Chemistry International* 2004, **26** (5), 26–28.

5 IOCD was established in 1981 after an initiative of Professor Pierre Crabbé. The organization and its activities are described in J.-M. Lehn, E.R. Blout and R.H. Maybury, *Chemistry International* 2002, **24** (3), 3-5.

6 A description of the project and information about the task group members are available on the IUPAC Web site at www.iupac.org/projects/2004/2004-017-1-500.html.

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An Overview of the International Council for Science

by Carthage Smith and Thomas Rosswall

Founded in 1931, the International Council for Science (ICSU) is a nongovernmental organization representing a global membership that includes both national scientific bodies (101 members) and international scientific unions (27 members). Chemistry has played an important role in ICSU from the outset, with IUPAC being one of its original members.

Through its international network, ICSU coordinates interdisciplinary research to address major issues of relevance to both science and society. In addition, the Council actively advocates for freedom in the conduct of science, promotes equitable access to scientific data and information, and facilitates science education and capacity building.

The Council acts as a forum for the exchange of ideas, the communication of scientific information, and the development of scientific standards. ICSU's members organize scientific conferences, congresses, and symposia all around the world—in excess of 600 per year—and also produce a wide range of newsletters, handbooks, learned journals, and proceedings.

ICSU Officers (L to R). Front: Roger Elliott (Treasurer, UK), Ana Maria Cetto (Secretary General, Mexico), Jane Lubchenco (President, USA), Hiroyuki Yoshikawa (Past-President, Japan). Back: David Parry (Vice-President, New Zealand), Goverdhan Mehta (President-Elect, India), Peter Tyson (Vice-President, South Africa).

ICSU also helps create international and regional networks of scientists with similar interests and maintains close working relationships with a number of intergovernmental and non-governmental organizations, including UNESCO and the Third World Academy of Sciences (TWAS). Because of its broad membership, ICSU is frequently called upon to speak on behalf of the global scientific community and provide advice on matters ranging from ethics to the environment.

A Brief History

One of the oldest non-governmental organizations in the world, the Council is the result of the evolution and expansion of two earlier bodies known as the International Association for Academies (IAA) and the International Research Council (IRC). Reflecting the growing importance of scientific collaboration across national boundaries, the IAA was established in 1899 with 10 members (nine European nations and the USA). Around the same time, a number of scientific disciplines also created international associations. Some 20 years later (1919), as the need for interdisciplinary research to address the links between science and society became more evident, these bodies joined forces to create the IRC. IUPAC became a member of IRC in 1922.

In 1931, IRC members unanimously approved a proposal to reorganize the Council into a much larger organization composed of 40 national scientific bodies and 8 international scientific unions. Members wanted to highlight the principle that all parties were equal partners, and thus chose to call themselves the International Council for Scientific Unions.

ICSU continued to grow and evolve, adding many new members in both categories. The membership currently comprises 101 national bodies and 27 scientific unions. Over the years, ICSU began to address specific global issues through the creation of interdisciplinary bodies and developed partnerships with other organizations. In 1998, members agreed that the Council's current composition and activities would be better reflected by modifying the name to the International Council for Science, while retaining the existing acronym.

Developing a Science Strategy

At the beginning of the 21st century, ICSU remains unique in its international and multidisciplinary membership. However, the growth of international science

initiatives has made it clear that the Council must identify its own niche and focus on areas where its efforts will have the greatest impact. To this end, a new standing Committee on Scientific Planning and Review (CSPR) was established in 1998. CSPR and the Executive Board have initiated a number of activities to help define future needs and strategic priorities.

ICSU's Mission

In order to strengthen international science for the benefit of society, ICSU mobilizes the knowledge and resources of the international science community to:

- identify and address major issues of importance to science and society
- facilitate interaction among scientists across all disciplines and from all countries
- promote the participation of all scientists-regardless of race, citizenship, language, political stance, or gender-in the international scientific endeavor
- provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector

Identifying Emerging Issues

ICSU is seeking to identify areas in which scientific developments could have significant impacts on technology, the economy, and society. In 2002, the Council published a meta-analysis of national and regional foresight studies, which had been commissioned by Science and Technology Policy Research (SPRU) at the University of Sussex. The SPRU Report,[1] provided the basis for a consultation in 2003 with all ICSU members on potential future priorities for science and society at the international level. This has led to the identification of 10 broad themes; some are already being partially addressed by ICSU, others are completely new.

Assessments of Specific Areas of Science

One of the biggest challenges facing any organization with a long history is determining whether its structure and operations meet the demands of the day. Over the years, ICSU has established a range of interdisciplinary bodies and policy/advisory committees that address international science issues. But one of the Council's weaknesses has been failing to fully analyze how these groups evolve over time and to properly assess distinctions, complementarities, and areas of overlap in light of new needs and priorities.

Under the aegis of CSPR, ad hoc expert panels have been established to assess three broad areas: environment and its relation to sustainable development, data and information, and capacity building. The report on the first of these areas[2] was published earlier this year and includes recommendations on the status of existing ICSU bodies as well as proposals for new interdisciplinary programs. The other two assessment reports will be published in late 2004 and early in 2005.

The Universality of Science and the Interface with Society

One of the founding principles of ICSU, which is embedded in its statutes, is the "Universality of Science." The essential elements of this principle are non-discrimination and equity. In the past, particularly during the Cold War, ICSU's Standing Committee on Freedom in the Conduct of Science enabled many grateful scientists to obtain visas to attend international meetings. Visa problems remain a major obstacle in some countries and for some nationalities. The changing international political climate and concerns about security have made it more difficult for scientists to travel freely and created new threats to universality and to the free exchange of data, information, and materials.

The future role and responsibilities of ICSU with regard to universality is one area of focus for the ongoing strategic review: "Science and Society: Rights and Responsibilities." The other major area is the interface between science and society, including topics of pressing concern to all of science such as ethics, public communication, risk, and uncertainty. This important review, which will include recommendations for new ICSU activities, will be published early in 2005.

Enhancing the ICSU Grants Program

The ICSU Grants Programme, which is co-funded by UNESCO, seeks to support international and interdisciplinary issues that, because of their complex nature, are difficult to address through national or disciplinary

1 *Identification of Emerging Issues in Science and Society: An International Perspective on National Foresight Studies*. ICSU. 2002. ISBN 0-930357-54-X.

2 *Environment and its Relation to Sustainable Development*; report of the CSR Assessment Panel. ICSU. 2004 ISBN 0-930357-59-0.
Both reports are available online at <www.icsu.org>.

channels. The program promotes forward-looking projects and, in many instances, awards are granted for areas of investigation that are not yet on the agenda of governments or other organizations. Although the overall budget is relatively small (USD 850000 for 2004), ICSU support often helps recipients attract additional funding from other sources. A minimum of three cooperating ICSU member organizations is required on any single grant project.

Over the past three years, ICSU has taken steps to improve the program by initiating a competitive peer-review process and identifying five broad priority areas: emerging science and technology, science and technology for sustainable development, capacity building and science education, dissemination of information on science and technology, and the science/policy interface.

Regional Offices will Strengthen Global and Local Science

One of the major challenges for ICSU is to truly incorporate the needs and priorities of developing countries into its strategic planning and other activities. At the 27th General Assembly (Rio de Janeiro, September 2002), national and union members adopted a recommendation that ICSU establish four regional offices for developing countries, to be located in Africa, the Arab Region, Asia, and Latin America and the Caribbean. The goal of this fundamental change in the ICSU structure is twofold. First, it should enhance participation of developing country scientists and regional scientific organizations in ICSU programs and activities. Second, it will allow ICSU to play a more active role in strengthening science within the context of regional priorities and building capacity.

Things have moved rapidly since the General Assembly in 2002 and, after extensive regional consultations, ICSU has signed an agreement with the National Research Foundation in South Africa to host the first ICSU regional office. Negotiations are being concluded with the Mexican Academy of Sciences to host the second office and discussions are underway with potential hosts in the other regions.

One of the most important aims of this decentralization is to improve interaction among members of the ICSU family within a specific geographic area. In this way, ICSU hopes to both strengthen regional scientific networks and help strengthen the presence of scienists from developing countries in the international arena.

Priority Themes 2003–04

Following a broad consultation with all ICSU members in 2003, 10 broad themes were identified for potential action by ICSU. For more details see "A Foresight Analysis of Priorities for Future ICSU Action" at <www.icsu.org>.

1. nanotechnology
2. molecular biosciences
3. natural and man-made hazards
4. complex systems science
5. cognitive neurosciences
6. global change and earth system science
7. sustainable development
   - i. water
   - ii. energy
   - iii. health
   - iv. agriculture, food, and nutrition
   - v. biodiversity
8. data, information, and the digital divide
9. capacity building and investment in basic science
10. science, society, and ethics

Using Science to Help Shape the Future

In recent years, ICSU has taken a much more proactive role in major international initiatives that are not exclusively focused on science, but where science has an important contribution to make. With increased emphasis on the links between science and society, the Council recognizes the need to strengthen its existing partnerships and expand its network to include links with social and medical sciences and engineering, as well as relevant players in the non-scientific community: government agencies, business and industry, and civil society.

Sustainable Development

At the request of the United Nations, ICSU collaborated with the World Federation of Engineering Organizations, TWAS, the Inter Academy Panel on International Issues, and the International Social Science Council to organize the global science and technology community's contributions to the World Summit on Sustainable Development, held August 2002 in Johannesburg, South Africa. Subsequently,

this partnership provided input to the U.N. Commission on Sustainable Development, which is an annual forum with political leaders and other key stakeholders. During the 2004-2005, the commission will work on issues of freshwater, sanitation, and human settlements—all topics in which science has a critical role to play.

ICSU Affiliates

National Members (101)
ICSU's national members provide input, from a national, multi-disciplinary perspective, on priority areas for future ICSU activities. They also play an important role in facilitating links with national governments and science agencies. The majority of ICSU national members are scientific academies, although some are national funding agencies or other nationally representative science bodies.

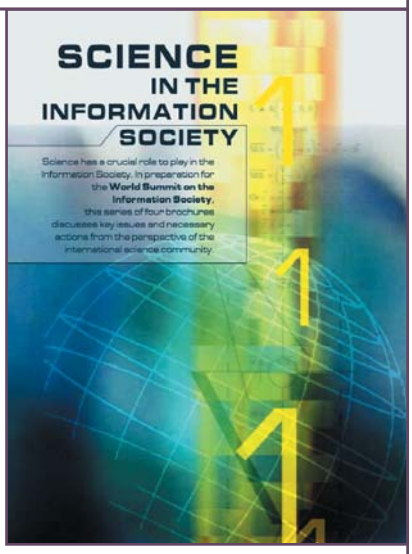
Scientific Union Members (27)
ICSU relies on its union members to provide scientific expertise and input, from an international, disciplinary perspective, on scientific priority areas for future ICSU activities. They play a crucial role as representatives of the scientific community.

Scientific Associates (23)
Whether international or regional scientific organizations, ICSU's scientific associates bring their own particular perspectives to relevant ICSU discussions and activities. For example, the Third World Academy of Sciences is a key partner in defining ICSU's strategy for developing countries.

The Information Society

The first ever U.N. World Summit on the Information Society (WSIS) is taking place in two phases (Geneva, 2003 and Tunis, 2005). It is a unique opportunity to address some of the critical issues that underpin the "digital divide" and are currently preventing universal access to scientific data and information.

In March 2003, ICSU and its Committee on Data for Science and Technology (CODATA) organized an international meeting of scientists that was hosted by UNESCO in Paris. The outcome was an agenda for action, "Science in the Information Society," which has subsequently been formally endorsed by many ICSU member organizations. Working in partnership with other international science organizations, principally CERN and TWAS, this agenda was highlighted and further developed in a series of WSIS preparatory meetings and at key events at the Geneva Summit. It was incorporated, almost in its entirety, into the formal documents that were eventually agreed upon by heads of state in Geneva.



This ICSU publication, **Science in the Information Society***, was incorporated into the formal documents that were agreed upon by heads of state at the 2003 U.N. World Summit on the Information Society in Geneva.*

In Preparation for the 28th General Assembly

China will host the next General Assembly at Suzhou in October 2005. This will mark an important milestone in ICSU's evolution, as the overall strategy for 2006–2012 will be unveiled. In addition to the activities highlighted above, there are number of other exciting developments in the pipeline that will be incorporated into this future roadmap. For example, planning is actively underway for a major new multi-disciplinary research program, the International Polar Year 2007–2008; a working group on energy and sustainable societies is preparing its recommendations; and, another ad hoc group is considering basic sciences.

ICSU is going through an intense period of growth and change. It will continue to focus on what makes it unique: the ability to bring together scientists from different countries and disciplines to address scientific issues for which an international, interdisciplinary approach is essential. The General Assembly in Suzhou will be an opportunity for all the ICSU members to reaffirm their own commitment to working together to strengthen international science for the benefit of society.

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www.icsu.org

Women in Chemistry

Her Lab in Your Life: Women in Chemistry is a new exhibition that takes a fresh look at everyday life, revealing how chemical science and engineering help shape it. Designed by the Chemical Heritage Foundation (CHF)—a U.S.-based foundation—this exhibition showcases women chemists who have helped create our modern world and their historic contributions to science and technology. From the action of atoms to the substance of stars, these women have given us new visions of the material world and our place in it. The exhibition—traveling or online—was created especially for high school and college students but designed to engage general audiences.

*Her Lab in Your Life**

by Josh McIlvain

CHF's newest traveling exhibit, *Her Lab in Your Life: Women in Chemistry*, focuses on the rich history of women chemists by highlighting some of their accomplishments from the Renaissance to the present. The exhibit's purpose is to interest teenage women in the history of women chemists so that they will view a career in chemistry as a possibility.

We must show to the girls who are studying science in our schools that it has a very close relation to our everyday life.—Ellen H. Richards (1879)

Why was this audience chosen? The words of Stephanie Burns (president and chief operating officer of Dow Corning) in *Chemical and Engineering News* answer that question: "We know that young girls are interested in science during their early years in school, but by the time they get into high school, they lose interest. We have to put more emphasis into making science fun at the high-school level." Thanks to the generous support of the Hach Scientific Foundation, *Her Lab in Your Life* was created to meet this challenge.

The central message of *Her Lab in Your Life* is that women's important contributions to chemistry have helped create the world we live in today. To promote this message, the exhibit team concentrated on three related themes: women chemists have improved our understanding of the physical world, they have helped shape the material circumstances and popular culture of our everyday lives, and they have broken new ground in the chemical professions and served as role models for young women.

Choosing the Women and Their Story

Faced with the difficult task of choosing which important and interesting women chemists to include, the exhibit team eventually selected 68 and created research files for each one. Such a large number is clear proof that the achievements of women chemists are not isolated blips on a professional map. Many who did not make it into the panel of the traveling exhibit have been included on the exhibit's companion Web site.

Some of the women highlighted in *Her Lab in Your Life* are still alive and active chemists. Also included are some famous women in the history of chemistry, such as Marie Curie, Dorothy Crowfoot Hodgkin, and Ellen Richards; their inclusion helps "ground" the rest of the experience, for theirs are among the few names visitors will likely recognize. The exhibit discusses many professions, representing the prominence of women chemists in several chemical fields and show-

*This article first appeared in *Chemical Heritage*, spring 2004 issue; reproduced with permission from the CHF.

ing visitors the variety of careers to which chemistry can lead. *Her Lab in Your Life* also points out that women chemists from many backgrounds have made important contributions to chemistry.

Creating an exhibit on the history of women chemists that would engage a teenage audience presented an exciting challenge. The exhibit would also need to travel, be durable, and yet have enough presence to intrigue visitors to stop and spend time with it. How would the exhibit present the stories of Shannon Lucid, the NASA biochemist who set the American record (since broken) for most days in space; Susan Solomon, who helped determine the chemistry behind the ozone hole; Allene Rosalind Jeanes, who helped develop intravenous fluids and invent xanthan gum; and over 60 other chemists to a technologically sophisticated, media-savvy, and notoriously fickle audience used to high-speed Internet connections, iPods, factoids, and MTV?

In an interview I conducted with Melissa Sherman, global new business manager at DuPont, she explained how a college internship at 3M was her first exposure to "real world" applications of chemistry: "I became aware that chemistry was involved in the plastic on your computer keyboard, the fibers in your carpet, the fibers in your clothing, the cosmetics you wear on your face, the perfumes you use, the hair care products you use, as well as the plastic on automobiles or the rubber on your tires." The ubiquity of chemistry and how it has shaped and continues to shape our everyday lives is what makes its history so interesting. The exhibit team uses this ubiquity as the setting for the stories of women chemists.

Shaping and Designing the Exhibit

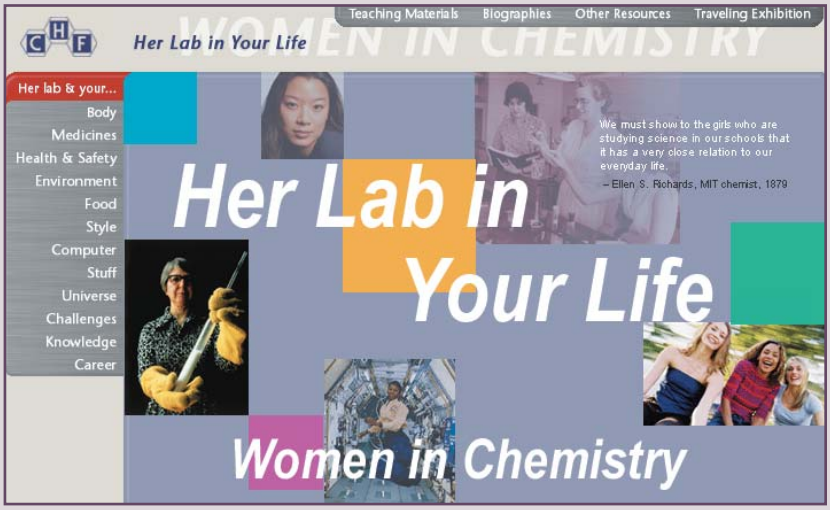
First came the physical form of the exhibit. Displays would be captured on all four sides of freestanding, L-shaped structures, six-and-a-half-feet tall. These Ls, of which there are four, can be configured in a variety of ways to fit a variety of rooms. Since visitors could approach the exhibit from any direction, the design had to avoid making viewers follow a mandatory path to grasp the exhibit's ideas. Twelve different thematic stations were created to frame the stories of the women chemists: Life (biochemistry), Medicine (pharmaceuticals), Stuff (materials), Environment, Discovery, Style (Cosmetics and fashion), Food, Sanitation, Work (variety of careers), Knowledge (education), Challenges, and Chips (semiconductors).

The exhibit's design took cues from today's youth culture—the genres teenage women favor and the places they find familiar. Borrowing from graphic novels, the Medicine station uses comic-book art to tell the stories of Gertrude Elion creating drugs for leukemia, herpes, and meningitis; Dorothy Hodgkin determining penicillin structure; and Chen Zhao helping develop protease inhibitors to fight AIDS. The Style station features a mock cover of a fashion magazine showing a model wearing fashion accessories and clothing that are then deconstructed to relate them to various women chemists who created them—such as Hazel Bishop and her no-smear lipstick, and Edith M. Flanigen and the synthetic emeralds she made (originally for masers). The Sanitation station is set in a restroom (the sinks side) and features Ellen Swallow Richards' survey of Massachusetts's water quality in the 1870s—work that led to the water-quality standards we take for granted today.

In the Challenges station, set in a dorm room, *Her Lab in Your Life* addresses the barriers that women faced in education and the chemical professions, particularly throughout the 20th century. These challenges—from outright discrimination to subtler forms of cultural discouragement—and the strides made in breaking them down are placed in the context of the broader story of the women's rights movement. That context is relevant because despite all the prior accomplishments of women chemists, they did not have a legal basis for fighting discrimination until the Civil Rights Act of 1964 was passed. The most telling artifacts of cultural sexism are two chemistry sets from the early 1960s. "Chemistry Set for Boys,"

The Exhibit Online

The companion Web site to *Her Lab in Your Life* allows virtual visitors from across the globe to "visit" the exhibition and to learn more about the ways women chemists have helped change the modern world. The site will eventually include teaching materials, expanded biographies, and links to additional Web resources.

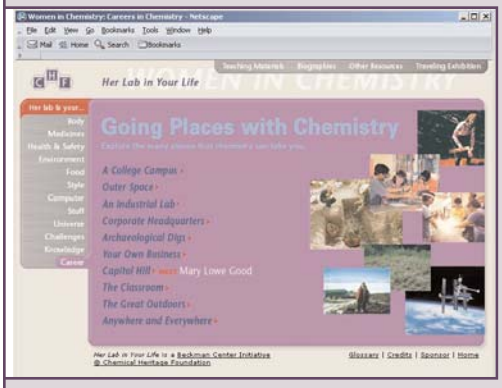


Online, the 12 themes are presented independently, and from each of these sections, one can meet women who pioneered the discipline:

Body Life is a chemical process, and the human body a fascinating and complex chemical system. Here, you can take a breath of fresh air with Ruth Erica Benesch, walk in the park with Judith P. Klinman, or feel the electricity with Jacqueline Barton.

Medicines Chemistry is used to track down new treatments and manufacture cures. Meet here women chemists who helped develop and mass-produce life-saving drugs from penicillin to protease inhibitors.

Health & Safety Sanitation Clean water, wholesome groceries, and safe workplaces are often taken for granted nowadays, but women chemists established many of the standards in sanitation and public health. Go from here to test the waters with Kathryn Hach-Darrow.



Environment Protecting the environment requires knowledge-especially knowledge of chemistry. While certain chemicals can damage the environment, chemistry is required to identify the problems, detect the pollutants, clean up the mess, and prevent future problems. Go clean up the air with Kathleen C. Taylor, and see how Diane Gates-Anderson found chemical solutions to chemical problems in managing safe disposal of harmful pollutants.

Food From the chemical analysis needed to structure nutritional diets for low-income families to the invention of xanthan gum, women chemists have continually put food on the table.

Style Women chemists have put their skills to work in today's fashion industry, using chemical processes to create new materials and improved fabrics.

Computer Chips help you drive your car, cook your food, play your music, power your cellular phone, and more. Chips are made of semiconductor materials and in that industry, every step is a chemical step. Here Elsa Reichmanis and Jennie Hwang will show you that small is powerful. Women chemists like them have helped develop and advance the world of semiconductors.

Stuff Creating and/or improving everyday products is another thing that chemists do well. Check out the work of these women chemists who made high-tech fibers, wrinkle-free, stain- or flame-resistant fabrics, or even synthetic bones.

Finally there is more in **Universe** Here, discovery is portrayed as a thrill that drives many women chemists in pursuit of their science; in **Challenges** where you can meet the first women chemists who faced daunting professional and social challenges, but whose desire and determination gave them the strength to overcome these obstacles; **Knowledge** presents what hard work it took for chemists, as teachers, writers, and advocates, to ensure girls' inclusion in the chemistry classroom; and finally **Career** illustrates the many places that chemistry as a career can take you.

www.chemheritage.org/women_chemistry

encased in metal, proudly displays on the front two boys playing with chemistry; the "Lab Technicians Set for Girls," which lacks a picture but comes in a pink zippered briefcase with light blue trim, risks being mistaken for a make-up kit. Balancing this history of oppression and discrimination are the stories of "firsts" for women chemists, which include Gerty Cori, the first American woman to win a Nobel Prize in the sciences (1947); Marie Daly, the first African-American woman to earn a Ph.D. in chemistry (1947); and Anna Harrison, the first woman elected president of the American Chemical Society (1978).

The most telling artifacts of cultural sexism are two chemistry sets from the early 1960s.

The Knowledge station reveals the power of education and the danger of being kept out of the classroom. Is chemistry class a pain? *Her Lab in Your Life* asks, well, what if you weren't allowed to go? In the 19th century most young women would have needed Jane Marcet's *Conversations on Chemistry* to learn the subject. Most universities and colleges simply did not let women into chemistry classes. It took a dedicated effort from women's colleges like Mount Holyoke, Vassar, and Bryn Mawr to ensure that young women could not only learn chemistry but also be good investigative chemists. Nowadays your chemistry teacher may be a woman (Linda Ford was the ACS High School Chemistry Teacher of the Year in 2003) and your textbook may be written by a woman. The series of popular textbooks that Mary Fieser wrote with her husband Louis were innovative in their use of real applications for chemistry in medicine and industry. Prominent in the exhibit is a large photograph of a modern high-school chemistry class; viewed from one angle, the girls disappear from the photograph, serving as a reminder for visitors not to take their access to education for granted.

It is important, however, not to tell the story of women chemists simply as a story of struggle and perseverance. Emphasizing the story of struggle may conceal the story of scientific accomplishment. Further, the exhibit should not give its target audience the over-arching impression that if a young woman goes into chemistry, the rest of her life will be one big migraine. The aim instead is to show her how chemistry leads to diverse professions that make significant impacts on people's lives.

In an interview with CHF, Margaret Tolbert, a senior spokesperson for the National Science Foundation and former director of the New Brunswick Laboratory, a government research facility for nuclear chemistry, made this point: "Young women … should make efforts to find out the diversity of careers that one can have as a result of having a degree in chemistry." When asked about her own experience in the world of chemistry, Tolbert responded, "My experience as a woman in chemistry and management has been most positive. Although I have encountered some challenges, there were none that I could not overcome."

Whether learning about the chemistry of food and how Cecile Hoover Edwards devised protein-rich vegetarian diets based on her chemical investigations and well-balanced, nutritious, and affordable diets for low-income families, or about how Rosalind Franklin's X-ray crystallography determined the double helix structure of DNA, visitors can wake up to the chemistry all around them—and take that interest into the future.

Josh McIlvain <joshm@chemheriatge.org> is staff researcher/fellowship coordinator for the Beckman Center for the History of Chemistry at the Chemical Heritage Foundation, in Philadelphia, Pennsylvania, USA. To learn about hosting the exhibit, contact Josh by e-mail or by phone at +1 215 925 2178, ext 238.

www.chemheritage.org

The Chemical Heritage Foundation is an Associated Organization of IUPAC. It serves the community of the chemical and molecular sciences, and the wider public, by treasuring the past, educating the present, and inspiring the future.

The Future of Chemistry Education

Istanbul is a 2600-year old city, former capital of the Byzantine and Ottoman empires, and a melting pot for civilizations and cultures. Today, Istanbul is a world leader in scientific and cultural activities. It should therefore be no surprise that the 18th International Conference on Chemical Education, held in Istanbul from 3–8 August 2004, was extremely successful and offered a vision of what the future of chemistry education ought to be.

by Lida Schoen

Delegates from 60 countries attended the conference, which was organized by the Turkish Chemical Society. The 353 delegates, including a large local contingent, could choose among 9 plenary lectures, 10 keynote lectures, 179 talks/presentations, and 153 posters in the well-equipped Hilton Convention Centre.

The Challenges of Today and Tomorrow

After, an impressive formal opening in Istanbul's Military Museum by the traditional brass band and welcoming remarks in which IUPAC was called the United Nations of Chemistry, John Bradley introduced the first two plenary lecturers: Peter Atkins, chairman of the IUPAC Committee on Chemistry Education (CCE) and Peter Mahaffy, chairman of the CCE subcommittee on Public Understanding of Chemistry.

Peter Atkins (University of Oxford, UK) described the importance of chemistry in Turkey and pointed out that on the Turkish flag the moon in its last quarter resembles the "C" of Chemistry and emphasizes the theme of the conference: "Communicating Chemistry: the Challenge." One of the best approaches to chemistry education, Atkins stated, is for teachers and communicators to demonstrate that the underlying ideas of chemistry are very simple—doing so will help bridge the concept-context gap for students and the general public. He said that the general public will lose interest if too many technical details are provided.

Peter Mahaffy and Hale Bayram (18th ICCE Secretary General).

Atkins said that abstraction is the root of the public's fear of chemistry. And although sophisticated computer graphics can help the public better understand chemistry, Atkins doesn't regard the computer as the key to solving the problem. He also pointed out that an intensive focus on mathematics when teaching chemistry tends to put off students. Integrating mathematics in chemistry on a need-to-know basis can reduce this burden. Atkins also discussed how chemistry classes often become overly complex due to the interplay of influences, multiplicity of concepts, and avalanche of facts. On the positive side, and using superimposed triangles to make his point, he pointed out that there are many multi-media teaching aids and new techniques such as computation, or even electrochemistry (clean energy) that can drive motivate students and chemistry forward.

In his lecture called **"Shaping What is to Come," Peter Mahaffy** (King's University College, Alberta, Canada) introduced a fourth element to the more traditional trilogy of symbolic, macroscopic, and molecular levels of thinking about chemistry: the human element. As proposed by Mahaffy, Tetrahedral Chemistry Education is a new conceptual metaphor for working with students and the public (see page 14). In his presentation Mahaffy recognized Can Etik's entry in last year's poster competition "It's a Chemical World!" Etik, a teenager from Istanbul, was presented with a certificate in recognition of his winning poster *Chemistry is Everywhere* (see page 16).

Chemistry Education for Development

Although we live in an age of globalization, the gap between richer and poorer countries continues to widen. Not surprisingly, studies have shown that countries with higher gross national products have populations with higher science literacy. Developing countries, which view science and technology as essential components of their economic development, are at a distinct disadvantage. "How Can We Close the Gap?" was the question **John Bradley** (University of the Witwatersrand, Johannesburg, South Africa) posed in his lecture.

As Bradley pointed out, chemistry educators, however inventive, need resources. In some countries a textbook is all they can expect. But teachers need more: reliable sources of chemistry information, pictorial matter (posters, transparencies, videos), and resources for practical activities. Over the past few

years, said Bradley, joint programs of IUPAC and UNESCO have focused attention on these needs. The DIDAC teaching resources—a set of (language-free) transparencies, supported by text (available in six languages), for teachers—have been made widely available on CD, and were recently posted online <www.iupac.org/didac>. Another example is the microchemistry concept, which has been promoted in developing countries. Some 15 countries have adopted the system as national policy and have acquired kits and chemicals using their own national budgets and donor funds.

Pedagogical Content Knowledge

Robert Bucat (University of Western Australia) argued that we now know that formal learning often constitutes little more than the ability to reproduce symbols and words, and to apply algorithms. Therefore, the question is no longer "What should be taught?," but "What is learned?"

According to Bucat, despite extensive knowledge about conditions necessary for effective learning, teachers have been provided with little guidance about the best methods for teaching particular chemistry topics. This may be partly because much of the chemical education research has used chemistry subject matter just as a vehicle to develop ideas and theories of pedagogy, such as constructivist approaches to learning, co-operative learning, learning styles and on-line learning, all of which can be considered independently of subject matter.

Bucat did not deny the importance of generic pedagogical issues, but he wants to know, "What happened to the content?" He stated that there is a need for pedagogical content knowledge (PCK), which refers to knowledge about the teaching and learning of particular subject matter. A vast difference exists between knowing about a topic and knowing about the teaching and learning of that topic. As Bucat pointed out, the drives of competent teachers are seldom recorded, their PCK retires with them, and so new teachers need to develop their abilities from scratch. The chemical education enterprise is crying out for topic-specific PCK according to Bucat.

Misconceptions About Chemical Concepts

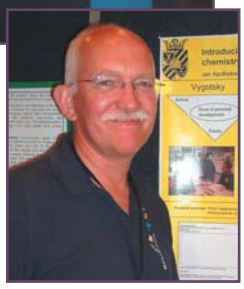
Mei-Hung Chiu (National Taiwan Normal University) reported on a study that examined students' understanding of a selected set of concepts. Although many studies have been conducted in the area of misconceptions, few studies have systematically collected students' conceptions of their understanding of chemical concepts. In this four-year study sponsored by the National Science Council in Taiwan, students' in Taiwan were systematically surveyed about their understanding of selected concepts. The potential causes for student misconceptions were examined in detail, and included sources such as experiments, reference books, language, textbooks, and after-school programs. All of these influence how students learn chemistry.

About 14 000 students—from grades 6 (elementary), 8 and 9 (junior high), and 11 (senior high)—were selected as the target samples. The students answered questions in a multiple-choice test and then had to explain why they gave their answers. Compared to other national surveys, results showed atypical misconceptions.

Norita Mohamed (Universiti Sains Malaysia in Penang) discussed how first-year chemistry students in Malaysia struggle with basic chemistry concepts. She suggested that knowledge and understanding of learning styles or preferences is the key to getting students actively involved in the learning process. As Mohamed noted, research suggests that the more students are actively engaged, the more they achieve. According to Mohamed, a survey is being conducted in Malaysia that will identify students' preferred learning style (Felder's Learning Style Inventory) and determine the correlation, if any, with their performance in chemistry (overall grade at the end of the semester).

Ram Lamba (University of Puerto Rico, Cayev, PR) asked not only what and how the students learn, but more exactly how they filter what is taught. Although lectures are a way to present information quickly, they do not always lead to effective learning. Students are often lost due to the lack of interchange and interaction of ideas with their fellow students and the teacher. Lamba also demonstrated that there is a limit to the amount of information the students—or in this case the audience—can process in a given time. During his presentation, Ram instructed the audience to remember numbers in a special way, but the audience gave up after it was asked to remember too many things at a time. Ram believes that teachers often ask students to store too much information at one time in their long-term memories.

Ram reported that the University of Puerto Rico has developed an introductory laboratory course that



Zafra Lerman (top) and Jan Apotheker.

uses experiments to provide students with experiences similar to those in the real world. The students work in groups and take advantage of each other's experimental conditions and data. Research showed that students who participated in the guided discovery approach received higher final grades and had different attitudes toward chemistry than students in typical chemistry courses.

Jan Apotheker (University of Groningen, Netherlands) also reported that cooperative learning in the chemistry classroom can be a powerful tool. Cooperative learning involves peers helping to educate one another. While the influence of peers has an important role in education, the techniques of cooperative learning are not always easy to implement in the classroom. Apotheker presented two worksheets designed to help overcome start-up problems.

Chemistry in the Arts and Everyday Life

As several speakers discussed, there is a growing panoply of alternative teaching styles that can be used to demonstrate to non-science majors the value of chemistry in everyday life. **Nan-Kan Chen** reported that in Taiwan, non-science majors lack a science background, and even enter college with "chemophobia." To attract the interest of these students, some chemistry professors are emphasising the practical and daily applications of chemistry with the aid of multimedia presentations, laboratory visits, and demonstration kits.

Tuija H. Timonen (Helsinki, Finland)—one of the few actual school teachers attending the Conference—discussed how integrating chemistry into arts and crafts lessons is another way to help students relate chemical principles to everyday life. As Timonen pointed out, colors play an important role in how teenagers perceive their appearances. Natural colorants offer a many-sided theme for integrating science and environmental protection. Timonen described a project in which the arts, crafts, and

Tetrahedral Chemistry Education: Shaping What is to Come

by Peter Mahaffy

The tetrahedron is a geometrical figure instantly recognized by chemists as shaping countless compounds found in nature and synthesized in laboratories. At the beginning of the 20th Century, Jacobus van 't Hoff was awarded the Nobel Prize in Chemistry for his work that led to the prominence of this image in chemistry. Might the tetrahedron also be a geometrical figure that can help us describe and shape chemistry education in the 21st century?

In the last decade chemistry education has been fruitfully described by planar triangles, particularly the triangle of thinking levels (symbolic, macroscopic, and molecular) suggested by Alex Johnstone as being central to understanding chemistry.[1] We've been very well served by that triangular metaphor, which has helped educators address misconceptions students have at each of the three thinking levels as they learn chemistry.

Yet chemistry education must respond to global challenges. Professional associations, including IUPAC and national chemistry societies, as well as the chemical industry are calling for fresh approaches to building trust between chemists and the general public and increasing global interest and understanding about our chemical world. Research presented to 350 delegates from 60 countries at the 18th International Conference on Chemical Education (ICCE) in Istanbul 3–8 August 2004 highlighted innovative ways of reaching the human learners in our classrooms and helping citizens around the world make responsible decisions about chemical substances, reactions, and processes central to their lives.

To build trust and public understanding we need to emphasize new contours of chemistry education, highlighting the human element in and outside the classroom. And the language and metaphors that we use to describe chemistry education need to reflect that new emphasis. In the opening session of the ICCE Conference, I suggested a new conceptual metaphor for our work with students and the public—that we move chemistry education into three dimensions, visualizing the shape of things to come in chemistry education as tetrahedral,[2] rather than triangular planar. We need to find new ways

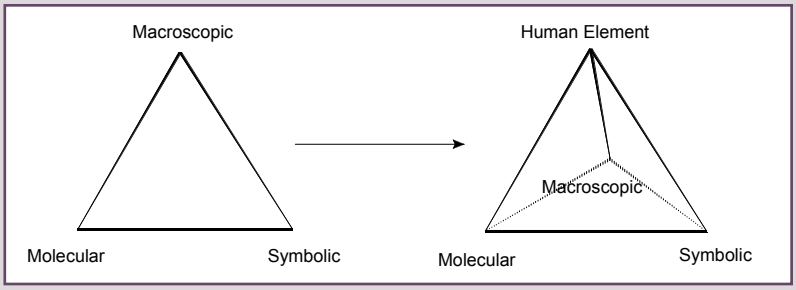
chemistry were integrated. In the chemistry lessons students isolate anthraquinone pigments from the fungus *Cortinarius sanguineus* and the roots of Rubia tinctoria. During the isolating process students learn the basics of laboratory work. The result is a colorant, which they then use in craft lessons for dying and printing yarn and fabric. The dyed materials are then made into products, which are shown in an exhibition at the end of the project. According to Timonen, girls especially thought that this project was more interesting than traditional learning.

In Portugal, ceramic tiles, which decorate churches, palaces, fountains, and even simple houses, are a very important part of the artistic heritage. **Maria Elisa Maia** (Lisboa, Portugal) reported how chemistry students are playing a role in the conservation and restoration of these national treasurers. Maia reported that the secondary school Rafael Bordalo Pinheiro has a special vocational program in ceramics. Students and a teacher from the school collaborated with technicians, restorating the tiles in the Nossa Senhora da Nazaré Church. Salination is the main problem at Nazaré, which is located near the Atlantic. According to Maia, the students prepared a kit for identification of the ions, worked on location, and took samples back to school to do a more complete analysis. Another fieldwork example, was presented by **Šefka Horvat-Kurbegovi** (Zagreb, Croatia), who discussed the restoration and conservation of works of art at the cathedral of Zagreb.

The molecular dance* of chemistry is an inspiration for the performing arts, and as **Zafra Lerman** (Columbia College, Chicago, USA) argued, the arts can be effective tools to communicate, teach, and learn chemistry. While the public learns from the media about popular topics such as gene therapy, cloning, the human genome,

Nan-Kan Chen (top) and Mei-Hung Chiu.

*The molecular dance is a favorite simile of John C. Polanyi (1986 Nobel prize winner), who acknowledged that observing a chemical reaction is like observing dance partners while they are on stage rather than in the wings before or after the dance. <www.utoronto.ca/jpolanyi/profile/profile2.html>.



of integrating the web of human connections into our students' discovery of the symbolic, macroscopic, and molecular levels of thinking about chemistry.

Tetrahedral chemistry education can challenge us to find new ways of bringing chemistry to life for students and the public. This means grounding the macroscopic, molecular and symbolic dimensions of chemistry in "real world" problems and solutions, including industrial processes and environmental applications. We should stress educating science and non-science majors about the processes of science, and the interactions between science and society. Tetrahedral chemistry education also emphasizes the human learner—through case studies, investigative projects, problem solving strategies, active learning, and matching pedagogical strategies to the learning styles of students. Numerous examples of innovative and successful "tetrahedral" strategies were presented throughout the week of the ICCE Conference.

The Committee on Chemistry Education pays attention to the vital human element of IUPAC's educational mandate. The committee, which has responsibility for the biennial ICCE conferences, focuses its work in two areas: Public Understanding of Chemistry (PUC) and Chemistry Education for Development (CED). Individuals, divisions, or standing committees with suggestions for activities and initiatives to shape the future of chemistry education are encouraged to contact CCE Chair Peter Atkins, PUC Subcommittee Chair Peter Mahaffy, or CED Subcommittee Chair Ram Lamba.

www.iupac.org/standing/cce.html

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and stem cells, it doesn't know that the basis for this research is chemistry. Lerman explained that students who major in art, music, dance, drama, and poetry are happy to enrol in a chemistry class to get inspiration for their work. The chemical bond has become one of the most attractive subjects for drama and dance productions. For example, those lovers, sodium and chlorine, were portrayed in a mock performance of Romeo and Juliet by a troop of students from Columbia.

Between lectures and posters, delegates were exposed to topics as varied as chemistry curriculum, new approaches to teacher training, micro-scale chemistry, student attitudes and perception, distance education, interdisciplinary education, green chemistry, and chemistry and society. It seemed that no subject was forgotten!

As we were reminded by John Bradley at the end of his plenary lecture: Those of us attending the 18th ICCE are fortunate. We have an opportunity to engage in professional discourse, to learn a lot, and to teach others in this very diverse, stimulating international meeting. This good fortune brings responsibility. Most of us go home stimulated and energized and few of us successfully transfer these feelings and the new knowledge to our colleagues. But we could do more . . .

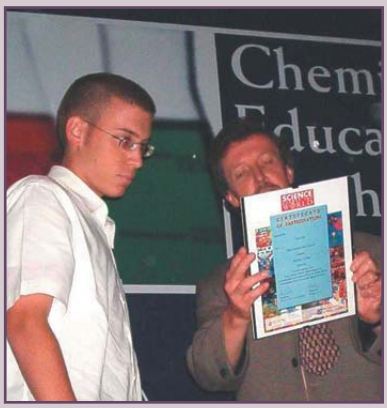
The 19th ICCE will be held 12–17 August 2006 in Seoul, Korea, on the theme of "Chemistry and Chemical Education for Humanity" <www.19icce.org>. In 2006 the Korean Chemical Society, which has 5000 members, will celebrate its sixtieth anniversary.

Lida Schoen <amschoen@xs4all.nl>, based in the Netherlands, is a titular member of the IUPAC Committee on Chemistry Education and the Subcommittee on the Public Understanding of Chemistry, and is a member of the Science Across the World team.

Chemistry is Everywhere

In January 2003, Professor Hale Bayram, the Secretary General of the Organizing Committee of the 18th ICCE and a teacher trainer in Istanbul, alerted chemistry teachers Selmin Aydin and Hülya Kordel about IUPAC's poster competition "It's a Chemical World!" Sixteen-year old Can Etik, a student in their class, produced one of the winning posters: *Chemistry is Everywhere*, which represents the atomic, microscopic, and macroscopic world in beautiful watercolor.

by Can Etik



Peter Mahaffy (right) presents Can Etik with a certificate of recognition.

In the summer of 2003, the school (Ozel Kalamis Lisesi in Istanbul) phoned Etik in Britain, where he was on vacation, to tell him he had won the prize. Upon his return home to Turkey, Etik gave interviews to magazines, radio, and television; He had became an artistic scientific celebrity! Etik said that his father used to draw, and that maybe he inherited this artistic gift from him. This could well be the case, his twin brother Cem won another Science Across the World competition called "When the Wind Blows" <www.scienceacross.org.

The Etik brothers, who are concentrating on science, have two more years to go in high school. They haven't decided yet what field of study they will pursue after finishing school. Their parents postponed their vacation plans to attend the 18th ICCE ceremony at which Can Etik was presented with a certificate of recognition by Peter Mahaffy.

Young Observers Going to Beijing

IUPAC is pleased to announce its call for applications for Young Observers to participate in the 40th IUPAC Congress being held in Beijing 14–19 August 2005. The theme of the Congress is "Innovation in Chemistry." To encourage young scientists to participate in this unique Congress, the organizers have established a program offering travel assistance. For details visit the congress Web site.

In the spirit of innovation, IUPAC will also facilitate the participation of Young Observers in the concurrent General Assembly. The Young Observer program provides an excellent opportunity for young scientists to establish international collaborations, gain knowledge of global research activities, and participate in IUPAC activities. Some Young Observers from previous assemblies have remained actively involved in IUPAC by joining and chairing subcommittees and task groups.

Awards will be offered by IUPAC to candidates from all National Adhering Organizations (NAOs) and Associate NAOs. Both the U.S. and U.K. NAOs will independently select and support the participation of young scientists from their countries as well. All successful candidates are expected to submit an abstract of a poster or paper to be presented at the Congress; such abstracts will be subject to adjudication as will all other submissions for presentation at the meeting.

For more details about these programs, including applications procedures, age limits, criteria for selection, and timelines/deadlines, please inquire to one of the following, depending on your current location:

- In the USA, contact Valerie Theberge at the National Research Council <iupac-us@nas.edu>
- In the UK, contact Stanley Langer at the Royal Society of Chemistry <langers@rsc.org>
- All other IUPAC NAOs/ANAOs, contact the IUPAC Secretariat <secretariat@iupac.org>

For details and updates about the IUPAC GA and Congress, visit the following Web site: <www.iupac.org/symposia/2005.html#140805>.

www.iupac.org/news/archives/2004/40thCongress-yc.html>

See Congress advertisement on back cover.

Marian Góral Received the 2004 Franzosini Award

At the 3rd Annual Meeting of the Subcommittee on Solubility and Equilibrium Data, held 24–25 July 2004 in Aveiro, Portugal, the Franzosini Award was given to Dr. Marian Góral in appreciation of his scientific contributions to the Solubility Data Project.

Dr. Góral's research interests are the same as the Subcommittee on Solubility and Equilibrium Data (SSED). He is the co-author of new evaluations in the updated SDS volumes on hydrocarbon-water systems (8 parts of volume 81 already have been accepted for publication) and also the co-author of the series of publications "Recommended Liquid-Liquid Equilibrium Data" in the *Journal of Physical and Chemical Reference Data*. Two of these manuscripts already have been accepted for publication: Part 1: Binary C5-C11 Alkane-Water Systems and Part 2: Unsaturated Hydrocarbon-Water Systems.

At the 3rd annual SSED meeting, Dr. Góral presented the method used for critical evaluation of solubility data of water-hydrocarbon systems. These new procedures are based on an equation of state containing an association term and on generalized solubility equations.

Dr. Marian Góral is with the Institute of Physical Chemistry, Polish Academy of Sciences, Warsaw.

International Year of Physics, 2005

On 1 June 2004, following its fifty-eighth session, the United Nations declared that 2005 would be the International Year of Physics.

The Year of Physics, is timed to coincide with the centenary of seminal scientific discoveries by Albert Einstein. Celebrations throughout the year and the world will emphasize that physics provides the basis for understanding nature, and through its applications, many of today's technological advances.

Electromotivity to Replace Electromotive Force?

by Vladimir Simeon

As generally known, the so–called *electromotive force* is an important parameter of the reaction taking place in an electrochemical cell because it is proportional to the reaction gradient of Gibbs energy:

$$E = -\frac{1}{\nu F}\left(\frac{\partial G}{\partial \xi}\right)_{T,p} = -\frac{\Delta_r G}{\nu F} \qquad (1)$$

ξ and *ν* denote the advancement (extent) of the cell reaction and the number of exchanged electrons, respectively. If the leads connecting the electrodes to the measuring instrument are identical in chemical composition, the electromotive force can be defined [1,2] as the zero-current limit of the Galvani potential difference between two electrodes:

$$E = \lim_{I \to 0} \Delta\varphi \qquad (2)$$

The traditional name "electromotive force" (in use since 1827)[3] is obviously inconsistent with the definition (2) and the term "force" is potentially misleading. Nevertheless, this name is still widely used and has its place in authoritative international manuals of recommended terminology and symbols, such as IUPAC's "Green Book"[1] and "Compendium"[4] or ISO 31,[5] not to speak of numerous textbooks. Several alternatives to the name "electromotive force" have been proposed, one of the more recent ones being the four-word phrase *zero-current cell potential*.[6]

By inspecting the family of words containing the common fragment "motiv," it can be seen that one of its members is the word "motivity" (first recorded around 1687)[3] meaning "the power of moving or producing motion."[3,7] The word "motivity" may be used to devise a suitable substitute for the name "electromotive force," *viz.* ELECTROMOTIVITY.

There are some important advantages of using the term "electromotivity" for *E*, instead of "electromotive force" or "zero-current cell potential":

- The meaning of the proposed name, "electromotivity," is perfectly consistent with the defining equation (2) where the zero-current conditions are additionally stipulated.
- Consisting of one single word, the proposed name is both economical and easy to combine into composite names or phrases (e.g. standard electromotivity, relative standard electromotivity, thermal electromotivity, etc.).
- The equivocal word "potential" (having at least three meanings: potential, potential difference, potential energy) is not used.

Believing that these reasons are sufficient, I am proposing the acceptance of the name "electromotivity" for the physical quantity *E*, defined by Eq. (2), as a recommended substitute for the traditional name "electromotive force."

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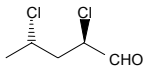
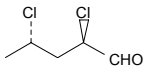
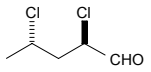
Bonded by Stereobonds

by Hubert Maehr

We all agree that a molecular diagram representative of a chiral compound should comprise all elements pertaining to the stereochemical information and we abet the current efforts by IUPAC in its attempt to design a corresponding graphical solution. It certainly is an arduous task to consider or accommodate the myriad of opinions and suggestions that the task group (project headed by William G. Town, # 2003-045-3-800; Jul-Aug 2004 *CI*, p. 23) is confronted with and to finally arrive at a proposal that chemists will embrace and actually use. Some of these opinions that were recently voiced demand a reply.

I concur with the summary of the present state of affairs succinctly presented by Kaupp and Naimi-Jamal (Jan-Feb 2004 *CI,* p. 15) and their proposal for a targeted use of the common stereobonds to bring lucidity to the chemical literature. Solid and hashed wedge bonds should indicate absolute configuration, and "thick and hatched" bonds could represent racemates. It is difficult to imagine a simpler solution to the current problem and I would also like to point out that it is precisely this bond allocation that was proposed by us almost 20 years ago (*J. Chem. Edu.* 1985, **62**, 114–120) and recently reiterated in detail (*J. Chem. Inf. Comput. Sci.*, 2002, **42**, 894–902).

Flack points out (Jul-Aug 2004 *CI*, p. 21) that molecular structure should be able to distinguish three disparate cases, namely enantiopure compounds of known absolute configuration, enantiopure compounds of unknown absolute configuration, and racemates. He also correctly observed that Kaupp and Naimi-Jamal's suggestions for molecular diagrams address only two of these categories and do not produce graphical representations of enantiopure compounds of unknown absolute configuration. Again, I would like to emphasize that our proposals contained in the above-mentioned papers, address all three scenarios. We also presented examples of pragmatic significance such as single-diagram representations of manifold independent relative configurations as are often encountered, especially during structure elucidation of natural products (e.g., palitoxin). In brief, for every verbal stereochemical nuance, we offered a single pictorial counterpart whose basic elements are summarized below.

	Enantiostatus		
	enantiopure / enantioenriched	**enantiopure, but unknown chirality sense**	**racemic**
Verbal Description	[*R*-(*R**,*S**)]-2,4-dichloropentanal,	(*R**,*S**)-2,4-dichloropentanal	[(±)-(*R**,*S**)]-2,4-dichloropentanal
Pictorial Description			

The letter of M. Oki (Jul-Aug 2004 *CI*, p. 22) also deserves a rebuttal. He is concerned that "thick and hatched" bonds do not provide stereochemical information. Let me paraphrase a section of our above-mentioned publication. Clearly, a line, thick or slender, hatched or solid, obviously lacks differentiation of its termini. Such a line indeed appears inherently incapable of serving as a stereobond. Thick, hatched, or broken lines, however, are used as bonds in the context of a longstanding but tacit convention. Accordingly, the *stereogenic unit* to which the line-type bond symbol is attached is considered to lie in the picture plane so that the bold line reveals its ligand in front of that plane, whereas the hashed symbol is intended to show that the ligand is behind it. This convention elevates line symbols to fully functional stereobonds.

The comment by McNaught (Jan-Feb 2004 *CI*, p. 16) also elicits a comment. He is concerned that the proposal of targeted redeployment of established stereobonds as descriptors of detailed stereochemical information would be difficult, as the reader would have no means of recognizing that a convention was being used. This apprehension, in our opinion, is unfounded. Imagine, for a moment, that our proposed convention would be in effect. Those readers who are incognizant of the convention would be at exactly the same level of understanding as all of us are presently accustomed. We now look at a structural diagram and wonder what the visible, chiral connotations really mean. More often than not, we have to consult the accompanying text to ascertain the chiral meaning of the diagram or, given a synthetic scheme, we arrive at the stereochemical information after studying the starting materials and reagents used. But those readers who are familiar with the convention would benefit from an unprecedented level of unequivocal information contained in a single molecular diagram. And the ratio of the acquainted versus unacquainted would surely increase exponentially as a function of time. Those who did not know the convention would certainly not receive wrong information. It would only protract the shadow of ambiguity.

Allocating the six commonly used stereobonds, shown above, as determinants of complete, graphic stereochemical descriptions appears very appealing to many of us. The comments by Kaupp and Naimai-Jamal are representative of this conviction.

I doubt that there will ever be a perfect solution. When I asked Kurt Mislow, a paragon of stereochemistry, about his opinion of our proposal, he nodded thoughtfully and said: "I guess this is about as good as we can do. What a shame we can not color-code."

Hubert Maehr <hubert.maehr@ROCHE.COM> is at Roche Research Center,

The Project Place

Information about new, current, and complete IUPAC projects and related initiatives.
See also www.iupac.org/projects

Reference Methods, Standards, and Applications of Photoluminescence

Measurements of the fluorescence properties of molecules are critical to the development of an understanding of the photophysics and photochemistry of the singlet excited state(s) of the species. A reliable and standard methodology is also required if published data are to be used to the photochemical community at large. Methods for fluorescence-decay analysis are also an integral part of the determination of the photophysical parameters of the species, as these time-resolved fluorescence properties are useful in spectroscopy, kinetics, energy transfer, analytical applications, and in characterization of chemical, biological, and physical systems which emit light.

The purpose of this new project is to review and update the two previous IUPAC documents covering this topic, namely "Reference Materials for Fluorescence Measurement," *Pure Appl. Chem.*, 60(7), 1107–1114 (1988) and "Recommended Methods for Fluorescence Decay Analysis," *Pure Appl. Chem.*, 62(8), 1631–1648 (1990). The project, which will include advances registered since the earlier publication, will emphasize newly developed reference materials and methods.

The fields to be covered by the project include calibration (spectra, quantum yields, decay times); procedures (steady-state, time-resolved methods including ultrafast techniques, single-molecule studies); and applications to biological (cells, organelles, membranes) and other microorganized systems (gels, films, solids, and, in general, complex environments, usually contaminated by light scattering).

A task group for the project, including nearly 20 experts from different specialties and countries, was formed and leaders for the different subtasks were nominated. The photochemical community is encouraged to participate by joining any of the subgroups. Communication will be performed through the project Web page, and a vast dissemination plan will be also devised. The project began mid-year in 2004 and will end at the end of 2006. Before final documents are written, advance reports and document drafts will be issued.

For more information, contact the Task Group Chairman Enrique San Román <esr@qi.fcen.uba.ar> or Fred Brouwer <fred@science.uva.nl>.

www.iupac.org/projects/2004/2004-021-1-300.html

Glossary of Terms Used in Biomolecular Screening

The field of biomolecular screening, an important component of the drug discovery process, has evolved rapidly in recent years. Along with the new technologies and techniques that are now routinely used in lead discovery and optimization have come new nomenclature and terminology. Biomolecular screening stands at a key interface with medicinal chemistry and biology in the drug discovery process. Effective communication between these disciplines and among scientists of different backgrounds is dependent on clear and consistent understanding and application of the terminology particular to the field.

This project, a collaborative effort between the IUPAC Chemistry and Human Health Division and the Society for Biomolecular Screening, seeks to provide an authoritative glossary of the terms commonly used in biomolecular screening.

For more information, contact Task Group Chairman John Proudfoot <jproudfo@rdg.boehringer-ingelheim.com>.

www.iupac.org/projects/2004/2004-019-3-700.html

Practical Studies for Medicinal Chemistry Guidelines

The goal of this new project, which is supported by the IUPACs Chemistry and Human Health Division, is to provide developing countries with a practical textbook on medicinal chemistry. The textbook will take into account the special characteristics and needs of developing countries, such as methods for using natural resources or the difficulty of paying for reagents or other materials. The project is intended to encourage postgraduate research in these countries in the area of new-drug discovery. It is hoped that this research can lead to drugs for forgotten diseases such as Tuberculosis, Malaria, and Chagas that principally affect developing countries and receive little attention from developed countries.

The major output of this project will be a book to be titled *Practical Studies for Medicinal Chemistry Students: An Integrating Approach for Developing Countries*, which will be made available in print and online. The text will be written in English, but some texts will also be in Spanish and Portuguese when provided by the authors.

The book will integrate information from a variety of disciplines involved in medicinal chemistry, such as organic synthesis, isolation, structural identification, structure-activity relationships, and biological activities. It will be possible to perform the experiments in the book with easily accessible materials, with starting products (natural products from the area, for example, economic reagents), and low-cost instrumentation.

An outline of the book is presented on the project Web page at the address below.

For more information, contact the Task Group Chairman, Antonio Monge Vega <cifa@unav.es>.

www.iupac.org/projects/2004/2004-028-1-700.html

Internationally Agreed Terminology for Observations in Scientific Communication

This two-year project based on the C-NPU generic database deals with properties that are observed in the medical laboratory, but not defined by the seven dimensions of the SI system. (The NPU is the Nomenclature, Properties, and Units in Laboratory Medicine coding). The VIM (International Vocabulary of Basic and General Terms in Metrology), which defines the primitive concepts of the SI system, is designed for metrology: the science of measurement. However, most scientific disciplines, not only laboratory medicine, also rely—some predominantly—on observation. Thus, this project intends to design a vocabulary shared by both observations and measurement. Developing a common framework to integrate the concepts of property, and in a more restricted sense of quantity, the project includes explaining to laboratory medicine workers the meaning of and usefulness of this view.

For more information, contact Task Group Chairman Françoise Pontet <francoise.pontet@wanadoo.fr>.

www.iupac.org/projects/2004/2004-023-1-700.html

Biophysico-Chemical Processes of Heavy Metals and Metalloids in Soil Environments

The objective of this project is to produce a reference providing the scientific community with a critical evaluation of the biophysico-chemical processes of metals and metalloids in soil environments. The evaluation, which is being conducted by a multidisciplinary group of soil and environmental scientists, will cover interactions with soil components (clay minerals, organics, microorganisms) as well as their speciation, mobility, bioavailability, and toxicity. It will also examine innovative restoration strategies for polluted soils.

The behavior of heavy metals and metalloids depends on chemical, physico-chemical, and biological factors associated with microbial activities. Dynamics and equilibria of these elements in soil environments are significantly influenced by structural, surface, and solution chemistry of soils and interactions of soil minerals with organic components and microorganisms. These physicochemical-biological interactions would influence the transfer of these elements from the inorganic and organic soil constituents to the soil solution and to plants.

Biogeochemical processes operating in soil environments that affect the fate, behavior, and bioavailability of metals and metalloids is currently an area of active research. Yet, a comprehensive and detailed book describing the current state of knowledge on the subject is absent from scientific literature. This book will bring a critical, qualitative and quantitative review of the fundamentals of the physics and chemistry of heavy-metal and metalloid interactions in soils, including the influence of soil microorganisms on these processes. In addition, the book will review the latest advances in spectroscopy and how they can be used to study various aspects of heavy-metal and metalloid interactions with inorganic and organic components.

The book will be co-edited by A. Violante, P.M. Huang, and G.M. Gadd.

For more information, contact Task Group Chairman Antonio Violante <violante@unina.it>.

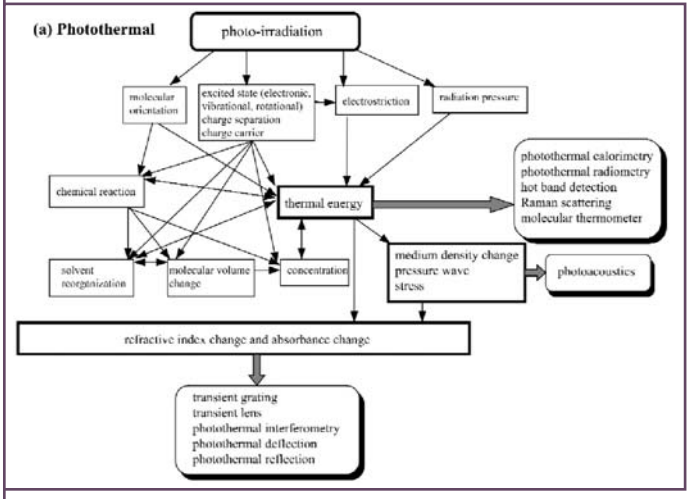
www.iupac.org/projects/2004/2004-003-3-600.html

Quantities, Terminology, and Symbols in Photothermal and Related Spectroscopies (IUPAC Recommendations 2004)

M. Terazima et al.

Pure and Applied Chemistry,
Vol. 76, No. 6, pp. 1083–1118 (2004)

The interaction of electromagnetic radiation with matter causes absorption, emission, and scattering of radiation. Except for emission and scattering, the absorbed electromagnetic energy is converted to heat by various nonradiative processes and induces changes in temperature, pressure, and refractive index of the medium. In photothermal spectroscopy, the effects caused by these changes are monitored by various methods. The discovery of the photothermal effect dates back to Bell's discovery of the photoacoustic effect in 1880, but it is after the invention of the laser that the photothermal spectroscopies became popular. In 1964, Gordon et al. found a beam divergence effect from liquid samples that were placed in a gas laser cavity. This phenomenon was correctly interpreted in terms of the "thermal lens" effect produced by heating induced by the Gaussian laser beam. The thermal lens method soon became a standard technique to detect the thermal energy produced by nonradiative transitions. Since then, various types of photothermal methods have been developed and applied to a variety of problems. Today, photothermal spectroscopy is widely used in physics, chemistry, biology, and engineering.



Relations among the origins and detection methods of photothermal effects, which are caused by the heating effect after photoirradiation.

This paper presents quantities, terminology, and symbols of terms related to photothermal phenomena and used in photothermal and related spectroscopies. The terms used in the literature to describe photothermal phenomena and methods are reviewed, and a glossary of terms is given. The origins of photothermal phenomena, as well as the relations among various photothermal effects, are summarized. The listed terms cover the terminology in transient grating, transient lens, photoacoustic spectroscopy, photothermal radiometry, calorimetry, interferometry, deflection, reflection, and other related spectroscopies, which use or are related to photothermal effects.

www.iupac.org/publications/pac/2004/7606/7606x1083.html

Electrochemical Detection in Liquid Flow Analytical Techniques: Characterization and Classification (IUPAC Technical Report)

K. Tóth, K. Stulík, W. Kutner, Z. Fehér, and E. Lindner

Pure and Applied Chemistry
Vol. 76, No. 6, pp. 1119–1138, 2004

Since the early 1970s, a large number of papers has been published on different liquid flow analytical techniques. The flow analysis database on the World Wide Web <www.flowinjection.com> lists more than 10 000 references. In 1994, IUPAC classified the analytical methods based on flowing media and defined flow analytical systems, component parts, and terms for describing their performance. Then, fundamentals of analytical aspects of chemical process control were discussed in 1999 and information essential for characterizing a flow-based analytical system has been provided in 2002. The aim of the present report is to extend the existing, recommended, and consistent terminology to electrochemical detection and detectors used in flow analytical techniques with a brief critical overview of the currently used electrochemical flow-through detectors.

Liquid flow analytical techniques are classified, and definitions are provided of flow-injection analysis,

segmented flow analysis, flow titration, continuous monitoring, liquid chromatography, and capillary electrophoresis. Electrochemical detection and flow through detection cells are characterized with respect to the surface and bulk detection. The detector performance is discussed in terms of its principal analytical parameters, such as detection limit and dynamic concentration range, as well as its dynamic characteristics, such as the response time, sampling frequency, transport lag, and long-term stability. Moreover, different detection modes are critically evaluated, including both potentiostatic and galvano-static techniques. Factors influencing sensitivity and detection limit, which include electronic and hydrodynamic approach, are also discussed. Different detector designs are critically reviewed, and the special features of electrochemical detectors for flow analytical techniques are emphasized.

www.iupac.org/publications/pac/2004/7606/7606x1119.html

Piezoelectric Chemical Sensors (IUPAC Technical Report)

R. P. Buck, E. Lindner, W. Kutner, and G. Inzelt
Pure and Applied Chemistry
Vol. 76, No. 6, pp. 1139–1160 (2004)

The rapid expansion of the field of piezoelectric sensing devices, within the larger area of chemical sensors and biosensors, requires improved classification and characterization of relevant concepts and principles. This report addresses mostly the application of piezoelectric sensing devices in electroanalytical chemistry based on the quartz crystal microbalance (QCM) technology, and it has been coordinated with relevant documents of physics and electrical engineering. Basic terms and definitions related to piezoelectric materials and sensing devices, electric transducers, and analytical measurements with piezoelectric chemical sensors are provided. In addition, the more essential response equations are presented.

www.iupac.org/publications/pac/2004/7606/7606x1139.html

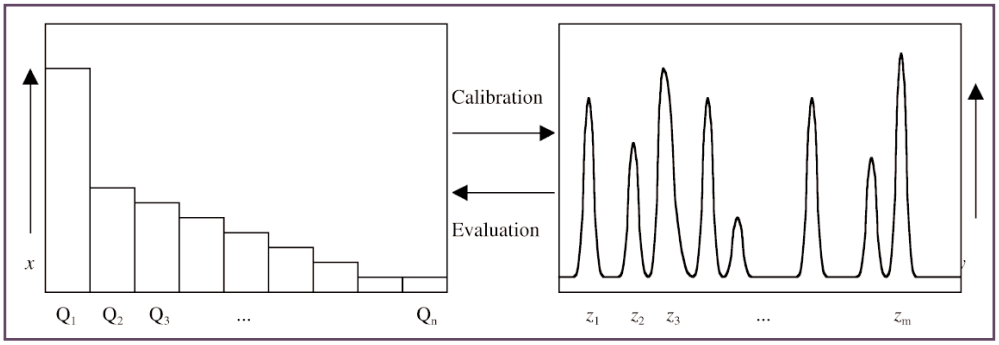
Guidelines for Calibration in Analytical Chemistry. Part 2: Multicomponent Calibration (IUPAC Technical Report)

K. Danzer, M. Otto, and L.A. Currie
Pure and Applied Chemistry
Vol. 76, No. 6, pp. 1215–1225 (2004)

Calibration in analytical chemistry refers to the relation between sample domain and measurement domain (signal domain) expressed by an analytical function $x = f_s(Q)$ representing a pattern of chemical species Q and their amounts or concentrations x in a given test sample on the one hand and a measured function $y = f(z)$ that may be a spectrum, chromatogram, etc.

Simultaneous multispecies analyses are carried out mainly by spectroscopic and chromatographic methods in a more or less selective way. For the determination of n species Q_i (i = 1,2 ...n), at least n signals must be measured which should be well separated in the ideal case. In analytical practice, the situation can be different.

www.iupac.org/publications/pac/2004/7606/7606x1215.html



Relationship between sample domain and signal domain in case of elemental analysis.

Critical Evaluation of the State of the Art of the Analysis of Light Elements in Thin Films Demonstrated Using the Examples of SiO_XN_Y and AlO_XN_Y Films (IUPAC Technical Report)

S. Dreer and P. Wilhartitz
Pure and Applied Chemistry
Vol. 76, No. 6, pp. 1161–1213 (2004)

The quantitative analysis of thin films containing light elements is very important in improving the coating processes and technological properties of the products. In order to review the state of the art of modern analytical techniques for such applications, the model systems SiO_XN_Y and AlO_XN_Y were selected. Over 1000 abstracts were screened, and the relevant literature was evaluated to give a comprehensive overview of instruments, analytical procedures and results, film types, deposition methods, and investigation goals. From more than 150 citations, the limitations, drawbacks, and pitfalls of the different methods were extracted and reviewed critically, while in addition, improvements were proposed where possible. These suggestions are combined with the newest results of investigation by the authors of this paper. Recommendations concerning the optimized combination of analytical methods for different analytical problems have been worked out on the basis of all results. Analysis of various multicomponent systems containing light elements demonstrated the applicability of the different methods of analysis in combination to all film systems with related compositions.

www.iupac.org/publications/pac/2004/7606/7606x1161.html

Mechanisms of Immunosensitization to Metals (IUPAC Technical Report)

D.M. Templeton
Pure and Applied Chemistry
Vol. 76, No. 6, pp. 1255–1268 (2004)

Many metal ions produce immunosensitization. While metals common in the body, such as Na, K, Ca, Mg, and Fe, are immunologically inactive, some trace elements are strong immunosensitzers. Often, exposure to high local concentrations of a metal in the lung or on the skin initiates the immunological process and leads to acute or chronic disease. Exposures to such metals in the workplace, in connection with drug therapy, or in everyday life have considerable health consequences for society.

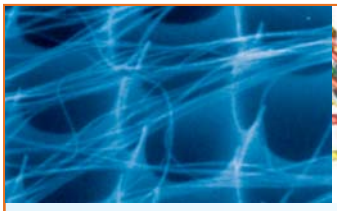
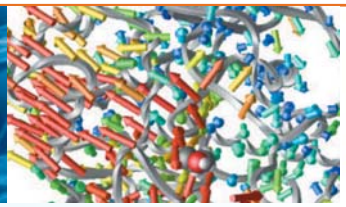
This present review summarizes our knowledge of the mechanisms by which certain trace elements evoke allergenicity. Some physiological electrolytes (e.g., Na^+, K^+) and macro-nutrients (e.g., $Ca2^+$, $Fe3^+$) are immunologically inactive. However, some trace elements essential for cell function (e.g., $Co2^+$, $Cu2^+$, $Cr3^+$),as well as nonessential elements generally considered toxic (e.g., Hg species) or in use as therapeutic agents (e.g., some species of Pt and Au), can give rise to adverse immune reactions. Specific immunological responses to Ni, Co, Cr, Hg, Be, Cu, Pt, Pd, Ir, In, and Au are discussed. In general, these elements can activate T or B cells by specific receptor interactions, resulting in clonal expansion of a metal-specific lymphocyte and an immune response (typically dermatitis) upon re-exposure.

This report constitutes the background for another IUPAC project which goal is to evaluate and harmonize the use of specific biomarkers for metal sensitization.

www.iupac.org/publications/pac/2004/7606/7606x1255.html

Other Technical Reports and Errata are published in the June 2004 issue of *Pure and Applied Chemistry* (Vol. 76, No. 6), including:

www.iupac.org/publications/pac/2004/7606/

ROYAL SOCIETY OF CHEMISTRY AWARDS

This is the fourth year of the latest 10-year cycle of the RSC's industrially-sponsored awards. Through these awards, the RSC bestows the highest accolade on members of the chemical science community. For this latest cycle, the scheme has been extended very considerably, with the number of awards on offer increased by 30 per cent on previous years. Many cutting edge areas of chemistry are now recognised, including advances in biomembrane chemistry, chemical biology, green chemistry, nanotechnology, fuel cell science, nucleic acids chemistry and sensors. The RSC is indebted to the continuing support of existing industrial sponsors and to the many new sponsors that have come forward so generously.

Each award is made to those of British nationality, including Commonwealth citizens, or those normally domiciled in the British Isles, and is not limited to members of the RSC. Each award consists of a silver medallion and a prize of £500. For each award, equal consideration will be given to those candidates who have made fundamental contributions to their subject as well as to those whose work has been directed to its application. Account will also be taken of significant contributions in applied science not reflected in publications. The subject areas are interpreted in the broadest manner to ensure that no worthy candidate is excluded.

This latest tranche of 17 awards for 2004 is as follows.

- **Chemistry of the noble metals:** including advances in electroplating and refining technology.
- **Corrosion science:** awarded for studies leading to new concepts in corrosion science and technology.
- **Fuel cell science and technology—the Francis Bacon medal:** awarded for the development of novel chemical science and technology leading to practical fuel cell design and operation.
- **Heterogeneous catalysis:** awarded for the development of novel heterogeneous catalysts or processes dependent upon them.
- **Heterocyclic chemistry:** covering the synthesis, structure determination and reactions of all types of heterocyclic compounds.
- **High throughput drug discovery methodologies:** awarded for ground-breaking innovations that have enabled a significant acceleration of the drug discovery process.
- **Magnetic resonance spectroscopy:** awarded for studies leading to improved methods in magnetic resonance spectroscopy.
- **Mass spectrometry:** awarded for studies leading to improved techniques for the identification and analysis by mass spectrometry.
- **Organic reaction mechanisms:** covering the studies of the mechanisms of organic reactions.
- **Organometallic chemistry:** including any aspect of the chemistry of the main group and transition element organic compounds.
- **Peptides and proteins:** covering advances in the chemical synthesis of peptides, new understanding of protein structure and function, or for new insights into protein-protein interactions and protein folding mechanisms.
- **Reactions kinetics and mechanisms:** relating to the principles governing reaction rates and mechanisms.
- **Sensors:** awarded for chemical input into the design of novel sensors or novel applications of existing sensors.
- **Solid state chemistry:** covering the area of the chemistry, physics and materials science of solids with particular reference to the reactivity of solids.
- **Structural chemistry:** covering studies involving novelty of approach or leading to fundamental theoretical advances in the development of general structural principles.
- **Surface and colloid chemistry:** embracing interfacial studies in general.
- **Tertiary education:** for teachers in higher and advanced further education.

The closing date for nominations for the above awards is 31 January 2005 and further details and application/nomination forms may be obtained from Stanley Langer on +44 (0)20 7440 3325; email: langers@rsc.org, or visit <www.rsc.org/lap/awards/industry.htm>.

Chemistry at the Interfaces

P.R. Sundararajan, W.Z.Y. Wang, and A.M. MacMillan (editors)
Pure and Applied Chemistry
Vol. 76, Nos. 7–8, pp. 1295–1603 (2004)

A double issue of *Pure and Applied Chemistry* has been devoted to a selection of papers presented at the 39th IUPAC Congress and 86th Conference of the Canadian Society for Chemistry held 10-15 August 2003 in Ottawa, Canada. "Chemistry at the Interfaces" was the title of the conference, which was organized along six general chemical themes: Analytical, Chemical Education, Inorganic, Macromolecular Science and Engineering, Organic, and Physical and Theoretical. The congress offered broad symposia topics from nanoparticles and carbon nanotubes to metalloproteins and metals in medicine to the chemistry of nucleic acids. The selections made for this issue of *PAC,* prefaced by Alex McAuley, Congress president, involve the interdisciplinary aspects of macromolecular science and engineering and nucleic acids chemistry.

Controlling Self-Assembly

Ubiquitous in nature, molecular self-assembly relies on two key elements: chemical complementarity and structural compatibility. While non-covalent interactions such as hydrogen bonds, ionic bonds, and van de Waals interactions play a role in self-assembly of molecular motifs, it is equally important to understand the mechanism of self-assembly, in terms of atomic and molecular sequences. In other words, how the primary structure of a molecule or a sequence of molecules controls the secondary and tertiary structures, which are the ultimate entities that dictate the functional properties of a molecular system.

The title of the congress symposium "Controlling the Self-Assembly in Macromolecular Systems: from Nature to Chemistry to Functional Properties" intentionally emphasized *control*. While self-assembly is enabled by the choice of motifs, controlling the *extent* of such self-assembly to precisely tailor the functional properties is a challenge. For example, can we command the same polymer system to self-assemble using, say, only 60% of the hydrogen bondable groups for one application, and 100% for another? Thus, discussion related to controlling the nature and the extent of self-assembly was the intent of this symposium chaired by P.R. Sundararajan. A broad range of topics was covered, including block copolymer vesicles, micelles for drug delivery, hydrogen-bonded supramolecular structures, and dendritic polymers with specific functional properties.

Polymers in Electronics and Photonics

Electro-active and photo-active polymers are being considered for use as the active components in a wide range of electronic and photonic devices, such as liquid crystals and light-emitting diodes displays, electro-optic modulators, optical attenuators, electronic circuits, solar cells, actuators, memory elements, lasers, and chemical and biological sensors. In comparison with inorganic materials, functional polymers can be readily fabricated as thin films on substrates at much lower processing temperatures and even directly incorporated into specifically defined locations on a substrate using the printing technology.

In their paper, Yamamoto et al. describe the design, synthesis, and properties of a new class of metal-binding dendrimers. The authors show the state-of-the-art synthesis, unique properties, and potential applications of these polyazomethine dendrimers. In a paper by Wong et al., the synthesis and multifunctional properties of phenylenevinylene oligomers are described. The structurally well-defined oligomers are particularly interesting for a number of applications such as light-emitting diodes and solar cells.

Papers by Dalton and Wang deal with recent advances in the field of organic materials, which have telecommunications applications. Nonlinear optical polymers as described by Dalton and near infrared electrochromic organic materials as reviewed by Wang show great potential for use in a number of telecommunication devices, such as modulators and variable optical attenuators that operate in the near-infrared wavelengths.

Papers by Barrett, Ikeda, Rochon, and Zhao deal with azobenzene and photo-active liquid crystal polymers. Finally, Sundararajan offers morphological reasoning in his paper to account for the enhanced charge carrier mobility in the doped polymer systems, which is useful for the rational design of polymer-based optoelectronic devices.

Chemistry of Nucleic Acids

New developments in the chemistry of nucleic acids demonstrate growing interdependence with disciplines such as biology, medicine, and materials science, and offer the promise of unimagined future opportunities and consequences. The date of this symposium afforded a happy opportunity to celebrate the 50th anniversary

of the historical paper by Watson and Crick, which continues to inspire endeavors in nucleic acid chemistry.

The ensuing papers in this issue are introduced with a brief overview by Andrew MacMillan, chair of the symposium, of the developments and milestones that have characterized the past 50 years. MacMillan emphasizes the diversity of current research in this field, including work on synthetic design and methodology, targeted synthesis, and structure-function.

For an overview of the 2003 IUPAC Congress and Conference of the Canadian Society for Chemistry see Nov-Dec 2003 *CI*, p. 10 or <www.iupac.org/publications/ci/2003/2506/3_mcauley.html>.

www.iupac.org/publications/pac/2004/7607

Macromolecules and Materials Science

R.D. Sanderson and H. Pasch (editors)
***Macromolecular Symposia*, Vol. 214**
Wiley-VCH, 2004, pp. 1–379
ISBN 3-527-31047-9

As part of its activities, UNESCO encourages and sponsors UNESCO Schools and scientific conferences in collaboration with scientific associations such as the IUPAC. The UNESCO School and Conference on Macromolecules and Materials Science is held annually at different locations in South Africa. World authorities in various fields of macromolecular science give tutorials at the UNESCO School and informative plenaries at the conference. The exposure to new ideas and advanced concepts in macromolecular science is of great importance to South African students and senior staff from different universities and research institutions.

The 6th UNESCO School & IUPAC Conference (14–17 April 2003, Kruger National Park, Mpumalanga, South Africa) focused on polymer properties with a special session on the characterization of polyolefins. Abridged versions of a number of papers have been compiled in this volume of *Macromolecular Symposia*. The content of the papers is also available in the Virtual Teaching Encyclopaedia, which also contains papers from previous UNESCO conferences.

www.sun.ac.za/unesco/
www.iupac.org/publications/macro/2004/214_preface.html

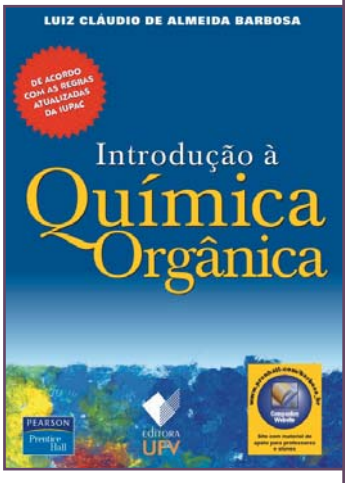
Introdução à Química Orgânica

Luiz Cláudio de Almeida Barbosa
Pearson Prentice Hall, 2004
ISBN 85-7605-006-4

Organic chemistry underpins every aspect of our lives. We take for granted that the cells in our bodies will function with unerring accuracy, yet they must carry out millions of complex chemical transformations of organic compounds every second. We also expect that drugs will be available for all of our ailments; that brightly colored synthetic plastics, paints, and fabrics can be purchased from our shopping malls; and that good-quality food will be readily available from the crops that have been protected from the ravages of insects, fungi, and weeds. The quality of our lives is thus inextricably linked to life-saving drugs; synthetic polymers; insecticides, fungicides and herbicides; and a myriad other organic chemicals.

The importance of organic chemistry to students of biology, medicine, veterinary science, pharmacy, agronomy, food science, and agriculture is not in doubt. These students will find everything they need to know in Professor de Almeida Barbosa's new book. Written in Portuguese, the book is a concise, yet comprehensive introduction to all aspects of modern organic chemistry. The treatment is rigorous, yet the biological interests of the students have not been overlooked. The text is full of fascinating examples of molecules with interesting biological properties.

Luiz-Cláudio de Almeida Barbosa writes with great authority since he has carried out cutting-edge research in both the United Kingdom and Brazil, says Professor John Mann from Queen's University of Belfast.



The former edition of this textbook, published in 1998, was used in several universities and helped to reinforce the use of IUPAC recommendations in Brazil. The IUPAC rules are highlighted in the latest version of the publication.

www.prenhall.com/barbosa_br

Polymers in Medicine, Nanotechnology, Degradation, and Stabilization

by R.D. Sanderson

The **7th Annual UNESCO/IUPAC Conference on Macromolecules** focusing on "Polymers in Medicine, Nanotechnology, Degradation, and Stabilization," took place 5–8 April 2004 in Stellenbosch, South Africa. The organizing committee comprised J. Wendorff (Phillips-University of Marburg, Germany), A.J. van Reenen (Stellenbosch University, South Africa), Aneli Fourie (UNESCO Associated Centre for Macromolecules and Materials, Chemistry & Polymer Science Division, University of Stellenbosch, South Africa), and myself.

About 200 delegates representing 19 countries other than South Africa participated in the conference. Delegates from the African continent were from Uganda, Zimbabwe, Zambia, Mauritius, Egypt, Libya, and Lesotho. Other countries represented included Russia, China, Turkey, India, France, Germany, United Kingdom, USA, Israel, Switzerland, Netherlands, Czech Republic, Denmark, Slovenia, Italy, and Australia. The total number of students who actively participated at the conference was 75.

Forty talks were presented, of which 7 were plenary lectures, 26 invited lectures, and 7 oral submissions. The talks focused on state-of-the-art activity and advancements in various fields. All others were accommodated in a lively poster session, which proved to be especially popular for student presentations.

Conference topics included polymer nanofibres and nanotubes; promising objects for applications in medicine; structure-property correlations of bone, bone-cement, and polymers; polymers in cardiovascular applications; bio-inspired cationic surfactants; facile synthesis of supramolecular materials via the ionic self-assembly route; and the effect of thermo-oxidative degradation and stabilization on the mechanical properties of polypropylene.

Bringing together experts on the same theme led to lively discussions on the preciseness of using certain techniques and also brought to light the availability of analytical subroutines on certain analytical equipment that the manufacturer often fails to explain to the customer.

The overseas plenary and invited speakers stressed the importance of postgraduate-level training in polymer science and chemistry in Africa. In particular they emphasized the importance of this field to the economies of the African continent.

An encyclopedic CD-ROM 2004 (PolymerED) for use in teaching is being created that will consist of many of the abstracts as well as conference talks. This encyclopedia provides an excellent tool for teaching and expanding course notes and will be made available to all speakers at the conference. It will be placed in an abridged form on the conference Web site after approval by each of the contributors. Abstracts and papers are being collected for peer review and will be published in a issue of *Macromolecular Symposia*.

The 8th Annual UNESCO/IUPAC Conference on Macromolecules: "Polymers for Africa," 4–9 June 2005, is scheduled to take place at Sugar Beach Resort, Mauritius.

Prof. R.D. Sanderson <rds@sun.ac.za> served as the conference chairman. He is a professor in the Department of Chemistry at the University of Stellenbosch in South Africa. He is also director of the Institute for Polymer Science and director of the UNESCO Associated Centre for Macromolecules and Materials.

Biodegradable Polymers and Plastics

by In-Joo Chin

The **Eighth World Conference on Biodegradable Polymers and Plastics** was held at Hanyang University in Seoul, Korea, from 1–4 June 2004. The conference was sponsored by IUPAC and jointly organized by the Polymer Society of Korea, Biodegradable Plastics Society Japan, BioEnvironmental Polymer Society, European Degradable Polymer Society, Korean Biodegradable Plastics Association, and Hanyang University. It brought together 238 participants from 19 countries including Japan, USA, China, Italy, Germany, Sweden, Poland, Australia, Taiwan, Thailand, UK, and the Netherlands.

Conference participation was well balanced among academia, research institutions, and industries. About half of the attendees were from abroad. The conference was co-chaired by Seung Soon Im, Department of Polymer and Textile Engineering, Hanyang University, and Young Ha Kim, Biomaterials Research Center, KIST, Seoul, Korea.

The meeting featured 36 invited lectures and almost 100 contributed oral and poster presentations,

which were classified as follows:

- Microbial Poly(hydroxy alkanoate)s
- Poly(lactic acid)s
- Biodegradable Polyesters and Polyurethanes
- Hydrogels and Biomedical Applications
- Blends and Processing
- Structure and Properties of Degradable Polymers
- Standards and Regulations

During the first session, a number of world-renowned experts reported on recent progress in biodegradable polymers and plastics:

- R. Narayan and D. Graiver—"Drivers, Standards, and Technologies for Biobased, Biodegradable Polymer Materials"
- A.-C. Albertsson—"Degradable Aliphatic Polyesters and Poly(ether-esters) for Tissue Engineering and Drug Delivery"
- Y. Doi—"Engineering and Environmental Impact of Polyester Biosynthesis from Renewable Carbon Resources"
- G. Swift—"Impact of Origin of Resources and Polymer Structure and Compositions on the Production and Availability of Biodegradable Polymers"
- G. Ghislandi and G. Floridi—"Mater-Bi Products"

It was noteworthy that a significant number of papers were presented on various aspects of microbial poly(hydroxy alkanoate)s and their copolymers:

- S.Y. Lee on the systems biological approach for the production of various polyhydroxyalkanoates by metabolically engineered *Escherichia coli*
- L.K. Nielsen on the production of PHB in sugarcane
- Noda on Nodax™ PHA copolymers and their blends
- Y. Inoue on the structure, properties and biodegradation of some bacterial copoly(hydroxyalkanoate)s.

G.Q. Chen discussed recent findings on the production of poly(hydroxybutyrate-*co*-hydroxyhexanoate) by recombinant *Aeromonas hydrophilia* harboring genes of *phA*, *phB*, and *vgb*. H.N. Chang reported on the PHA production on an industrial scale using high-density cell culture. T. Iwata discussed the structure and biodegradability of poly[(R)-3-hydroxybutyrate] fiber and films and Y.B. Kim talked about the shape memorizing PHBVs.

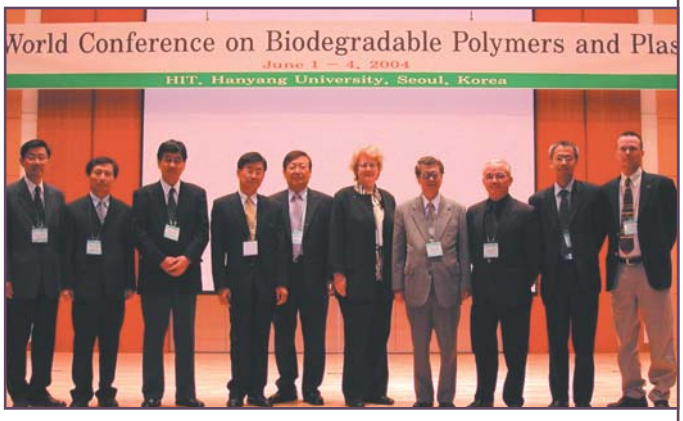
Poly(lactic acid) is another important class of biodegradable polymer. P.J. Dijkstra spoke about the new developments in polylactide chemistry, S.H. Kim about the PLA synthesis in the supercritical chlorodifluoromethane, and Y. Kimura about a novel synthesis approach to stereo-block PLA. Proceedings of the selected papers will be published in *Macromolecular Symposia*.

A number of leaders in the biodegradable polymers and plastics industry participated in the conference. Navamont (producer of Mater-Bi), Cargill Dow, Procter and Gamble (producer of Nodax™), BASF (producer of Ecoflex), Showa High Polymer (producer of Bionelle), Mitsui Chemicals, and IRe Chemical of Korea all presented their recent research and development activities. Also, several Korean companies such as SK Chemicals, Toray Saehan, IRe Chemical, Daesang, and Yuhan Kimberly, all members of the Korean Biodegradable Plastics Association, financially supported the conference.

Since 1989, when the series started, the conference has been held in Toronto, Canada; Montpellier, France; Osaka, Japan; Durham, North Carolina, USA; Stockholm, Sweden; Honolulu, Hawaii, USA; and Tirrenia, Italy. It was very meaningful to have the 8th World Conference on Biodegradable Polymers and Plastics in Korea, because public awareness about the reuse and recycling of sustainable resources and the preservation of the environment has been growing steadily in many Asian countries. In fact, in the session on Standards and Regulations, industrial development activities in the biodegradable plastics of Japan, China, and Taiwan were reviewed. The standardization effort in Korea was also presented.

The 9th World Conference on Biodegradable Polymers and Plastics will be held in the USA in 2006. J.L. Willett of the USDA accepted responsibility for preparing the next meeting.

In-Joo Chin <ichin@inha.ac.kr>, conference secretary, is a professor in the Department of Polymer Engineering in Seoul, Korea.



Functional and Nano Systems

by Courtney Young

Because functional and nano systems are of current national and international interest, the **2nd IUPAC International Symposium on Macro- and Supra-Molecular Architectures and Materials (MAM-04): Functional and Nano Systems**, held 13–17 June 2004 in Missoula, Montana, USA, was extremely timely. Topics included, but were not limited to, minerals, metals, materials, processes, self-assembly, adsorption, characterization and analysis, interphases, biomaterials, biomedicine, bio-inspired technology, design and modeling, composites, coatings, membranes, thin films, gels, colloids, electronics, polymers, photonics, biochips, quantum dots, magnetic clusters, sensors and controls, imaging and patterning, genetic engineering, drug delivery and diagnostics, machines and robotics, batteries and fuel cells, surface modification, synthesis, and catalysis.

These topics and their applications were covered by 74 presentations of which 20 were invited, 22 were contributed and 32 were posters. Dick Jones (University of Kent, Canterbury, UK), as the official IUPAC representative, provided an excellent introduction of the IUPAC organization during the opening session.

Poster presenters also gave "one-minute" presentations during a session to entice the audience to attend their posters. Needless to say, this helped make the poster session a highlight of the symposium. Poster awards were given to Tomohiro Iwasaki, Waseda University, Japan (1st place); Sun Min Park, Pohang University, Korea (2nd place); and Dan Nielsen, University of Montana, USA (3rd place) for best presentations.

MAM-04 was chaired and organized by Ed Rosenberg and Kurt Geckeler. The organizers edited and distributed the proceedings of the symposium at the meeting. A number of lectures were delivered by distinguished international experts, including Nobel Prize Laureate Robert Huber (Germany), who gave a plenary lecture.

Overall, the symposium was very successful and the meeting objectives were met. It provided an interdisciplinary forum for scientists and engineers to meet and discuss their work. Before, during, and after sessions, groups of various sizes were observed, often with a speaker, having their own meetings. Such meetings were also a constant at dinners each of the evenings that hosted dinners were not scheduled.

Finally, it is worth noting that, unfortunately, participants from China and the Middle East encountered problems in obtaining visas to travel to the USA. In some cases, registered participants were unable to attend the symposium, and lecture sessions had to be rearranged.

Courtney Young is a professor in and head of MontanaTech, Metallurgical and Materials Engineering Department of the University of Montana, USA.

π-Electron Systems

by George Malliaras and John Reynolds

The **Sixth International Symposium on Functional π-Electron Systems (Fπ6)** was held on 14–18 June 2004 at the Cornell University campus, in Ithaca, New York, USA. The symposium was attended by about 500 participants and sponsored by the Kinki Chemical Society of Japan, the Air Force Office of Scientific Research, and the Office of Naval Research.

This symposium series began in 1989 in Osaka, Japan, as the "International Symposium on Functional Dyes." Past symposia were held in Kobe (Japan, 1992), Santa Cruz (California, 1995), Osaka (Japan, 1999) and Ulm (Germany, 2002). The name of the symposium was changed a few years back to reflect its broadened scope and to align it with recent developments in academic, industrial, and government research institutions.

The Fπ symposium series has developed through the years to become a unique forum for the discussion of structure-properties relationships in π-conjugated materials. These include organic semiconductors (with applications in display technologies and low-cost electronics), as well as biologically relevant mate-

Polymer LEDs made by Gang Yu, 5" x 5" and 5.1" diameter, to commemorate the 2000 Nobel Prize. These single pixel polymer LEDs are fixed digital images with a resolution of 80 dpi. (Courtesy of Alan Heeger and Gang Yu of DuPont Displays.)

rials such as DNA.

Fπ6 brought together chemists, physicists, biologists, and engineers to discuss recent developments in the field of π-conjugated materials. The technical program included 5 keynote lectures, 35 plenary lectures, 90 highlighted and contributed oral presentations, and 3 extensive poster sessions. The opening address was given by Zen-ichi Yoshida (Kyoto University), founder of the Fπ series.

The theme of the symposium was defined by the five keynote lectures. Each day began with a keynote lecture and was followed by plenary, contributed, and poster presentations. The keynote lectures were given by:

- Roald Hoffmann (Cornell): "Waiting to be Made: Some as (yet) Unknown π-Electron Systems"
- Andrew Holmes (Cambridge): "Controlled Synthesis of Light-Emitting Polymers"
- Klaus Müllen (MPI Mainz): "Putting the Molecules into Molecular Electronics"
- Gary Schuster (Georgia Tech): "Long-Distance Charge Transfer in Duplex DNA: Mechanism and Meaning"
- Yasuhiko Shirota (Osaka): "Synthesis, Properties, and Applications of Amorphous Molecular Materials"

The plenary, contributed and poster presentations addressed advances in:

- Synthesis of functional π-electron materials
- Processing and patterning
- Structure (bulk, surface/interface)
- Properties (electronic, biological, mechanical, etc.)
- Applications
- Industrial aspects of π-electron materials

Located in the Finger Lakes region, Ithaca provided an ideal setting for the meeting. The region features a multitude of scenic gorges, state parks, and award-winning wineries. Combining the best of rural and urban life, Ithaca was voted one of the top 10 best places for families to live in the USA. The state-of-the-art lecture halls of the Cornell campus, the availability of dormitory rooms (in addition to regular hotel rooms) at walking distance from the lecture rooms, and easy access to the Internet and exercise facilities enhanced the quality of the meeting. Fπ7 will be held in Osaka (Japan) in May 2006.

George Malliaras <george@ccmr.cornell.edu>, organizer of the Fπ6, is an assistant professor of Materials Science and Engineering at Cornell University in Ithaca, New York, USA. John Reynolds <reynolds@chem.ufl.edu> is a professor at the University of Florida in Gainesville, Florida, USA.

Biomolecular Chemistry

by David StC. Black

The **7th International Symposium on Biomolecular Chemistry**—ISBOC-7—was held at the University of Sheffield from 27 June to 1 July 2004. The first thing to note is that the previous descriptor in the title, namely "Bioorganic" was deliberately replaced by the word "Biomolecular," in order to broaden the scope and allow the introduction of "bioinorganic" chemistry. This series of conferences is planned by the Biomolecular Subcommittee of the IUPAC Division of Organic and Biomolecular Chemistry. The conference was master-minded by Michael Blackburn and his committee, in collaboration with the Royal Society of Chemistry, and by all measures was a great success.

The key ingredient in any conference is a high quality scientific content. The approximately 250 participants were given a veritable feast of stimulating and informative plenary and invited lectures, and they joined in many vigorous and stimulating discussions. The statistics show that there were 7 plenary, 5 keynote, and 23 invited lectures, 38 contributed oral presentations, and 86 poster presentations. The posters were on display for the entire duration of the symposium, and extended lunch and tea breaks allowed generous time for discussion.

Biomolecular chemistry is arguably the most important area of chemistry for development during this century, as it deals with fundamental questions relating to the controlling mechanisms of life itself. The scene was set in the opening lecture, the Alexander Todd Lecture, sponsored by Yusuf Hamied of Cipla Ltd. (Bombay and London), and delivered by George Whitesides (Harvard University, USA), who dealt with both the fundamental and applied aspects of biomolecular chemistry. Whitesides spoke of the need to understand the fundamental nature of the cell as a system of chemical reactions, and the shift in emphasis in biology from structure to function, leading for example to important research on protein-ligand interactions, which by their floppy nature are still beyond the accuracy of modelling techniques. Moving to the applied area of the pharmaceutical industry, practicalities such as cost become highly significant, and change will be needed in planning future drug development. Polyvalency is a promising approach, and genomics provides a new tool, but new assays will need to be simple and inexpensive, if costs are to be contained. The current state of structure-based

drug discovery was outlined by Hans-Joachim Böhm (Roche, Basel, Switzerland), who showed that computational prediction of binding affinities have led to enhanced hit rates.

The University of Sheffield Krebs Lecture was given by Stephen Lippard (MIT, USA), whose bioinorganic research is aimed towards an understanding of the biological oxidation of hydrocarbons at non-heme diiron centres, and to the development of practical synthetic models that will achieve the same thing in vitro. The theme of mixed-valent iron systems was developed further by Carl Wieghardt (Mülheim, Germany) and James Cowan (Ohio State University, USA). The bioinorganic theme was neatly linked back into a major bioorganic area by Bengt Nordén (Chalmers University, Gothenburg, Sweden) in a lecture on the role of binuclear ruthenium intercalators in the study of DNA binding mechanisms, which emphasized the importance of kinetic rather than thermodynamic recognition.

Dieter Seebach (ETH, Zürich, Switzerland) brought us up to date with the exciting new properties of oligomers from homologated proteinogenic amino acids. In only eight years, the enormous amount of synthetic work required has been more than repaid by the results. The critical tertiary structural motifs occur in smaller oligomers than for the proteins, and consequently these oligomers are a practical prospect for diagnostic and pharmaceutical applications.

The role of real proteins in enzymes was the subject of the lecture on dihydrofolate reductases by Stephen Benkovic (Penn State University, USA), which brought all the armory of physical organic chemistry to bear on the understanding of conformational changes which are responsible for function. Dudley Williams (Cambridge, UK) advanced the hypothesis that increasing hydrogen bonding results in the strengthening of existing ones and leads to significant lowering of ligand-protein binding energies. All the leading experts then participated in a remarkably lively and extended discussion on the possible novelty and validity of this hypothesis. Those graduate students present will look back on this discussion in years to come and realize its significance. Further research on enzymatic transition state structures was described by Vern Schramm (Albert Einstein College of Medicine, New York, USA) on N-ribosyltransferases: the design of new drugs can be advantageously based on matching the transition state structure. Using a combinatorial screening approach, enzymes can be evolved to provide mutants which can show enhanced enantioselectivity in reactions that are valuable for synthetic organic chemistry. Manfred Reetz (Mülheim, Germany) has developed this technique and shown that even more exciting applications lie ahead. Experimental evidence emphasises that enantioselectivity arises in the dynamic reaction process, and not as a result of the fit of the substrate or product.

Just one dramatic example of the rapid progress being made in dealing with large biological macromolecules was illustrated in the lecture by Carol Robinson (Cambridge, UK), who explained how mass spectrometry can now be used to learn about interactions between intact proteins and small molecules. The use of nano-electrospray mass spectrometry has allowed the molecular mass measurement of several ribosymes, which are composed of three very large RNA molecules and over 50 different proteins.

The scope of the conference was sufficiently broad to include lectures on the biological impact of small RNAs (Kazunari Taira, Tokyo, Japan) and synthetic multifunctional pores (Stefan Matile, Geneva, Switzerland).

The overall framework of the conference grouped the oral and poster presentations into six symposia, on proteins and peptides, bioinorganic chemistry, synthetic and bioorganic chemistry, structure and mechanism, biothermodynamics, and biospectroscopy. The posters were available for most of the conference and relaxed coffee and lunch breaks provided ample opportunity for discussion of them. In addition to an excellent conference banquet in the historic Cutlers Hall, a special feature of the social program was a piano recital by the internationally renowned local pianist Benjamin Frith on the Bosendorfer Imperial grand piano in the Firth Hall of Sheffield University.

ISBOC-8, the next conference in this exciting—and increasingly important—series, will be held in approximately two years' time in Florida, USA, chaired by Russell Kerr.

David StC. Black <d.black@unsw.edu.au> was IUPAC representative at the ISBOC-7. He is now IUPAC Secretary General, and has been a member of the IUPAC Division of Organic and Biomolecular Chemistry since 1994. He is a professor at the University of New South Wales, in Sydney, Australia.

Food Safety

3–4 March 2005, Brussels, Belgium

The **3rd AOAC Europe /Eurachem Symposium: Legal Limits on the Road to Food Safety—Establishing Sound Criteria for Compliance Decisions** will be held 3–4 March 2005 in Brussels, Belgium. The symposium is intended for an audience of food and feed analysts, quality-assurance managers, administrators, and academics.

Quality-assurance managers as well as competent authorities have to consider a number of factors when deciding how to comply with European Union or national legislation. They require more information than just analytical results because there are so many different standards for food safety. Critical issues to be addressed by this symposium are as follows:

- regulatory issues and requirements
- assessment of compliance
- sampling and its uncertainty
- use of different methods of analysis
- quality issues in analysis and measurement uncertainty
- data tracking and tracing as part of quality control

The symposium will include lectures by invited speakers, a poster session, and five-minute poster presentations. The symposium will be held at the Hotel Bedford in the center of Brussels.

For more information contact Margaret Lauwaars <Margaret.lauwaars@cc.eu.int>, IRMM FSQ, Retieseweg 111, B-2440 Belgium.

Analytical Methodologies in Trace Metal Speciation

6–9 April 2005, Luxembourg

The International Association of Environmental Analytical Chemistry will hold the **10th IAEAC Workshop on Progress in Analytical Methodologies in Trace Metal Speciation** in Luxembourg, 6–9 April 2005.

This workshop will address the current and future status of chemical speciation. The program will include keynote lectures and podium and poster sessions covering recent developments in the study of chemical species in environmental and biological systems.

Main topics include the following:

- speciation in food and in food production
- importance of speciation in industrial processes
- role of speciation in transport and bioavailability in biological systems
- speciation and global change
- new perspectives in the determination of labile and non-labile chemical species in environmental compartments
- microbial transformation of inorganic metals and metalloids
- speciation of emerging pollutants

http://chemspec2005.crpgl.lu

Hydrogen Energy

13–15 July 2005, Istanbul, Turkey

The first meeting of the **International Hydrogen Energy Congress** will be held 13–15 July 2005 at the Istanbul Lutfi Kirdar Convention Center, where 6000 delegates can have parallel sessions in 26 rooms at the same time. Furthermore, an exhibition area of about 10 000-square meters is provided inside the conference center for the exhibitors.

Increasing interest in hydrogen energy has made this meeting necessary. It will bring together researchers and practitioners from industry, academia, and government from all over the world. IHEC-2005 will offer a full range of hydrogen-energy-related invited lectures, technical sessions, and exhibits. The congress and exhibition are planned to be the largest event ever organized on the topic of renewable and hydrogen energy technologies.

For further details, including registration, the scientific timetable, and social activities visit the congress Web site.

www.ihec2005.org

Polymer Gels and Networks

10–14 July 2005, Prague, Czech Republic

The **68th Prague Meeting on Macromolecules and 44th Microsymposium** will provide a discussion forum for participants from academia and industry interested in the science and technology of synthetic and natural polymer gels and networks. The meeting will place emphasis on theoretical and experimental studies of the relations between the formation, chemical composition, structure, and properties of polymer networks and gels. Special attention will be paid to hydrogels used in biomedical applications, such as drug delivery and tissue engineering.

Meeting topics include preparation and chemical modification of networks and gels; gelation and network formation; gel and network states of matter; gels in life sciences, technology, and applications. The technical program includes about 10 main lectures, 10 invited lectures, and 20 oral lectures. Those participants who wish to present an oral lecture should submit a brief summary with the preliminary registration card to the PMM Secretariat before 31 December 2004. Two poster sessions are planned as well. The number of posters is not limited.

DEADLINES: Preliminary registration and offers of oral lectures: **31 December 2004**; final registration and abstracts: **15 April 2005**.

See calendar on page 36 for contact information

www.imc.cas.cz/sympo/44micros.html

Nanostructured Advanced Materials

5–8 September 2005
Stellenbosch, South Africa

The **Third IUPAC Workshop on Advanced Materials** (WAMIII) focusing on "Nanostructured Advanced Materials," will be held from 5–8 September 2005 in Stellenbosch, South Africa. The workshop will feature invited and submitted papers and poster contributions in addition to five plenaries covering the five main themes:

- nanoparticles: centers in application (gold nanoparticles, nanomagnet exciting new particles)
- nano-electronics
- electrospinning
- bottom-up design and self-assembly
- synthesis application and characterization

Based on the resounding success of the previous meetings in Hong Kong and Bangalore, this workshop should again strengthen the ties and collaborations between experts around the world and hopefully invigorate developments on the African Continent, especially in South Africa.

Potential lecturers are invited to submit abstracts by 1 March 2005.

See calendar on page 37 for contact information

www.sun.ac.za/unesco/Conferences/WAMIII/HOMEPAGE2005.htm

Visas

It is a condition of sponsorships that organizers of meetings under the auspices of IUPAC, in considering the locations of such meetings, should take all possible steps to ensure the freedom 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 application 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.

How to Apply for IUPAC Sponsorship

Conference organizers are invited to complete an Application for IUPAC Sponsorship (AIS) preferably 2 years and at least 12 months before the Conference. Further information on granting sponsorhsip is included in the AIS and is available upon request from the IUPAC Secretariat or online. <www.iupac.org/symposia/application.html>.

Physics and Sustainable Development

31 October–2 November 2005
Durban, South Africa

The United Nations has declared 2005 to be the International Year of Physics in commemoration of the 100 th anniversary of Einstein's "Miraculous Year" in which he published three of his most famous papers. Part of the planned celebrations is the **World Conference on Physics and Sustainable Development** to be held 31 October to 2 November 2005 in Durban, South Africa. Participants from developed and developing nations will join together to examine the contributions that physics has made to society in order to formulate and sharpen action-oriented plans for the contributions that it can and should make in future. This conference will be cosponsored by UNESCO, the Abdus Salam International Centre for Physics, the International Union of Pure and Applied Physics, and the South African Institute of Physics.

The World Conference will be the first global forum to focus the physics community on development goals and to create new mechanisms of cooperation toward their achievement. The conference will be held in conjunction with the 2005 General Assembly of IUPAP and is expected to attract 400–500 participants from across the globe.

Four themes have been chosen for the conference: Physics and Economic Development, Physics and Health, Energy and the Environment, and Physics Education. An International Advisory Committee comprised of Nobel Laureates and other international science leaders will work with a Planning Committee to prepare the program. In part, the conference will be a follow up to the UNESCO-ICSU World Conference on Science which was held in June 1999 and sought to strengthen the ties between science and society, as well as to the broader United Nations World Summit on Sustainable Development that was held in Johannesburg in the summer of 2002. The conference is expected to lead to important action items that organizations of physicists, including all of the national physical societies, will join together to implement collectively.

www.wcpsd.org

Mycotoxins and Phycotoxins

21-26 May 2007, Istanbul, Turkey

The **XIIth International IUPAC Symposium on Mycotoxins and Phycotoxins** will be held 21–26 May 2007 in Istanbul, Turkey. Since IUPAC initiated this series of symposia in 1973 in Sweden, 10 symposia have been held in the following locations: Pulawy, Poland; Paris; Lausanne, Switzerland; Vienna; Pretoria, South Africa; Tokyo; Mexico City; Rome; Guaruja, Brazil and Maryland, USA. These symposia, which have become the principal interdisciplinary meetings on mycotoxins and phycotoxins, provide overviews of research and developments in analytical chemistry, risk assessment, effects on human health, control, and remediation strategies.

The XIIth meeting will comprise a number of plenary lectures reviewing the principal areas of the symposium plus contributed papers selected by a Scientific Committee. As with previous symposia, poster sessions will play an important part in the symposium and there will be a concurrent instrument and manufacturers exhibition.

This symposium will be hosted by Tubitak-Ankara Test and Analysis Laboratory (ATAL), founded in 1994. Tubitak-ATAL provides testing, analyses, consulting, and training, and specializes in mycotoxins analysis and method validation.

A call for contributed papers will be made in May 2006.

www.atal.tubitak.gov.tr/iupac2007-mycotoxin

Mark Your Calendar

Upcoming IUPAC-sponsored events
See also www.iupac.org/symposia
for links to specific event Web site

2004

16–18 November 2004 • Chemical Education and Sustainable Development • Moscow, Russia
The 2nd International Conference on Chemical Education and Sustainable Development
Prof. P.D. Sarkisov, Mendeleyev University of Chemical Technology, Miusskaya sq., 9 RU-125047 Moscow, Russia, Tel.: +7 095 973 2419, Fax: +7 095 200 4204, E-mail: rector@muctr.edu.ru or tarasnp@muctr.edu.ru

30 November–3 December 2004 • Agriculture • Jesenik, Czech Republic
Chemistry for Agriculture
Dr. Adam Pawelczyk, Wroclaw University of Technology, Smoluchowskiego 25, 50-370 Wroclaw, Poland, Tel.: +48 (0) 71-3202930, Fax: +48 (0) 71 3203469, E-mail: adam.pawelczyk@pwr.wroc.pl

6–8 December 2004 • Fats, Oils, and Oilseeds Analysis and Production • Tunis, Tunisia
IUPAC-AOCS Workshop <www.aocs.org/meetings/>

2005

14–17 February 2005 • Crop Protection Chemistry in Latin America • San Jose, Costa Rica
International Workshop on Crop Protection Chemistry in Latin America: Harmonized Approaches for Environmental Assessment and Regulation
<www.iupac.org/symposia/2005/crop-protection-chemistry>

20–25 February 2005 • Nanotechnology • Luxor, Egypt
Nanotechnology: Science and Application (NanoTech Insight '05)
Dr. Mohamed Abdel-Mottaleb, Institute of Physics, TU-Chemnitz, Department of Optical Spectroscopy & Molecular Physics, Reichenhainerstr. 70, D-09107 Chemnitz, Germany
Tel.: +49 0 371 531 4807, Fax: +49 0 371 531 3060, E-mail: mohamed.abdel-motaleb@physik.tu-chemnitz.de

27 February–2 March 2005 • Heterocyclic Chemistry • Gainesville, Florida, USA
6th Florida Heterocyclic Conference
Prof. Alan R. Katritzky, University of Florida, Dept. of Chemistry, Gainesville, FL 32611-7200, USA, Tel.: +1 352 392 0554, Fax: +1 352 392 9199, E-mail: katritzky@chem.ufl.edu

17–22 April 2005 • Nuclear Analytical Methods • Rio de Janeiro, Brazil
8th International Conference on Nuclear Analytical Methods in the Life Sciences
Prof. Dr. Elisabete De Nadai, Universidad de São Paulo, Centro de Energia Nuclear na Agricultura, Laboratório de Radioisótopos, Caixa Postal 96, CEP 13400-970 Piracicaba, São Paulo, Brazil, Tel.: +55 19 34294655, Fax: +55 19 34294654, E-mail: lis@cena.usp.br

21–22 April 2005 • Clinical Laboratory • Barcelona, Spain
Third European Symposium on Clinical Laboratory and In Vitro Diagnostic Industry
Dr. Josep Lluis Bedini, Hospital Clínic, Laboratori Core, Barcelona, E-08036 Catalonia, Spain, Tel.: +34 93 227 98 69, Fax: +34 93 227 93 76, E-mail: jlbedini@clinic.ub.es

4–9 June 2005 • Polymers and Biopolymers • Réduit, Mauritius
8th UNESCO School and IUPAC Conference on Macromolecules: "*Polymers for Africa*"
Dr. Dhanjay Jhurry, Department of Chemistry, University of Mauritius, Réduit, Mauritius, Tel.: +230 454 1041 - ext 1472, Fax: +230 465 6928, E-mail: djhurry@uom.ac.mu

26–30 June 2005 • Polymeric Materials • Prague, Czech Republic
23rd Discussion Conference PMM Current and Future Trends in Polymeric Materials
Prof. Miroslav Raab (Chairman), c/o P.M.M. Secretariat, Institute of Macromolecular Chemistry AS CR, Heyrovského nám. 2 CZ - 162 06 Praha 6, Czech Republic, Tel.: + 420 296 809 281, Fax: +420 809 296 410, E-mail: sympo@imc.cas.cz

10–14 July 2005 • Polymer Gels • Prague, Czech Republic
68th Prague Meeting on Macromolecules and 44th Microsymposium on "*Polymer Gels and Networks*"
Prof. Michal Ilavsky, Academy of the Sciences, Insitute of Macromolecular Chemistry, Heyrovského nám. 2 CZ-162 06 Prague 6, Czech Republic, Tel.: +420 296 809 281, Fax: +420 809 296 410 , E-mail: ilavsky@kmf.troja.mff.cuni.cz

17–21 July 2005 • Organometallic Chemistry • Geneva, Switzerland
13th International Symposium on Organometallic Chemistry Directed Towards Organic Synthesis (OMCOS-13),
Prof. E. Peter Kündig, Department of Organic Chemistry, University of Geneva, 30 Quai Ernest Ansermet, CH 1211 Geneva 4, Switzerland, Tel.: +41 22 379 6526, Fax: +41 22 328 7396, E-mail: Peter.Kundig@chiorg.unige.ch

17–22 July 2005 • Carotenoids • Edinburgh, Scotland
14th International Symposium on Carotenoids
Prof. Andrew J. Young, School of Biological and Earth Sciences, John Moores University, Byrom St. Liverpool L3 3AF, UK, Tel.: +44 151 231 2173 / 3575, Fax: + 44 151 207 3224, E-mail: a.j.young@livjm.ac.uk

13–21 August 2005 • IUPAC 43rd General Assembly • Beijing, China
IUPAC Secretariat, Tel.: +1 919 485 8700, Fax: +1 919 485 8706, E-mail: secretariat@iupac.org

14–19 August 2005 • IUPAC 40th Congress—Innovation in Chemistry • Beijing, China
Prof. Xibai Qiu, IUPAC-2005 Secretariat, c/o Chinese Chemical Society, PO Box 2709, Beijing 100080, China, Tel.: +86 (10) 62568157, Fax: +86 (10) 62568157, E-mail: qiuxb@iccas.ac.cn **(see back cover)**

21–25 August 2005 • Solution Chemistry • Portoroz, Slovenia
International Conference on Solution Chemistry
Prof. Vojko Vlachy, Faculty of Chemistry and Chemical Technology, University of Ljubljana, Aškerceva 5, POB 537, SL 1001 Ljubljana, Slovenia, E-mail: vojko.vlachy@uni-lj.si

30 August–3 September 2005 • Learning Science • Barcelona, Spain
European Science Education Research Association—"Contributions of Research to Enhancing Students' Interest in Learning Science"
Dr. Roser Pinto, CRECIM Centre de Recerca per a l'Educacio Cientifica i Matematica, Campus de la UAB-Edifici G5, E-08193 Bellaterra, Barcelona, Spain, Tel.: +34 93 5813206, Fax: +34 93 5811169, E-mail: roser.pinto@uab.es

4–9 September 2005 • Analytical Spectroscopy • Antwerp, Belgium
Colloquium Spectroscopicum Internationale XXXIV
Prof. Rene Van Grieken, Department of Chemistry, University of Antwerp, B-2610 Antwerp, Belgium, Tel.: +32 3 820 2362, Fax: +32 3 820 2376, E-mail: rene.vangrieken@ua.ac.be

5–9 September 2005 • Nanostructured Advanced Materials • Stellenbosch, South Africa
3rd IUPAC Workshop on New Directions in Chemistry—Workshop on Nanostructured Advanced Materials (WAM III)
Prof. R.D. Sanderson, University of Stellenbosch, Department of Chemistry & Polymer Science, Private Bag X1, Matieland 7602, South Africa, E-mail: rds@sun.ac.za

10–13 September 2005 • Macromolecule-Metal Complexes • Tirrenia (Pisa), Italy
11th IUPAC International Symposium on Macromolecule-Metal Complexes (MMC-11)
Prof. Francesco Ciardelli, Chemistry and Industrial Chemistry Department, University of Pisa, via Risorgimento, 35, I-56126 Pisa, Italy, Tel.: +39 0502219229, Fax: +39 0502219320, E-mail: fciard@dcci.unipi.it

11–15 September 2005 • Boron Chemistry • Sendai, Japan
12th International Meeting on Boron Chemistry
Prof. Yoshinori Yamamoto, Department of Chemistry, Graduate School of Science, Tohoku University, Sendai, Japan, 980-8578, Tel.: +81 22 217 6581, Fax: +81 22 217 6784, E-mail: yoshi@yamamoto1.chem.tohoku.ac.jp

2006

10–13 January 2006 • Green Chemistry • Delhi, India
Second International Symposium on Green/Sustainable Chemistry
Dr. M. Kidwai, Department of Chemistry, University of Delhi, Delhi-110007, India, Fax: +91 11 27666235, E-mail: mkidwai@mantraonline.com

6–11 August 2006 • Pesticide Chemistry • Kobe, Japan
11th International Congress of Pesticide Chemistry
Dr. Hisashi Miyagawa, Division Applied Life Sciences, Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan, Tel.: +81 75 753 6118, Fax: +81 75 753 6123, E-mail: miyagawa@kais.kyoto-u.ac.jp

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