

# IUPAC

## **Global Perspective in Chemistry**

**Biennial Report, 1998–1999**

Additional information is on the IUPAC Web site: <http://www.iupac.org>

*IUPAC's mission is to advance the worldwide aspects of the chemical sciences\* and to contribute to the application of chemistry in the service of Mankind. In so doing, IUPAC promotes the norms, values, standards, and ethics of science and advocates the free exchange of scientific information and unimpeded access of scientists to participation in activities related to the chemical sciences.*

\*In recognition of the role of chemistry as a central science in a wide range of fields, the term "chemical sciences" is used here to refer to chemistry, broadly defined, and to those disciplines and technologies that make significant use of chemistry.



# IUPAC Biennial Report 1998–1999

Now in its 81<sup>st</sup> year, the International Union of Pure and Applied Chemistry (IUPAC) continues to carry out a wide range of activities, with particular emphasis on establishing international standards of chemical nomenclature and terminology, sponsoring international scientific conferences, and fostering global communication in chemistry. Two years ago IUPAC adopted its first Strategic Plan, based on ten long-range goals. During the 1998–1999 biennium, the Union has

undertaken a number of initiatives in line with the Strategic Plan and has made major changes in its structure and operations to address contemporary issues.

This report lists IUPAC's long-range goals and provides some illustrations of actions taken during the last two years toward meeting those goals. The Union's work is done almost entirely by hundreds of volunteer scientists from many countries who serve on IUPAC's many Committees and Commissions.

## Current IUPAC Activities Summarized by Strategic Goals

### Goal 1

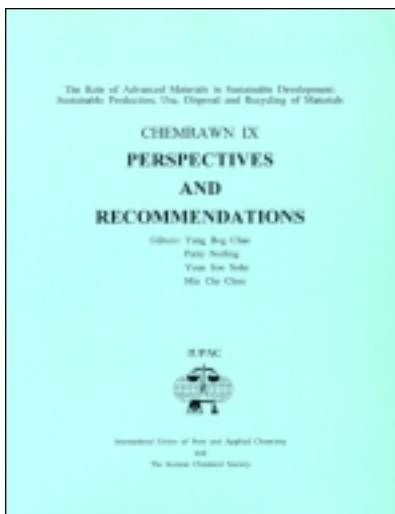
**IUPAC will serve as a scientific, international, nongovernmental body in objectively addressing global issues involving the chemical sciences. Where appropriate, IUPAC will represent the interests of chemistry in governmental and nongovernmental forums.**

The strategic thrusts under Goal 1 pertain primarily to broad issues that often involve extensive interdisciplinary activities outside the chemical sciences.

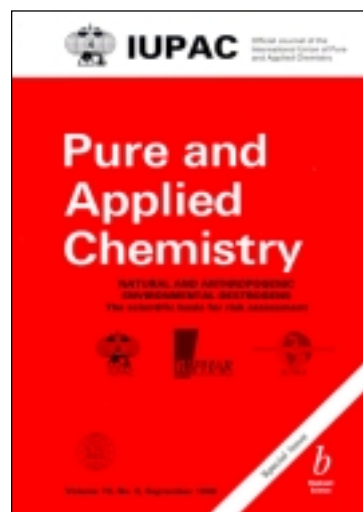
One of the Union's principal mechanisms for addressing global issues is the CHEMRAWN Program (*Chemical Research Applied to World Needs*), which has acted through a series of international conferences. To date, ten such conferences have taken place, and conferences are now planned in Education, Clean Energy, and Green Chemistry. The conferences are interdisciplinary, involving participation by world leaders from sci-

ence and technology and also government, industry, and the concerned public. Each conference develops and distributes to decision-makers throughout the world a set of recommendations complete with planned follow-up actions through a Future Actions Committee.

In 1995, IUPAC formed a Division of Chemistry and the Environment and a Division of Chemistry and Human Health, in order to develop programs on chemical aspects of these important areas. Environmental projects range from extensive critical evaluation and compilation of basic data on the kinetics of processes



occurring in the atmosphere (with recent publications covering some 650 pages) to a special publication on the potential problem of endocrine disrupters in the environment. The latter project, carried out in collaboration with the International Unions of Pharmacology and Toxicology, with additional financial support from the International Council for Science (ICSU), was designed to bring together objective technical and nontechnical information to support sound public policy discussions of the



subject. The document appeared as the September 1998 issue of IUPAC's official journal *Pure and Applied Chemistry* (PAC) and has been widely disseminated. As a result, and

in collaboration with ICSU SCOPE (Scientific Committee on Problems of the Environment), IUPAC has initiated a further evaluation of the state of the art

and of needed research in this area.

IUPAC has conducted several workshops aimed at developing a set of recommendations for international cooperation in the utilization of bioresources. The workshops are a follow-up to a meeting held in Phuket, Thailand (1997), at which an IUPAC Declaration concerning the conservation and sustainable utilization of biological diversity was adopted. Biodiversity workshops in Brazil and Thailand (the latter cofunded by UNESCO) have identified issues that must be confronted in different environments, and two additional workshops are planned before recommendations are formulated in 2001.

The *ad hoc* Committee on Chemical Weapons Destruction Technologies plans to complete and disseminate a report on the advantages and disadvantages of various technologies in an effort to provide scientific background to policy-makers on this highly significant topic.



## Goal 2

**IUPAC will contribute to the advancement of research in the chemical sciences throughout the world.**

IUPAC does not have the resources to conduct or support experimental research projects *per se*. The projects carried out by the Union's Divisions and Operational Committees provide information and networks that furnish important support for research. The universal language of chemistry that has been largely developed and maintained by IUPAC—its symbols, nomenclature, and terminology—are essential for worldwide communication and progress in the chemical sciences. Values of physical data, from atomic weights to thermodynamic quantities, are likewise accepted throughout the world because of the IUPAC label of quality and the participation of prominent scientists from physics and other sciences, as well as chemistry. Similarly, IUPAC sponsorship of meetings and symposia is a hallmark of scientific quality. Published lectures and proceedings of such meetings bring the information to a worldwide audience.

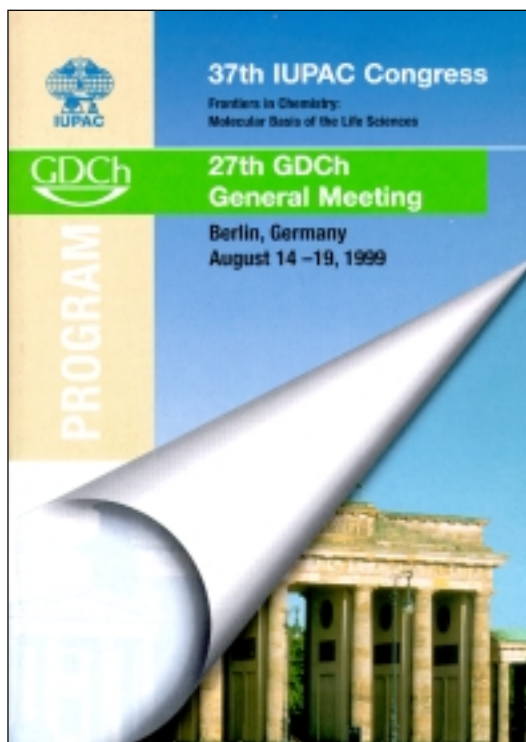
The biennial IUPAC Congress, which was organized by the Gesellschaft Deutscher Chemiker, was held in Berlin in August 1999 with the theme *Frontiers in Chemistry: Molecular Basis of the Life*

*Sciences*. Over 3000 chemists from 55 countries attended the meeting, which featured plenary lectures by Nobel laureates and other leading scientists who discussed new aspects of the chemical sciences and their relationships to cell biology, neuroscience, immunology,

genetics, and other biomedical sciences. This focus on the life sciences is particularly appropriate in view of the new IUPAC interdisciplinary program in biomolecular chemistry led by the re-named Division of Organic and Biomolecular Chemistry.

During 1998–1999, IUPAC sponsored 45 symposia, which were held in 24 countries and covered subjects that range over the whole gamut of chemistry. In

addition, a workshop on *Advanced Materials*, held in Hong Kong in July 1999, was the first in a new series on *New Directions in Chemistry*, each of which will highlight a particular area in which chemistry plays an important role. This series is intended to augment the Congress and traditional IUPAC-sponsored symposia in emphasizing the Union's commitment to encouraging research in broad areas of contemporary importance.





The first workshop was timely in view of IUPAC's current initiative on materials chemistry, which builds on existing programs in physical, solid state, and high-temperature chemistry and physical properties of synthetic polymers.

In collaboration with the International Union of Pure and Applied Physics, IUPAC formed a Task Group to establish priority of discovery/synthesis of elements 110–112 before the naming of these elements following IUPAC procedures. The Task Group's draft report has been reviewed in detail by the laboratories involved and is expected to be published in final form early in 2000.

A number of projects related to chemical nomenclature and terminology have been completed during the past two years, ranging from a revision of the basic nomenclature books in inorganic chemistry to glossaries of basic terms in polymer chemistry, photochemistry, and theoretical chemistry, along with updated nomenclature and terminology in analytical and organic chemistry. Overall,

27 separate documents provided definitive IUPAC recommendations for nomenclature, symbols, and terminology. In addition, recommendations have been published on the use of available computer programs for calculating electronic structure and properties of molecules to ensure meaningful presentation of results. Future directions for IUPAC's programs in chemical nomenclature were explored at the IUPAC Strategy Round Table on Representations of Structure: Nomenclature and its Alternatives, held in March 2000.

Other IUPAC projects provided critically evaluated data and standardized analytical methods, as published in 29 Technical Reports, most appearing in *Pure and Applied Chemistry*. The subjects cover a wide range of chemistry, including spectroelectrochemistry, nanostructures in electrochemistry, properties of high temperature superconductors, kinetic data useful for modeling in atmospheric chemistry, environmental catalysis, proper use of reference materials in chemical analyses, and variations of isotopic abundances of elements from different terrestrial and nonterrestrial sources.

Element	Name	Symbol
101	mendelevium	Md
102	nobelium	No
103	lawrencium	Lr
104	rutherfordium	Rf
105	dubnium	Db
106	seaborgium	Sg
107	bohrium	Bh
108	hassium	Hs
109	meitnerium	Mt



## Goal 3

**IUPAC will assist chemistry-related industry in its contributions to sustainable development, wealth creation, and improvement in the quality of life.**

From IUPAC's inception, the inclusion of the word "Applied" in its title signaled a strong tie to the chemical industry. IUPAC has long had a formal program of Company Associates and a Committee on Chemistry and Industry (COCI), which concentrates its efforts on programs and issues pertinent to industrial interests and concerns. During the last two years, the Union has begun a concerted effort to interact with leading chemical and pharmaceutical companies and especially with national and regional organizations that represent the chemical industry, such as the Chemical Manufacturers Association (CMA) in the United States, the Association of European Chemical Trade Associations (CEFIC), the Chemical Industry Association (CIA) in the United Kingdom, the Japanese Chemical Industry Association (JCIA), and Verband der Chemischen Industrie (VCI) in Germany. These discussions are designed to provide a framework for close cooperation between IUPAC bodies and relevant groups from industry, to establish areas in which IUPAC programs might advance industrial development, and to suggest ways in which industry might appropriately participate in mutually important projects.

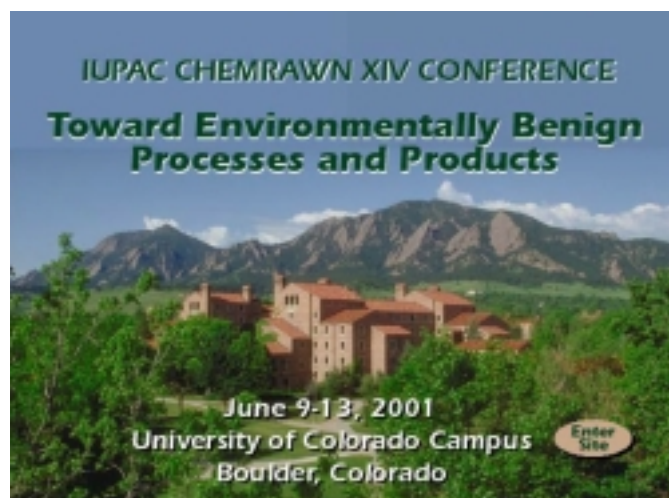
Some examples of IUPAC programs that are particularly attuned to the worldwide chemical industry are the following:

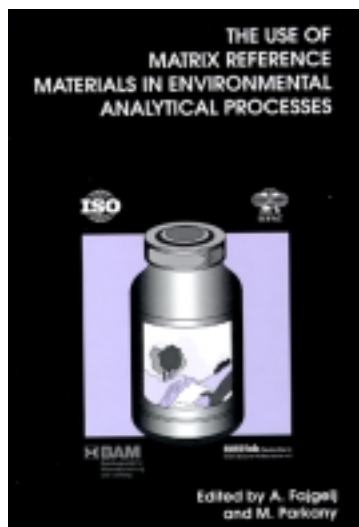
1. COCI's Workshops on Safety in Chemical Production, which have been held in developed

countries. A Workshop is being planned for 2000 in one of the eastern European countries.

2. The Training Program for Safety and Environmental Protection, in conjunction with UNIDO and UNESCO, which involves hands-on training for several weeks in the developed countries of experts in industrial plant safety from developing countries.
3. Two workshops on Reactions, Pathways, and Processes in Green Chemistry held during 1998, and
4. The planned CHEMRAWN Conference on Green Chemistry in 2001.

The special publications on chlorine and environmental estrogens (mentioned under Goal 1) address problems that are of particular importance to industrial processes. IUPAC has been asked to collaborate with the International Council of Chemical Associations (ICCA) to establish criteria for persistent organic pollutants to be regulated internationally.





The Union makes a vital contribution to a number of International Measurement Evaluation Programs (IMEP) that determine trace elements in areas as diverse as natural water, human serum, plastics,

and automobile catalysts and that are of immense value to the chemical industry and to human health.

Several IUPAC projects of broad scope have important applications in the chemical industry. For example, a Task Group on the Redefinition of pH scales is completing its work. Participation on the Task Force by representatives of industry and several national metrology laboratories will assure wide acceptance of the forthcoming IUPAC recommendations on this internationally important metric. Similarly, an Interdivisional Working Party on Harmonization of Quality Assurance Schemes has made significant contributions toward reaching international agreement on guidelines affecting industry.

The large-scale compilation of evaluated thermodynamic data supported by IUPAC finds widespread application in industry, as well as in academia. An ongoing project on the Characterization of Carbonaceous Materials is assem-

bling the various national standards for this important and widely used industrial material. Also, a number of IUPAC projects, carried out jointly by industrial and academic chemists, are devoted to synthetic polymers—for example, work on recycling of polymers; the influence of reprocessing on structure–property characteristics of PVC; studies on the biodegradable fibers made of poly( $\epsilon$ -caprolactone); methods of characterizing molecular weights and molecular weight distributions in commercial and other polymers; polymers for micro-electronic devices; and biomedical polymers.

IUPAC has established a web page providing information on national and regional patent regulations relating to biotechnology and genetic engineering, and plans to expand this effort to include a tutorial on intellectual property.

### IUPAC Commission on Biotechnology

Navigator to Global Biotechnology  
Biotechnology in a Global Environment.

Biotechnology has developed in the late 19<sup>th</sup> century with the discoveries in microbiology, enzymology and engineering. This has led to a fermentation industry centered around products such as ethanol, citric acid, amino acids. With the discovery of antibiotics and vitamins, this industry grew further but remained still global standard.

The development of genetic engineering in the early 1970s changed this situation dramatically. Fostered further scientific breakthroughs in immunology and cell biology, it has revolutionized the development of diagnostics, seed and agrochemicals and continues to impact on areas such as human health protection, animal breeding, environmental technology and energy production.

Industrialized countries have embraced this new technology and a new industry based on bio- and gene technology is emerging. Developing countries have become involved in major programs as well, but progress has been due to the limited resources in capital and manpower.

IUPAC, through its Commission on Biotechnology, is actively involved in disseminating information on development of biotechnology, and interacts with other committees of ICSU directed towards this goal.

Africa

Asia and Pacific

Europe

Middle East

North America

South America



## Goal 4

**IUPAC will facilitate the development of effective channels of communication in the international chemistry community.**

IUPAC's constituency consists of the entire world of chemistry, both organizational and individual. Because IUPAC activities impact chemical organizations as well as individual chemists, it has a unique communications challenge. Continuing contacts are maintained with the National Adhering Organizations (which are the Union's formal Members), and through the NAOs, IUPAC is in touch indirectly with national chemical organizations, industrial companies, and individual chemists. While channels of communication have been established to these constituencies, much effort is underway to improve them.

The Secretariat is concentrating on development of means for effective international electronic communication. Additional staff resources have been employed to develop the IUPAC web site as a reliable source of information, not only about IUPAC, but also as a facile means to link to other World Wide Web sites of interest to chemical scientists. This facility will be of particular value and importance to scientists and engineers who have inadequate access to institutional libraries containing the print editions of IUPAC publications. Through implementation of e-mail list servers, means have been provided for two-way communication among scientists involved in IUPAC programs and for dissemination of news in chemistry that is of interest within and outside IUPAC.

Descriptions of the activities of a number of IUPAC bodies are available on the IUPAC web site with cross-links to other specialized web sites maintained by indi-

vidual Commissions and other groups. In addition to published material from *Pure and Applied Chemistry* and *Chemistry International*, other publications, such as the *International Newsletter on Chemical Education* (published by IUPAC's Committee on Teaching of Chemistry), have begun to appear on the web site, as well as in printed form.

The use of print and electronic publication is being explored as an inexpensive complement to conventional scientific meetings. For example, two Symposia in Print (*Physical Organic Chemistry for 21<sup>st</sup> Century* and *Highlights in Bioorganic Chemistry*) have appeared in *Pure and Applied Chemistry*. The CHEMRAWN Committee is also considering the use of computer- and TV-based "virtual conferences" to obviate the need to travel to one location and thus reduce the high costs of CHEMRAWN conferences.

At the individual chemist level, IUPAC has had direct contact with several thousand interested scientists in 45 countries through the Affiliate Member Program since 1983. During the last two years, new programs and better means of communication have substantially augmented the traditional mechanisms.

The IUPAC Fellows Program was established with individuals who completed service on IUPAC bodies in 1997, and Fellowship has been offered to other former IUPAC volunteers via *Chemistry International* and the IUPAC web site. As additional scientists complete their terms on various IUPAC bodies and the number of Fellows increases, the program is expected to provide a means for two-

way communication on important issues in which IUPAC might make a significant contribution. Moreover, many Fellows are likely to be able and willing to serve

from time to time on future IUPAC task groups dealing with projects in their areas of expertise.

## Goal 5

**IUPAC will promote the service of chemistry to society in both developed and developing countries.**

In addition to the consideration of broad problems of societal interest, as discussed under Goal 1, IUPAC has obligations to society in general, outside the immediate realm of chemistry. In developed countries such obligations frequently take the form of participation in broad-based organizations devoted to science, metrology, and standardization, as well as the provision of chemical information of general value to the public. In developing

countries, IUPAC can sometimes best contribute to the development of chemistry by means of advice and assistance in improving organizational structures and/or the physical infrastructure on which scientific advances depend.

In July 1998, IUPAC organized a joint meeting with the African Association of Pure and Applied Chemistry (AAPAC) to investigate topics on which the two organizations can cooperate in improving the climate for chemistry in Africa, particularly in developing countries. An initiative in electronic communication is underway, with the intent of disseminating relevant information and possibly current publications in chemistry to individuals who have a strong background in chemistry but are working in areas where they have only limited access to world literature and infrequent intellectual contacts with their peers throughout the world. In this effort, IUPAC will work closely with other international organizations and build upon the broader electronic communication networks being put in place.

Three other examples of specific activities designed to benefit developing countries might be noted: (i) Conferences and workshops have recently been held in developing countries or aimed at attendees from developing countries, for example a workshop on bioorganic

INTERNATIONAL UNION OF  
PURE AND APPLIED CHEMISTRY

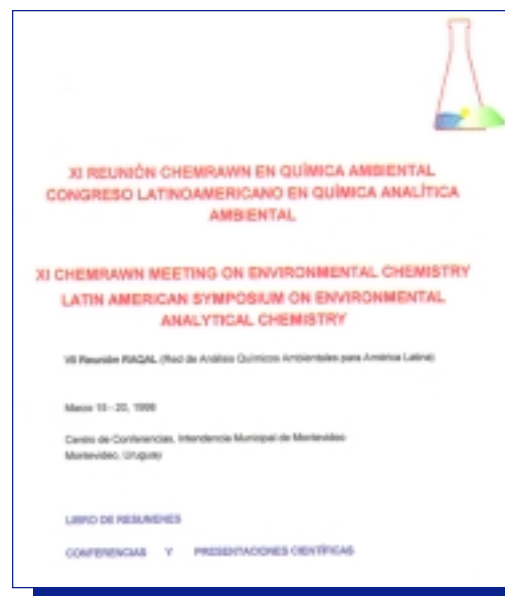


IUPAC-AAPC  
JOINT MEETING ON CHEMISTRY  
IN THE DEVELOPMENT OF AFRICA  
DURBAN, REPUBLIC OF SOUTH  
AFRICA, 11 JULY 1998

chemistry (Egypt, 1998), a postgraduate course in polymer science (Czech Republic, 1999) and a workshop on environmental analytical chemistry (Czech Republic, 1999). (ii) The problem of chemistry lab work in developing countries is now being addressed effectively by the global microchemistry program mounted by IUPAC's Committee on Teaching of Chemistry and UNESCO. (iii) Efforts are being made to produce and certify a standard reference material with contributions from many Latin American analytical chemists in several countries. The aims are twofold: to produce a standard material of particular importance to Latin American economies and to improve the competence of Latin American analytical chemists.

At the request of the presidents of the world's chemical societies, IUPAC will organize a meeting of leaders in chemistry from developed and developing countries to develop an action plan for continuing cooperative efforts.

In the more developed world, IUPAC's contributions to society are embodied partially by the appointment of formal representatives to many organizations outside chemistry, some dealing with other sciences, but others involved with metrology and regulatory development, which impinge on every aspect of indi-



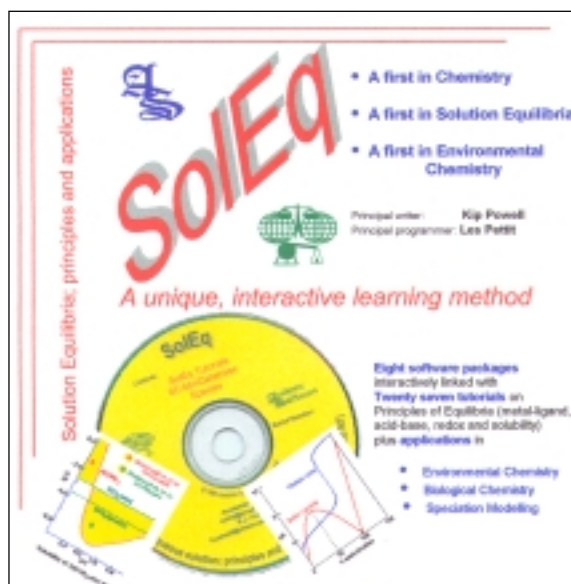
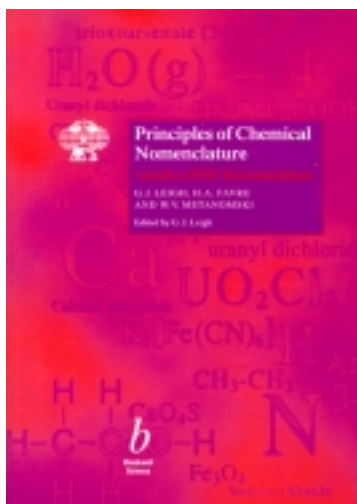
vidual and commercial society [e.g., the International Organization for Standardization (ISO), the International Committee on Weights and Measures (BIPM), and various committees of ICSU]. The names of chemicals, which are often ignored by chemists in using chemical formulas and computer-generated tables, are important in the legal and regulatory arenas, and the standardization of chemical measurement and analytical methods are of crucial importance to commerce and society.

## Goal 6

**IUPAC will utilize its global perspective to contribute toward the enhancement of education in chemistry and to advance the public understanding of chemistry and the scientific method.**

Scientists everywhere recognize the critical role played by formal and informal education at all levels, from kindergarten through graduate school, not only for future scientists but also for the general public. Educational systems, administration, and curricula vary drastically by country, locality, and individual school and teacher. IUPAC cannot hope to make an impact on detailed curricula or outreach activities in individual countries and localities, but it may be able to complement the efforts of national chemical societies and to coordinate exchange of information. IUPAC is exploring the roles it can realistically play in international science education with the aim of developing appropriate long-range policies. However, many effective programs are already underway and are illustrated in the following examples.

In addition to the long-established programs of trying to improve the teaching of chemistry at the primary and secondary levels, particularly in developing countries, IUPAC bodies are engaged in educational activities at other levels. Plans are being drawn for CHEMRAWN X: The Globalization of Chemical



Education: Preparing Chemical Scientists and Engineers for Transnational Industries. At intermediate levels, a report giving details of 21 tested and evaluated “Teaching Experiments in Solid State Chemistry” will shortly be made available to interested users on the web through the IUPAC web site. This educational resource is complemented by a bibliography on solid state chemistry to aid faculty seeking to add material on the solid state to introductory and inorganic chemistry courses.

Some specific recent projects relevant to education include a series of computer-based teaching tutorials of solution equilibria with contributions from analytical chemists in many countries; the creation of standard curricula and recommendations for minimum topics for lecture courses in polymer science; and a book on the principles of nomenclature that pro-

vides an easy-to-understand and usable overview of official IUPAC recommendations across the length and breadth of chemistry.

IUPAC's current educational activities

and potential initiatives in education are being examined by the recently appointed Education Strategy Development Committee (ESDC), which will recommend future program directions.

## Goal 7

**IUPAC will make special efforts to encourage the career development of young chemists.**

This Goal recognizes that the future development of the chemical sciences lies largely in the hands of the younger generation of scientists, who often encounter severe obstacles in an era of constrained resources. IUPAC is trying to develop programs that are perceived by "younger chemists" to be helpful to them and feasible for the Union to undertake within its resources.

Through the recently established IUPAC Prize for Young Chemists, the Union will encourage outstanding young research scientists at the beginning of their careers by making up to four awards each year for the most outstanding Ph.D. thesis in the general area of the chemical sciences, as described in a 1000-word essay. Each prize will consist of USD 1000 cash and travel expenses to the next IUPAC Congress. In keeping with IUPAC's status as a global organization, efforts will be made to assure fair geographic distribution of prizes.

With funding from IUPAC, the Gesellschaft Deutscher Chemiker, and UNESCO, 250 young scientists from developing countries were able to attend the IUPAC Congress in Berlin in 1999. Other NAOs also provided special funding for young chemists from their coun-

*International Union of Pure and Applied Chemistry*

### **IUPAC**

announces the 2000

### **IUPAC Prize for Young Chemists**

The IUPAC Prize for Young Chemists has been established to encourage outstanding **young research scientists** at the beginning of their careers.

The prize will be given for the **most outstanding Ph.D. thesis** in the general area of the **chemical sciences**, as described in a 1000-word essay.

#### **Prize USD 1 000 and travel**

to the IUPAC Congress in Brisbane, Australia, July 2001  
Each awardee will be invited to present a talk on his/her research and to participate in a plenary award session.

#### **Call for Nominations**

(deadline April 1, 2000)

For more information, including application form, please visit the IUPAC web site at [www.iupac.org/news/prize.html](http://www.iupac.org/news/prize.html) or contact the IUPAC Secretariat by e-mail at <secretariat@iupac.org> or by fax: +1 919 485 8706.



tries to attend the General Assembly and Congress in Berlin.

Where possible, special funding is sought for the attendance of young chemists at CHEMRAWN conferences. Often workshops for young chemists are held in conjunction with the conferences. IUPAC encourages financial support for young scientists at other symposia and

conferences.

The program now underway to restructure the organization and management of IUPAC's scientific programs is aimed partially at encouraging the participation of more young scientists. Some Divisions have been making special efforts to rejuvenate their membership and to recruit younger scientists.

## Goal 8

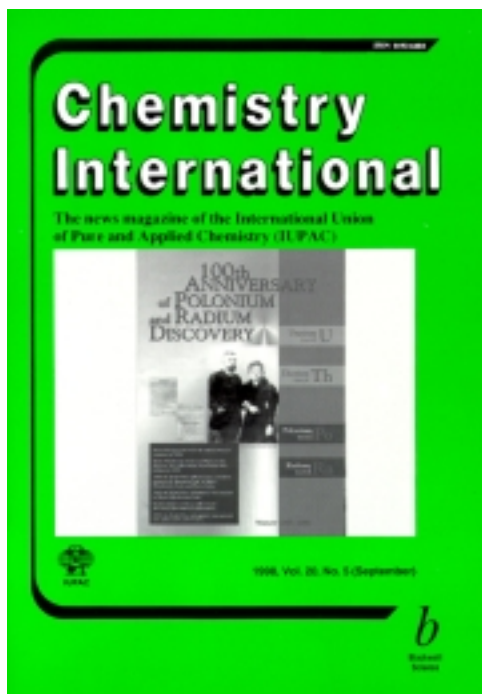
**IUPAC will broaden the geographical base of the Union and ensure that its human capital is drawn from all segments of the world chemistry community.**

IUPAC's membership consists of 45 NAOs, with an additional 16 Associate NAOs. While this representation is very good, there are still a number of countries with major chemical enterprises that do not participate in IUPAC activities. The principal strength of IUPAC lies in its broad, almost global, coverage, and its programs will be strengthened by inclusion of chemists from all countries that have significant activities in the chemical sciences and in the chemical industry.

Following successful regional meetings during 1996–1997 in North America, Europe, and Asia in order to facilitate interactions between the Union and chemists and their societies, IUPAC held a very productive meeting with the African Association of Pure and Applied Chemistry in July 1998. In addition,

the officers and other members of the Bureau have been making concerted efforts to attend national and regional meetings that provide an opportunity to meet with chemists from countries not now represented in IUPAC. Examples of meetings already attended are the Mendeleev Congress in Russia, the International Conference in Commemoration

of the 100<sup>th</sup> Anniversary of the Discovery of Polonium in Poland, the Federation of Latin American Chemical Societies, the First International Conference of South-East European Countries, and the Federation of European Chemical Societies. During the last biennium Bulgaria and Turkey returned to the Union as National Adhering Organizations, and three Associate NAOs were admitted: Cuba, Cyprus, and Tanzania.



IUPAC has convened meetings of the presidents of the world's regional chemical federations and societies in 1998 and 1999, and IUPAC officers participated in the meeting of national chemical society Presidents in Berlin in 1999. These fo-

rums provide opportunities to debate issues of international scope and to permit cooperative efforts to be developed by leadership of the world's major chemistry organizations.

## Goal 9

**IUPAC will encourage worldwide dissemination of information about the activities of the Union.**

Much of the valuable work done by IUPAC bodies is published only in *Pure and Applied Chemistry* or in specialized books and journals. Greater efforts are being made by individual IUPAC bodies and the Secretariat to distribute this information as early and as widely as possible to the relevant scientific community. Where possible, republication of reports in specialty journals continues, with references to *PAC* and hyperlinks to the IUPAC web site. In addition, the web site and ancillary sites operated by indi-

vidual IUPAC bodies now provide a further dimension to enhance dissemination. Many Provisional Recommendations as well as final Recommendations are now available on the IUPAC web site.

During the last two years, special efforts have been made to present the public face of IUPAC in invited articles and editorials for national chemical news magazines and related publications, for example, *Nachrichten aus Chemie*, *Science International*, and *Chemistry and Industry*.

## Goal 10

**IUPAC will assure sound management of its resources to provide maximum value for the funds invested in the Union.**

IUPAC is a volunteer organization. It accomplishes its goals through both the volunteer expertise and time of its scientific members and the stable financial support of its NAOs. IUPAC expenses are used primarily to support the work of its committees, their meetings, and publications. IUPAC has a continuing responsibility to demonstrate to its sponsors that all relevant management tools, including

the use of modern information technology, are employed to maximize productivity in the administration of the Union.

The comprehensive program to modify the organization and management of IUPAC's scientific work, approved by the Bureau and Council during the last biennium, is aimed at utilizing the Union's resources more effectively. The project-driven system will ensure that each pro-

posal is evaluated objectively *before* resources are committed, and the level of resources required can be monitored as the project progresses. The targeting of funds to active projects and the ability to provide funding as needed in a given time period will improve accountability and accelerate the completion of high-priority projects.

Almost all IUPAC bodies are increasingly finding it possible to minimize travel by using e-mail and web communications. The ability to post documents for comment and modification on the IUPAC web site and/or other sites has greatly increased the speed and efficiency of carrying out projects, while decreasing the costs in time and money.

IUPAC continues to obtain funds for specific projects from outside sources, such as ICSU and UNESCO, and expects to seek additional funds under the project-based system. In addition, significant partial support of a number of Commissions and other IUPAC bodies is provided by sources outside IUPAC. The

greatest indirect fiscal contribution to IUPAC's work continues to be derived from the employers of the members of IUPAC bodies, who cover salaries and often ancillary administrative expenses.

The Executive Director has made significant improvement in the efficiency of operation of the Secretariat, which has resulted in appreciable reductions in the cost of administration and is now permitting improvement in the operational support of IUPAC's scientific programs. Additional savings are anticipated under new publications contracts, which will permit enhancement of IUPAC's publications with equivalent or increased net income to the Union.

The finances of the Union are in excellent condition based on policies put in practice during the early 1990s. The good fiscal status will allow IUPAC to make the transition from a Commission-based organization to mainly a project-focused body. The IUPAC financial plan will support the strategic thrusts outlined in this document.