Secretary General's Column

Edwin D. Becker

During the last few months, the IUPAC Officers, Division Presidents, and others have spent a great deal of time considering the mission and structure of the Union in order to position IUPAC to best meet the challenges of the coming decade. As a prelude to the 39th General Assembly (see pages 96–104), I would like to give a summary of some of the major activities and actions.

Outside advice

As I indicated in a previous column (*Chem. Int.*, January 1997, pages 6–7), we held a meeting in London on 24 February, which brought together ten leaders in chemistry from eastern and western Europe. This meeting was a follow-up to one in North America (at the Belmont Conference Center). The London meeting was aimed at obtaining guidance on IUPAC's future roles in such areas as the objectives and priority areas of the Union; the service of chemistry to society, developing countries and the international community in general; the role of the Union in chemical education at all levels; international communication in the chemistry community; and the organization of IUPAC. The group provided 21 thoughtful recommendations on these and other topics. Many recommendations were reflected in later actions, as described below.

The third and final meeting in this series was held in Singapore on 21 June to sample opinion from a number of scientific leaders in the Asia/Pacific region. Recommendations will be available to the IUPAC Bureau for action at the General Assembly in Geneva.

Vice-President's Critical Assessment (VPCA)

Under our Bylaws, 'The Vice-President shall submit to the Bureau biennially a critical assessment of the programmes and projects of all IUPAC bodies'. Vice-President Jortner divided his 1997 Assessment into two major parts–Science Policy of the Union, and Structure and Function. In Part I, he commented on principles, general activities and future directions of the Union. In line with recommendations from the Belmont and London meetings, he proposed augmenting the general Objectives in the IUPAC Statutes with 13 Goals that would better define the mission and activities of IUPAC for the next few years. In Part II, he analyzed the current Divisional and Commission structure, and recommended specific changes to improve interdisciplinary activities and to close gaps in the Union's activities.

It is not possible here to give details of Prof. Jortner's VPCA, which runs to 34 pages. Copies have been distributed to Division Committees, Commission and Committee Officers and National Adhering Organizations and will be available at the General Assembly.

Organization and Management of IUPAC's Scientific Work

A special meeting of Division Presidents and Vice-Presidents in Frankfurt on 24 March focused on ways in which many of the recommendations in the VPCA can be implemented. The principal items discussed involve improved allocation of resources, possible modifications in the structure of Commissions and conduct of interdivisional activities. A major objective of virtually all participants was an increase in flexibility for Division Committees.

Building on the ideas expressed at this meeting and on historical efforts to bring about needed changes in the structure and operation of the Union, I presented to the Executive Committee (EC) at its meeting in Jerusalem on 6–7 April 1997 a paper that advocated moving much of our scientific work to a project-driven structure, with primarily time-limited Commissions selected to carry out well-defined projects in a specific period of time. Under this approach, Divisions would regard the entire worldwide chemical community as the resource both for ideas and for volunteers to carry out projects. Just how to generate such ideas, develop projects and seek out people able and willing to work on the projects is, of course, the key to success or failure. I am con-

vinced that ideas for useful work usually originate in a 'bottoms-up' manner, not as directed from 'top-down'. In fact, the establishment of the pool of Titular Members was to permit the undertaking of such 'top-down' projects generated outside the mainstream of Commission activity, but after several years there are very few such projects. If we implement the type of structure envisioned here, but without a good mechanism to identify and develop projects—and to secure the services of experts on the Commissions—we will destroy the valuable work that is now being done by Commissions. A great deal of thought and planning is needed to ensure that IUPAC can develop the processes to do this without the large cadre of long-term members of Commissions.

In this space I cannot begin to list the many advantages and possible pitfalls that I see in modifying our organization and procedures, and I am sure there are many others that I have not envisioned. The EC discussed this proposal in detail and decided to adopt the concept, but with the recognition that many details must be examined before it can be implemented. The EC also endorsed in principle the recommendations in the VPCA to establish clear Goals for IUPAC but, again, recognized that further thought and discussion are needed to refine the Goals. The EC concluded that a broad-based committee would be needed to develop the necessary strategic thrusts and to consider their implementation in terms of the structure and guidelines for scientific activity. The EC therefore authorized the formation of a Strategy Development and Implementation Committee (SDIC), to report back to the EC in April 1998. From the findings and recommendations of the SDIC, the EC expects to formulate specific proposals for approval by the Bureau in September 1998 and for necessary action by Council in 1999.

The SDIC, under the chairmanship of the President-Elect, includes representation from the Divisions, the Bureau, the Officers and the chemistry community at large. The Committee held its initial meeting on 24 June, so that some preliminary views might be reported to the Bureau and Council in Geneva.

39th IUPAC General Assembly

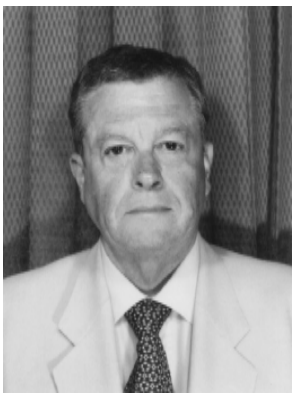
IUPAC General Assemblies are held in odd-numbered years. This year, the 39th General Assembly, will take place at the University of Geneva, Switzerland, 23–30 August. The General Assembly follows immediately after the 36th IUPAC Congress to allow participants to attend both events.

Prof. Jacques Weber, Chairman of the local Organizing Committee in Switzerland, writes:

The IUPAC General Assembly has little in common with a scientific conference or congress. It is indeed not open for general participation but restricted to Members of IUPAC Bodies that meet on this occasion. This is the case for practically all the IUPAC Committees and Commissions, which meet during the first half of the General Assembly, followed by the meeting of the IUPAC Council (see page 97).

The average attendance at these General Assemblies is 600–700 participants, the major problem being that the meeting of all the IUPAC Bodies may require the simultaneous use of up to 50 seminar rooms of various capacities (typically 10–30 seats) on the same site! In view of this constraint, it rapidly appeared that the University of Geneva was an ideal location for the General Assembly, especially as the modern Uni Mail Building offers very good facilities of that sort. Both Sciences II and Uni Mail Buildings will therefore share the venue of the General Assembly, with 26 meeting rooms reserved in the first facility and 24 in the second. These buildings lie quite close to one another, at a 10-minute walking distance, which should not be a problem for the delegates. In addition, both buildings are modern with large open spaces, ample photocopying capacity, and availability of computer rooms and cafeterias.

The whole scientific programme of the General As-



Prof. Jaques Weber

sembly is prepared by IUPAC itself, the local organizers being in charge of the accommodation, administrative secretariat, meeting rooms, social programme and financing. Indeed, as far as the latter point is concerned, the rule is that the host country finances the General Assembly, IUPAC making a financial contribution towards the subsistence and travel expenses of its Titular Members.

The first IUPAC General Assembly was organized in Rome in 1920; the most recent took place in Guildford, UK, in 1995. The IUPAC General Assemblies have been held three times before in Switzerland (Lucerne/Zürich, 1936; Zürich, 1955; Davos, 1979). A local Organizing Committee for the IUPAC Congress and General Assembly was set up by the New Swiss Chemical Society (NSCS) in March 1995. This followed a visit to Geneva of several members of the Oxford IUPAC Secretariat who found adequate both the venues chosen for the events and the conditions of accommodation.

In May 1995, the decision was made by IUPAC to hold the 39th General Assembly in Geneva. The decision was made in July 1995 also to hold the 36th IUPAC Congress in Geneva. The organizers expect that the competence and enthusiasm of the volunteers (students and staff of the Section of Chemistry of the University of Geneva) will lead to a successful 39th IUPAC General Assembly.

Adapted from *Chimia* 1996, **50**(6).

39th IUPAC Council Meeting

University of Geneva, Switzerland
29–30 August 1997

Election of Officers and Bureau Members

According to Statute 5.401, Council must elect:
(i) Officers of the Union
(ii) Elected Members of the Bureau

Nominations for the various positions that fall vacant at the end of 1997 must be received by the Secretary General at the IUPAC Secretariat before 29 June 1997, i.e. two months before the start of the Council meeting (Bylaw 2.221). The situation for each position (as this issue went to press on 20 June) is set out on pages 98–104:

President
Prof. J. Jortner (Israel), Vice-President and President-Elect, becomes President on 1 January 1998 (Statute 4.2).

Vice-President—Vacancy
The Vice-President to be elected at the 39th Council Meeting will be President-Elect, and will become President on 1 January 2000.

Council Agenda

1 Introductory Remarks and Finalization of Agenda
2 Approval of Minutes of 38th Council Meeting and Matters Arising
3 Ratification of Decisions Taken by Bureau and Executive Committee since 38th General Assembly
4 Announcement of Nominations for Union Officers and Bureau Members
5 Announcement of Time of Elections
6 Statutory Report of President on State of Union
7 Report of Secretary General
8 Biennial Report of Treasurer/Report of Finance Committee and Accounts for 1995–6/Appointment of Auditors for 1997–8
9 Reports of Division Presidents (10 minutes each)
10 Report of Committee on Printed and Electronic Publications (10 minutes only)
11 Report of CHEMRAWN Committee (10 minutes only)
12 Report of Committee on Chemistry and Industry (10 minutes only)
13 Report of Committee on Teaching of Chemistry (10 minutes only)
14 Report on and Review of Affiliate Membership Programme
15 Proposed Changes to Statutes and Bylaws
16 Continuation/Dissolution of Existing IUPAC Bodies, Proposals for New and Reconstituted Bodies/Terms of Reference
17 Proposals Formally Received from National Adhering Organizations
18 Ratification of Dates and Places of 40th General Assembly and 37th Congress (1999)
19 Budget Proposal and National Subscriptions for 1998–9
20 Election of Union Officers and Bureau Members and Approval of Elected Officers of Divisions
21 Provisional Places of 41st General Assembly and 38th Congress (2001)
22 Applications for Membership of IUPAC
23 Applications for Associated Organization Status of IUPAC and Review of Existing Associated Organizations
24 Adoption of Recommendations on Nomenclature and Symbols
25 Important Matters Discussed by Bureau at 39th General Assembly Not Covered by Items on Council Agenda
26 Any Other Business (discussion only)

Nominations for Vice-President received (as at 20 June 1997) are: Prof. P.S. Steyn (South Africa) and Dr A. Hayes (UK).

Prof. Pieter S. Steyn (South Africa)

Pieter Streicher Steyn was born on 5 January 1940 in Vryburg, Cape Province, Republic of South Africa. He is married with three children.

Education and Career: Prof. Steyn studied at the University of Stellenbosch, Stellenbosch: BSc, 1959; BSc (Hons), 1962; MSc (*cum laude*), 1963, and then at the University of South Africa: PhD, 1966. In 1967 he was awarded a Post-doctoral Fellowship at the School of Pharmacy of the University of Wisconsin, Madison, USA. He was appointed to the National Chemical Research Laboratory, CSIR in 1964 where he became Head of the Division of Organic Chemistry in 1983. From 1986 to 1987 he was Chief Director of the National Food Research Institute, CSIR, and from 1987 to 1992 he was Director of the Division of Food Science and Technology, CSIR. In December 1992, Prof. Steyn was appointed the first CSIR Fellow, this being the highest career position in science within the CSIR. In October 1993, he was appointed Head of the SASOL Centre for Chemistry, SASOL Professor of Chemistry and Director of the SASOL Centre of Separation Technology at the Potchefstroom University for Christian Higher Education.

Research Interests: Prof. Steyn's research career has been devoted to the isolation, analysis, structure elucidation, synthesis and biosynthesis of mycotoxins and, to some extent, other toxic and medicinal substances from plants. This research has been undertaken with numerous groups within South Africa and with research groups in Australia, Europe, Japan, New Zealand and the USA. Prof. Steyn has authored or co-authored 153 scientific papers and 20 reviews.

Offices and Assignments: These include: Elected one of 54 Founder Members of the Academy of Science of South Africa (1994-present); Vice-President of the South African Joint Council of Scientific Societies (1985–86); President of the South African Joint Council of Scientific Societies (1986–87) and President of the International Association for Cereal Science and Technology, Vienna (1992–94).

Prof. Pieter S. Steyn

Since 1967, Prof. Steyn has given lectures at the Conventions of the South African Chemical Institute, at the Specialist Conference on Organic Chemistry, and been invited to speak at numerous international meetings.

IUPAC Activities: Member of the South African National Committee for IUPAC (1973–present); Associate Member of the Food Contaminants Commission (1973–1978); Titular Member of the Food Chemistry Commission VI.1 (1979–1987); Vice-Chairman of the Food Chemistry Commission VI.1 (1983–1987); Member of the Applied Chemistry Division (1987–1997) and Vice-President (1989–1991); Member of the Bureau (1991–1995); President of the Applied Chemistry Division (1991-1995); Member of the Division Committee of the Division of Chemistry and the Environment (1996-1997); Elected Member of the Bureau and the Executive Committee (1996-1999); Member of the Editorial Advisory Board of Chemistry in the 21st Century (1991 - present); Member of the Committee on Publications and Electronic Printing (1996-1999); Member of the Committee on the Teaching of Chemistry (1996-1999); Member of the International Scientific Advisory Committees for the IUPAC Mycotoxin Symposia held in Paris (1976), Lausanne (1979), Vienna (1982), Pretoria (1985), Tokyo (1988), Mexico City (1992) and Rome (1996); Chairman of scientific sessions at most of the IUPAC Mycotoxin Symposia; Member of the Organizing Committee of the 13th IUPAC Symposium on the Chemistry of Natural Products, Pretoria, August 1982, and Chairman of the Finance Committee; Chairman of the Organizing Committee of the Sixth IUPAC Symposium on Mycotoxins and Phycotoxins, Pretoria, 22–25 July 1985 and Chairman of the Finance Committee; Organizing Chairman of the IUPAC Symposium: A Sustainable Environment—National and International Perspectives, Pretoria, December 1996; Member of the South African Delegation to IUPAC Council Meetings at Münich, Germany (1973); Madrid, Spain (1975); Warsaw, Poland (1977); Davos, Switzerland (1979); Leuven, Belgium (1981); Lyngby, Denmark (1983); Lyon, France (1985); Boston, USA (1987); Lund, Sweden (1989); Hamburg, Germany (1991); Lisbon, Portugal (1993); Guildford, UK (1995) and Geneva, Switzerland (1997).

Awards: Raikes Gold Medal of the South African Chemical Institute (1975), Gold Medal of the South African Chemical Institute (1987), CSIR Merit Prize (1987)—top award of the CSIR, Havenga Gold Medal

for Chemistry (1992) from *Die Suid-Afrikaanse Akademie vir Wetenskap en Kuns*, and Friedrich Schweizer Medal (1993) from the International Association for Cereal Science and Technology, Vienna.

Dr Alan Hayes CBE DL BSc(Gen) BSc (Spec Chem) PhD

Date of birth: 12 June 1930, Manchester, UK

Educated in the public system in Manchester including Technical School. Left school at 15 years of age and joined ICI in the Dyestuffs Division as a 'Lab Boy'.

Through study at evening and part time day classes at the Royal Technical College, Salford (now Salford University) obtained a BSc (Gen) 2nd Class and a BSc (Spec Chem) 1st Class, both London University External.

During this period, he had transferred to the Pharmaceutical Division of ICI and after National Service the company sent him to work in Lord Todd's Laboratory in Cambridge, where he obtained a PhD on the subject of 'Synthetic Approaches to Porphrins and Corrins' after two years.

Dr Hayes returned to work in the Chemistry Research Department of the ICI Pharmaceuticals Division and after four years was appointed Senior Scientist, then transferred to Biochemical Pharmacology, where he became Section Manager and then Biochemistry Research Manager after which Manager of Pharmaceutical Formulation, Analytical Development Quality Assurance and Control.

In 1973 Dr Hayes was appointed to the Board of the Pharmaceutical business and after doing service and marketing jobs he was appointed Deputy Chairman with responsibility for all Research, Technical and Medical matters.

In 1979 Dr Hayes was appointed Chairman of the Plant Protection Division of ICI with responsibility for all aspects of Research, Development, Production, Distribution, Marketing and Sales worldwide. By the time he retired in 1992 this business was achieving sales of $1.8bn and spending over $160m on R&D. Dr Hayes was also instrumental in founding ICI's entry into the Seeds Business and the expansion of its bioscience research. For a spell of two years in the period 1983–85 Dr Hayes served as Chief Planner for ICI in its Head Office organization. During his time in Agrochemicals he served two years as the President of the international trade association GIFAP.

Dr Alan Hayes

Since his retirement Dr Hayes has served as a non-executive Director on several Company Boards and also serves as Chairman of a local independent hospital. In addition, he is a member of the Council of the University of Surrey and of its Finance and Professional Training Committees. He is also Chairman of the Research Park Executive at Surrey University. He is Chairman of the Governing Body of the Chichester Institute of Higher Education.

Activity in scientific societies includes being a Fellow of the Royal Society of Chemistry and membership of the RSC's Science Affairs Board and its Finance Committee as well as being Chairman of Trustees of the Staff Pension Fund. Dr Hayes was President of the Society of Chemical Industry for 1994–96.

With regard to involvement in the affairs of IUPAC, this has largely been with the CHEMRAWN Committee and via that as an ex-officio member of the Bureau; Dr Hayes has also served as a member of the UK delegation to the General Assembly on several occasions.

Dr Hayes' first meeting with the Committee was immediately after CHEMRAWN III in the Hague, the Netherlands. Since then, he says, it has been 'a fascinating but at the same time a frustrating experience'. 'I have enjoyed immensely working with my colleagues on the Committee and I do feel that the whole CHEMRAWN enterprise has been well supported by the members of IUPAC and it has been good for the image of IUPAC. I am sure that in the next phase of its development it can go on to even greater achievements, especially if we can collaborate effectively with the international agencies and other international scientific unions. It has been a great privilege to serve as Deputy Chairman and latterly as Chairman of such a hard working and supportive group of colleagues.'

Past-President

The retiring President, Prof. A.E. Fischli (Switzerland), will remain an Officer (Statute 6.1) and a member of the Bureau for a period of two years (Statute 7.2).

Secretary General—No vacancy

Dr E.D. Becker (USA), the present Secretary General, is elected for the period 1996–1999.

Treasurer—Vacancy

Prof. J.M. Ward (UK), the present Treasurer, completes six years (1992–1997) of service, but he has decided not to stand for a final two years (Statute 6.52).

No nomination for Treasurer had been received as at 20 June 1997.

Bureau—Six vacancies (minimum)

According to Statute 7.2 the Bureau consists of the Officers, the Presidents of the Divisions/Sections, together with not less than ten other members elected by Council, who shall be known as 'Elected Members'. At the conclusion of the 38th Council in Guildford, there were ten Elected Members of the Bureau. At the 39th Council the Bureau will make recommendations to Council as to the number of Elected Members (ten or more), who should be on the Bureau for the succeeding two years.

Elected Members are elected for a period of four years, and they are eligible for election for a second period of four years.

No Adhering Organization shall have more than one Elected Member of the Bureau.

Statute 7.2 also states that 'the principle of fair geographic representation of Members shall be taken into account'.

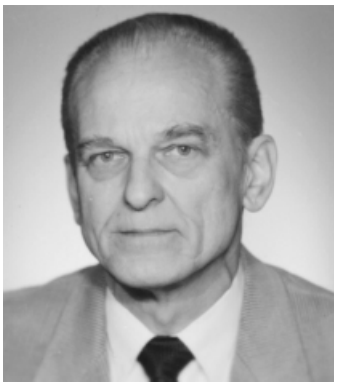
Nominations for Bureau received (as at 20 June 1997) are: Prof. P. Kratochvil (Czech Republic), Prof. G.J. Leigh (UK), Dr E.P. Przybylowicz (USA), Prof. L.K. Sydnes (Norway)—reappointment, and Prof. C.-H. Zhang (China)—reappointment.

Prof. Pavel Kratochvil (Czech Republic)

Prof. Pavel Kratochvil was born in Prague in 1930. Since 1990 he has been the Director of the Institute of Macromolecular Chemistry of the Academy of Sciences of the Czech Republic, one of the major institutes devoted to basic research in polymer science worldwide. He is also Professor of Macromolecular Chemistry at the Institute of Chemical Technology in Prague.

In 1953, he became a Master of Science in Chemical Engineering at the Institute of Chemical Technology in Prague. Until 1957 he was Lecturer on physico-chemical principles of technological processes at the Institute of Chemical Technology in Pardubice. In 1957, Kratochvil joined the Institute of Macromolecular Chemistry of the then Czechoslovak Academy of Sciences, where he has remained. In 1960, he obtained his PhD and in 1968 a DSc, both from the Academy. His main field of activity is the physical chemistry of polymers, particularly the investigation of solution properties of polymers and copolymers, and light scattering from polymer solutions.

Kratochvil is the author of more than 180 original communications in international journals, ten reviews, one monograph and five contributions to monographs. He has presented about 240 invited lectures and communications at international scientific meetings and lectures at foreign universities and research institutions.



Prof. Pavel Kratochvil

Kratochvil is a Founding Member of the Learned Society of the Czech Republic, Fellow of the Royal Society of Chemistry, UK, and a member of numerous boards, both national and international, among others the Czech National Committee for UNESCO and editorial boards of international technical journals. He is the holder of the Czechoslovak National Prize for Science in 1970 and of the Prize of the Czechoslovak Academy of Sciences in 1977. He has spent his sabbatical leaves as a visiting scientist or visiting professor in Canada, Germany, India, Mexico, Russia, Sweden and the USA.

Within IUPAC, Kratochvil started his activities as an observer in the Commission on Macromolecular Nomenclature in 1977. He was elected a Titular Member of this Commission in 1979 and served as its Chairman from 1985 to 1991. In the years 1985–1995 he was a Member of the Interdivisional Committee on Nomenclature and Symbols. He became a Member of the Macromolecular Division Committee in 1994. He has been closely involved in various IUPAC-sponsored meetings in Prague, including the International Symposia on Macromolecules in 1965 and 1992, being the Chairman of the latter one, and most of the Prague Meetings on Macromolecules (Microsymposia and Discussion Conferences) over the last 30 years. He has acted as the IUPAC official representative at about ten meetings. Kratochvil serves as the Chairman of the Czech National Committee for Chemistry, the IUPAC National Adhering Organization of the Czech Republic.

Prof. G. Jeffery Leigh (UK)

Prof. Leigh was born on 4 September 1934, and is married with two children.

Education and Career: Studied at University of London, King's College, graduating as top student in 1956,

and taking his PhD in silicon chemistry three years later. Appointed Lecturer in Chemistry in the Faculty of the University of Manchester Institute of Science and Technology (UMIST) in 1959, where he remained for six years, though one was spent on a sabbatical year as a CIBA Fellow with Prof. E.O. Fischer at the University of Munich, Germany.

In 1965, he moved to the University of Sussex, to join the Nitrogen Fixation Unit recently established by Prof. Joseph Chatt. As a coordination chemist, he studied the complex chemistry of dinitrogen as a model for the chemistry of nitrogenases. Under his direct supervision the chemistry group at the Unit became the leading laboratory on dinitrogen chemistry, and Prof. Leigh has now published some 250 scientific papers and supervised about 25 doctoral students. He is probably the world's leading authority on dinitrogen complex chemistry. He left the Nitrogen Fixation Laboratory as Deputy Director in 1994, to become the first Professor of Environmental Science in the University of Sussex. His work has been widely recognized, not least by Her Majesty the Queen by the award of an OBE for services to science. He has lectured in universities and at conferences all over the world, in English or in French, German, or Spanish when appropriate.

Related Professional Activities: Prof. Leigh has been involved in editing and publishing for many years, and has acted as a Deputy Editor of the *Journal of Organometallic Chemistry*, and as Chairman of the Editorial Board of *Dalton Transactions.* He has also served on the Boards of *Inorganic Biochemistry, Inorganica Chimica Acta*, and *Reaction Kinetics and Catalysis Letters.* Within the Royal Society of Chemistry, Prof. Leigh was instrumental in setting up the current system of Editorial Boards, and was founder Chairman of the Inorganic Biochemistry Discussion Group. He has also been Vice-President of the Dalton Division of the Royal Society of Chemistry.

IUPAC Record: Prof. Leigh has been involved in IUPAC activities for about 25 years and has accumulated a wealth of experience at all levels of the organization. He joined the Commission for the Nomenclature of Inorganic Chemistry in the late 1960s, and served as Associated and Titular Member before becoming Secretary for eight years. His major achievement was editing the 1990 version of the Nomenclature of Inorganic Chemistry. Subsequently, he moved to the Inorganic Division Committee, and has been Secretary and Vice-President for four year terms, and is currently finishing a two-year term as President. Not only is he editing an IUPAC book on the Principles of Nomenclature that will be published shortly, but he has also been very active in attempting to resolve the impasse over the names of the transfermium elements.

Dr Edwin (Ed) P. Przybylowicz (USA)

In 1991, after over 35 years with the Eastman Kodak Company, Dr Przybylowicz retired as Senior Vice-President and Director of Research. He joined Kodak as a Research Chemist in the Chemistry Division at the Research Laboratories in September 1956. During his career he had increasing technical and managerial responsibilities in the basic sciences, engineering, product development as well as the Clinical and Copy Products businesses. He became Assistant Director, Kodak Research Laboratories in 1983, was named Director of Research and elected a Senior Vice-President of the company in August 1985.

Dr Przybylowicz has been active in a number of programmes which are focused on the commercialization of technology and in stimulating closer working relationships between industry and academia. He is a Member of the Board of the New York State Science and Technology Foundation, a state foundation which has programmes designed to stimulate the transfer of technology between universities and industry. He is also a Commissioner of the US-Polish Joint Fund for Cooperation in Science and Engineering, a programme which fosters the collaboration of Polish and US scientists. Over the past three years he has co-chaired conferences and workshops on technology transfer in Poland, the Czech Republic and Russia.

Prof. G. Jeffery Leigh

Dr Edwin (Ed) P. Przybylowicz

From April 1994 to March 1996, Dr Przybylowicz was Director of the Chester F. Carlson Center for Imaging Science at the Rochester Institute of Technology. In March 1996 he became Assistant to the Dean, College of Science, Rochester Institute of Technology.

A native of Detroit, Michigan, Dr Przybylowicz received a BS degree in chemistry from the University of Michigan and a PhD degree in analytical chemistry from Massachusetts Institute of Technology. He has published over 20 technical articles and two books in the field of chemistry and photography and holds four patents in related fields.

Dr Przybylowicz was elected a Member of the National Academy of Engineering in 1990 and is active on a number of National Research Council committees. He is an Emeritus Member of the Industrial Research Institute. He also serves on a number of university visiting committees in engineering and the sciences.

Since 1993, Dr Przybylowicz has been a member of the IUPAC Finance Committee where he has helped to strengthen the financial condition of the Union through an improved investment strategy. IUPAC investments are used to keep the Union's operations stable and progressing towards the goals of the Divisions. His active participation in IUPAC affairs is another indicator of his international interests.

He is recipient of a number of awards. The Rochester Engineering Society awarded him the 1992 Leo East Award as 'Engineer of the Year'. In 1993 he was the recipient of the Greater Rochester Chamber of Commerce 'Civic Award in Science and Technology'; the 1994 recipient of the Distinguished Alumni Award from the University of Michigan, Department of Chemistry. In 1995 he was elected Honorary Member of the Society for Imaging Science and Technology for 'his life-long contributions to the advancement of imaging science and engineering, from his technical contributions at Kodak, to his work to enhance industry/university/government cooperation and to expand education in imaging'. In 1996, he was awarded the Malcolm E. Pruitt Award of the Council on Chemical Research for the promotion of university-industry relations.

He is married to the former Roberta Richardson of Owosso, Michigan, and they have eleven children, seven daughters and four sons. Roberta (Bobbi) has a degree in chemistry-biochemistry and was employed by Dow Chemical Company as well as the Arthur D. Little Company. She is currently a volunteer docent at the International Museum of Photography at the George Eastman House and at the Rochester Museum and Science Center in Rochester, NY. Ed and Bobbi's children work in professional fields ranging from healthcare and education to engineering and chemistry.

Prof. Leiv K. Sydnes (Norway)

Date of birth: 9 July 1948. Married, three children born in 1973, 1975 and 1977.

Education: Cand. mag., University of Oslo, December 1971; Cand. real., Organic Chemistry, University of Oslo, October 1974; Dr. philos., Organic Chemistry, University of Oslo, November 1978.

Employment: Research Associate, University of Oslo, 1974-1978; Postdoctoral Fellow, University of Western Ontario, Canada, 1978-1980; Associate Professor, University of Tromsø, 1980–1986; Visiting Professor, Iowa State University, USA, 1985–1986; Professor, University of Tromsø, 1987–1993; Adjunct Professor, University of Tromsø, 1993 to present; Professor, University of Bergen, 1993 to present.

Research and Scientific Publications: The MSc and Dr.philos. degrees were earned under the supervision of Prof. Lars Skattebøl, University of Oslo, on the basis of theses describing research in the field of *gem*-dihalocyclopropanes.

In Canada he worked with organic photochemistry in the research group of Prof. Paul de Mayo, Photochemistry Unit, University of Western Ontario.

The academic year 1985–86 was devoted to organometallic chemistry, which was employed to synthesize prostaglandin derivatives in the group of Prof. Richard Larock, Iowa State University.

The research is mainly concentrated on organic synthesis with emphasis on cyclopropane chemistry and photochemistry. Many of the problems currently investigated are related to the preparation of biologically active molecules. So far the research has resulted in 77 contributions in publications with a referee system. The research has also been presented in numerous lectures/poster presentations in Norway and abroad (more than 80 since 1987).

In his research Prof. Sydnes has so far enjoyed the cooperation of 34 graduate students, 11 PhD students and one postdoctoral student. Currently his research

Prof. Leiv K. Sydnes

group consists of eight graduate students, and five PhD students.

Over the years considerable financial support has been received from Norwegian research agencies and from Norwegian chemical companies (Norsk Hydro, Nycomed, Borregaard).

Non-scientific Publishing: Since 1976 Prof. Sydnes has also been involved in various kinds of non-scientific publishing related to chemistry. He has written more than 50 articles in national periodicals including book reviews of foreign scientific books, papers about chemistry topics for non-specialists, discussion papers about teaching etc. He has written three books covering laboratory work in introductory and intermediate organic chemistry at university level. He has published ten high-school textbooks in chemistry and two chemical textbooks for chemical colleges. He has contributed one or several chapters to 18 technical or more general scientific reports.

Other Professional Activities: In addition to having been and being involved in a large number of committees and boards at the University of Tromsø and now at the University of Bergen Prof. Sydnes has been engaged in professional activities as follows: Chairman, Division of Teaching, Norwegian Chemical Society 1976–78; Chairman, Northern Norway Section, Norwegian Chemical Society 1981–83; Vice-President, Norwegian Chemical Society 1989–92; President, Norwegian Chemical Society 1992–96. Bureau Member, IUPAC 1993 to present; Member, European Communities Chemistry Council (ECCC) 1994 to present; Member, European Communities Registration Board (ECRB) 1996 to present; Member of the COST D2 Management Committee (Selective Synthesis) 1992 to present; Member, INTAS Assessment Panel, Brussels 1994; Member of the Editorial Board, *Acta Chemica Scandinavica* 1989–1994; Member of the Editorial Board, Norwegian Journal of Chemistry (*Kjemi*) 1986 to present; Organizer of The National Organic Chemistry Meeting in 1988, 1992, 1996; Organizer of The Nordic Natural Product Meeting in Tromsø in 1982; Chairman, Organizing Committee, The National Laboratory and Chemical Fair 1992–93, 1994–95, 1996–97; Chairman of the Board, Unilab Analyse AS 1988–92; Member/Vice-Chairman of the Board, Tromsø Research Park AS 1990 to present.

Awards: Kyoto Institute of Technology Lectureship 1990 and The Thaulow Prize 1995.

Prof. C.-H. Zhang (Chinese Chemical Society, Beijing)

Prof. Cunhao Zhang was born in Tianjin, China, on 23 February 1928. He obtained his BSc from Central University, Nanjing in 1947, and MSc from the University of Michigan, USA, in 1950. He returned to China in November 1950 and has been with the Dalian Institute of Chemical Physics, Chinese Academy of Sciences since 1951, where he was an Assistant Professor from 1951–53, Associate Professor from 1953–62 and Professor of Chemistry from 1962. He was Deputy Director of the Institute during 1978–83, and Director from 1986–90. He was elected a Member of the Chinese Academy of Sciences (CAS), a title of the highest academic prestige in China, in 1980, became a Standing Member of the Chemistry Division of CAS by election in 1983, and was elected Chair of the Division in 1994, a position he still holds.

Prof. C.-H. Zhang

He became President of the National Natural Science Foundation of China in 1991. In 1992, he was elected a Fellow of the Third World Academy of Sciences.

Prof. Cunhao Zhang's research activities began in the early 1950s with heterogeneous catalysis. For five years, his group investigated the fluidized bed hydrogenation of carbon monoxide. This resulted in the development of a highly successful nitrided and alkalized fused iron catalyst.

His major research accomplishments have also included valuable contributions to combustion and short wavelength chemical lasers, and to the chemistry of excited molecules, in particular for the development of double resonance multiphoton ionization spectroscopy in probing ultrashort-lived and/or high-lying rovibronic states and in the study of quantum-state specific energy transfer dynamics of excited molecular species.

Prof. Cunhao Zhang has been an invited speaker at various universities and research institutions throughout the world including Germany, Japan, Republic of Korea, the Netherlands and the USA. He has also presented lectures at various international conferences, notably the San Francisco IQEC in 1986 and the 13th ICCE, San Juan, in 1994. He was a CSCPRC Scholar sponsored by US NAS to MIT, UC Berkeley, USC and UCLA in 1985 and a Ho Sin Hang Professor of Chemis-

try at the Chinese University of Hong Kong in 1996.

He holds part-time professorships at universities in several Chinese cities including Beijing, Nanjing and Fudan and is on the Editorial Boards of several journals including *Spectrochimica Acta* and *Chem. Phys. Letters.*

Prof. Cunhao Zhang is an Associate Editor of *Science (China), Chinese J. Chem. Physics* and *J. Molecular Science (China)* and before 1994, a Standing Council Member of the Chinese Chemical Society. He is also a Member of the Optical Society of America and an Associate Member of the IUPAC Commission on Molecular Structure and Spectroscopy. He was elected Vice-President of the China Association for Science and Technology in 1991 and again in 1996.

Report of the International Union of Pure and Applied Chemistry:1996

Mo Williams
Executive Secretary

As a non-General Assembly year, the business of the Union in 1996 was conducted through meetings of the Executive Committee (Oxford, April) and the Bureau (Oxford, September). The membership remained unchanged at 41 NAOs.

Consideration of the future scientific policy of the Union continued through a regional 'brainstorming' session in the USA (Belmont, June). Some 12 academic and industrial chemistry leaders from North America participated in an attempt to develop suitable long-term plans. Follow-up sessions are planned for 1997 in Europe (London, February) and in Asia (Singapore, June). A meeting of the IUPAC Officers with Division Presidents and Vice-Presidents (Frankfurt, March), to consider the recommendations arising from the 'brainstorming' sessions and the 1997 Vice-Presidential Critical Assessment.

Having resolved in 1995 to reconsider its earlier decision, by adopting the 1994 recommendations on names and symbols for the transfermium elements as provisional, the Union duly invited public comment during January–May 1996. The submissions were considered by the Commission on Nomenclature of Inorganic Chemistry (Chestertown/Maryland, August) and revised recommendations for elements 104–109 were referred for comment by the three laboratories concerned in the discovery of TFE. Eventually, the revised recommendations will be presented to the IUPAC Council (Geneva, August 1997) for final approval.

IUPAC considered a number of declarations, particularly the Manila Declaration of 1992 and the Melaka Accord of 1994, on the subject of biodiversity. An IUPAC statement drafted by its Medicinal Chemistry Section, *Preservation and Utilization of Natural Biodiversity in Context of Search for Economically Valuable Medicinal Biota,* was approved by the Bureau and published in the IUPAC journal *Pure and Applied Chemistry (PAC)* (December 1996). Several recommendations were made,

which should be considered by participants when promulgating declarations and enacting legislation on the topic.

Over the past few years, much concern has been expressed about the effect of chlorine and chlorine-containing compounds on the environment. In its capacity as an international non-governmental organization, IUPAC published a *White Book on Chlorine*. The chapters, prepared by 14 experts from throughout the world, critically evaluated various aspects of the subject and are of interest not only to academic institutions, industry, governmental agencies and environmental organizations, but also to the general public. Publication was as an issue of *PAC* (September 1996), and bulk copies were made available to the chemical industry through regional chemical manufacturers associations. The White Book attracted considerable attention, and similar analyses are envisaged of other globally important issues, in which IUPAC can play a role, standing firmly on a scientific foundation independent of governments and industry, by calling on its worldwide network of experts from various fields of chemistry.

CHEMRAWN IX—World Conference on The Role of Advanced Materials in Sustainable Development: Sustainable Production, Use, Disposal and Recycling of Materials—was held in Korea (Seoul, September). It was a follow-up to several earlier CHEMRAWN Conferences on related issues, organized to coincide with the 50th anniversary of the Korean Chemical Society. There were over 360 participants from 17 countries, and the Conference was generally held to have been a success. Important global and multinational problems were identified, such as the role of technology in reducing the ecological load, introduction of renewable energy sources, strategies for selection of and research for ecology-friendly processes, formulation of criteria for estimation of acceptability of current technologies for material production, and effective ways of international cooperation and information exchanges. Two panels on *What New Materials are Needed for Sustainable Development* and *Zero Emissions and Zero Waste Processing for Sustainable Development* focused on problems of primary importance. Proceedings and Perspectives and Recommendations prepared by the Future Actions Committee were published in early 1997.

A reconstituted Committee on Affiliate Membership was assigned the task of considering replacement of the Affiliate Membership Programme as such with elements of priority as identified by the Bureau and Council (Guildford, 1995), including a critical evaluation of the overheads and Secretariat staff costs. It met (Oxford, September) for extensive discussions, with the intention to finalise its recommendations for presentation to the Executive Committee (April 1997). A final proposal will then be submitted to the Council (Geneva, August 1997).

The retirement of the Executive Secretary (March 1997) and other senior staff provided a unique opportunity to move the IUPAC Secretariat elsewhere. After carefully evaluating several possibilities, it was decided to accept an offer to relocate the Secretariat at Research Triangle Park, North Carolina, during 1997 for at least the next ten years, and then to review the location every ten years. A significant financial investment in future information technology equipment and other facilities is required. The opportunity is being taken to update the *History of IUPAC* with a supplement covering 1987–1997 before the Secretariat is relocated.

Meanwhile, an IUPAC Home Page was launched in early 1996 on the Internet (WWW) as a subagent of the UK Royal Society of Chemistry's home page. It provides comprehensive information on the work of the Union, and includes directories of all IUPAC bodies. Chemists will be kept up to date with the Union's meetings and initiatives, training for safety and environmental protection. Also, they can visit chemical industrial WWW sites via hypertext links to the IUPAC Company Associates, and check on publications via the Union's publisher, Blackwell Science. The contents of the home page are being expanded to cover other IUPAC activities, and the possibility of developing IUPAC provisional recommendations via the page is under consideration.

ICSU funding was provided for three IUPAC projects in 1996. A main part of the Education Training project consisted of *The Design and Field Testing of An Environmental Package* by the Committee on Teaching of Chemistry: steady progress has been accomplished, and completion of the work is expected early in 1998.

The Quality Control in Trace and Process Analysis grant was used by the Commission on General Aspects of Analytical Chemistry to organize a meeting (Bologna, August) to discuss the first draft report. A final report is expected in mid-1997. The Water/Aqueous Chemistry grant was used in part to fund a meeting of the Commission on Equilibrium Data (Budapest, July), at which the project on *Complexation Processes in Seawater* was considered. Part I of the report was published (see technical report 5 in Appendix hereto), and a first draft of Part II is expected by mid-1997.

APPENDIX

The following reports on nomenclature, symbols, terminology, and conventions (IUPAC Recommendations 1996) were published during the year:

1 Commission on Chemical Kinetics. A glossary of terms used in chemical kinetics, including reaction dynamics. *Pure Appl. Chem.* 1996, **68**, 149–192.

2 Working Party on Theoretical and Computational Chemistry. Acronyms used in theoretical chemistry. *Pure Appl. Chem.* 1996, **68**, 387–456.

3 Commission on Molecular Structure and Spectroscopy. Symmetry, selection rules and nomenclature in surface spectroscopies. *Pure Appl. Chem.* 1996, **68**, 457–467.

4 Commission on Quantities and Units in Clinical Chemistry and International Federation of Clinical Chemistry. Glossary of terms in quantities and units in clinical chemistry. *Pure Appl. Chem.* 1996, **68**, 957–1000.

5 Commission on Agrochemicals and the Environment. Glossary of terms relating to pesticides. *Pure Appl. Chem.* 1996, **68,** 1167–1193.

6 Commission on Functional Polymers. Terminology for membranes and membrane processes. *Pure Appl. Chem.* 1996, **68,** 1479–1489.

7 Commission on Separation Methods in Analytical Chemistry. Nomenclature for non-linear chromatography. *Pure Appl. Chem.* 1996, **68,** 1591–1595.

8 Joint Commission on Biochemical Nomenclature. Nomenclature of carbohydrates. *Pure Appl. Chem.* 1996, **68,** 1919–2008.

9 Commission on Nomenclature of Organic Chemistry and Commission on Physical Organic Chemistry.

Basic terminology of stereochemistry. *Pure Appl. Chem.* 1996, **68**, 2193–2222.

10 Commission on Photochemistry. Glossary of terms used in photochemistry. *Pure Appl. Chem.* 1996, **68**, 2223–2286.

11 Commission on Macromolecular Nomenclature. Glossary of basic terms in polymer science. *Pure Appl. Chem.* 1996, **68**, 2287–2311.

12 Commission on Macromolecular Nomenclature. Definitions of terms relating to degradation, aging, and related chemical transformations of polymers. *Pure Appl. Chem.* 1996, **68**, 2313–2323.

13 Section on Medicinal Chemistry. Preservation and utilization of natural biodiversity in context of search for economically valuable medicinal biota. *Pure Appl. Chem.* 1996, **68**, 2325–2332.

The following technical reports were published during the year:

1 Commission on Molecular Structure and Spectroscopy. High resolution wavenumber standards for the infrared. *Pure Appl. Chem.* 1996, **68,** 193–208.

2 Commission on Equilibrium Data. Stability constants of metal complexes of amino acids with charged side chains—I: Positively charged side chains. *Pure Appl. Chem.* 1996, **68**, 469–496.

3 Commission on Polymer Characterization and Properties. Critically-evaluated propagation rate coefficients in free radical polymerizations—I. Styrene and methyl methacrylate. *Pure Appl. Chem.* 1996, **68**, 1491–1494.

4 Commission on Microchemical Techniques and Trace Analysis. Analytical methodology for determination of aluminium fractions in natural fresh waters. *Pure Appl. Chem.* 1996, **68**, 1597–1638.

5 Commission on Equilibrium Data. Specific problems in measurement and interpretation of complexation phenomena in seawater. *Pure Appl. Chem.* 1996, **68**, 1639–1656.

6 Commission on High Temperature and Solid State Chemistry. Quantitative analysis of a PbO-SiO_2 glass by electron microprobe. *Pure Appl. Chem.* 1996, **68**, 1657–1663.

7 Commission on Polymer Characterization and Properties. A collaborative study of structure and rheological properties of EVOH/SMA blends produced by reactive extrusion. *Pure Appl. Chem.* 1996, **68**, 1665–1682.

8 Committee on Chemistry and Industry. *IUPAC White Book on Chlorine. Pure Appl. Chem.* 1996, **68**, 1683–1824.

9 Section on Medicinal Chemistry. General features of contracts for natural product collaborations. *Pure Appl. Chem.* 1996, **68**, 2333–2337.

10 Commission on Atomic Weights and Isotopic Abundances. Atomic weights of the elements 1995. *Pure Appl. Chem.* 1996, **68**, 2339–2359.

11 Commission on Thermodynamics. *International Thermodynamic Tables of the Fluid State—Vol. 13: Methane.* Published in book form by Blackwell Science, Oxford, 1996.

12 Commission on Thermodynamics. *Transport Properties of Fluids: Their Correlation, Estimation and Prediction.* Published in book form by Cambridge University Press, 1996.

13 Commission on Thermodynamics. *Heat Capacity of Liquids: A Critical Review and Recommended Values.* Published in book form as Monograph 6 (in 2 volumes) in *J. Phys. Chem. Ref. Data* monograph series by American Chemical Society, Washington, DC, 1996.

14 Commission on Solubility Data. *Solubility Data Series—Vol. 62: Carbon Dioxide in Water and Aqueous Electrolyte Solutions*. Published in book form by Oxford University Press, Oxford, 1996.

15 Commission on Solubility Data. *Solubility Data Series—Vol. 63: Metals in Liquid Alkali Metals—I: Be to Os.* Published in book form by Oxford University Press, Oxford, 1996.

16 Commission on Solubility Data. *Solubility Data Series—Vol. 64: Metals in Liquid Alkali Metals—II: Co to Bi.* Published in book form by Oxford University Press, Oxford, 1996.

17 Commission on Solubility Data. *Solubility Data Series—Vol. 65: Copper (I) Halides* and *Pseudohalides*. Published in book form by Oxford University Press, Oxford, 1996.

18 Committee on Printed and Electronic Publications, *Chemistry for the 21st Century—Reactivity of Solids: Past, Present and Future*. Published in book form by Blackwell Science, Oxford, 1996.

19 Commission on Toxicology and Committee on Teaching of Chemistry, *Fundamental Toxicology for Chemists*. Published in book form by UK Royal Society of Chemistry, 1996.

20 Division on Organic Chemistry, *Highlights in Bioorganic Chemistry: A Symposium in Print, Pure Appl. Chem.* 1996, **68,** 2009–2192.

Thirty-six symposia were sponsored by IUPAC in 1996, namely:

1 26–29 February 1996. 8th International Conference on Phenothiazines and Structurally Related Psychotropic Compounds, Jaipur, India.

2 16–19 April 1996. International Conference on Chemical Physics on the Border of 21st Century, Moscow, Russia. [Proceedings to be published in *Pure Appl. Chem.,* 1997].

3 21–24 May 1996. 2nd International Symposium on Molecular Order and Mobility in Polymer Systems, St. Petersburg, Russia. [Proceedings published as *Macromolecular Symposia* Vol. 113 by Hüthig & Wepf Verlag, Basel, 1997].

4 26–31 May 1996. 2nd International Symposium on Free Radical Polymerization: Kinetics and Mechanisms, Santa Margherita Ligure, Genoa, Italy. [Proceedings published as *Macromolecular Symposia* Vol. 111 by Hüthig & Wepf Verlag, Basel, 1996].

5 27–31 May 1996. 9th International IUPAC Symposium on Mycotoxins and Phycotoxins, Rome, Italy.
6 24–28 June 1996. 11th Bratislava International Conference on Polymers: Thermal and Photo-induced Oxidation of Polymers and Its Inhibition in the Upcoming 21st Century, High Tatras, Slovak Republic. [Proceedings published as *Macromolecular Symposia* Vol. 115 by Hüthig & Wepf Verlag, Basel, 1997].
7 25–29 June 1996. 11th International Conference on Surface Forces, Moscow, Russia.
8 17–20 June 1996. International Symposium on Theoretical and Experimental Aspects of Protein Folding, San Luis, Argentina.
9 30 June–4 July 1996. 11th International Conference on Organic Synthesis, Amsterdam, Netherlands. [*Pure Appl. Chem.* 1997, **69**(3)].
10 30 June–5 July 1996. 11th International Congress on Catalysis, Baltimore, MD, USA. [Proceedings to be published by Elsevier, Amsterdam].
11 7–12 July 1996. 17th International Conference on Organometallic Chemistry, Brisbane, Australia.
12 14–20 July 1996. International Symposium on Sweeteners, Jerusalem, Israel. [Proceedings to be published in *Pure Appl. Chem.* 1997, **69**(4)].
13 14–19 July 1996. 14th International Conference on Chemical Education—Chemistry: Expanding the Boundaries, Brisbane, Australia.
14 15–18 July 1996. 37th Microsymposium on Macromolecules—(Bio)degradable Polymers: Chemical, Biological and Environmental Aspects, Prague, Czech Republic. [Proceedings to be published as a *Macromolecular Symposia* volume by Hüthig & Wepf Verlag, Basel, 1997].
15 22–25 July 1996. 7th International Symposium on Solubility Phenomena, Leoben, Austria. [Proceedings to be published in *Pure Appl. Chem.* 1997, **69**(5)].
16 21–26 July 1996. 18th International Carbohydrate Symposium, Milan, Italy. [Proceedings to be published in *Pure Appl. Chem.* 1997, **69**(7)].
17 21–26 July 1996. 16th IUPAC Symposium on Photochemistry, Helsinki, Finland. [Proceedings to be published in *Pure Appl. Chem.* 1997, **69**(4)].
18 4–9 August 1996. 36th IUPAC Symposium on Macromolecules, Seoul, Korea. [Proceedings to be published as a *Macromolecular Symposia* volume by Hüthig & Wepf Verlag, Basel, 1997].
19 14–17 August 1996. 2nd International Conference on Excitonic Processes in Condensed Matter, Kurort Gohrisch, Germany. [Proceedings to be published in *Pure Appl. Chem.* 1997, **69**(6)].
20 18–23 August 1996. 31st International Conference on Coordination Chemistry, Vancouver, Canada. [Proceedings to be published in *Pure Appl. Chem.* 1997].
21 18–23 August 1996. 11th International Symposium on Carotenoids, Leiden, Netherlands. [Proceedings to be published in *Pure Appl. Chem.* 1997].
22 20–25 August 1996. International Symposium on Macromolecular Condensed State, Beijing, China. [Proceedings to be published as a *Macromolecular Symposia* volume by Hüthig & Wepf Verlag, Basel, 1997].
23 25–29 August 1996. 13th IUPAC Conference on Physical Organic Chemistry, Inchon, Korea. [Proceedings to be published in *Pure Appl. Chem.* 1997].
24 25–30 August 1996. 14th IUPAC International Conference on Chemical Thermodynamics, Osaka, Japan. [Proceedings to be published in *Pure Appl. Chem.* 1997].
25 25–30 August, 1996. 10th International Biotechnology Symposium, Sydney, Australia.
26 1–4 September 1996. International Conference on Environmental Biotechnology, Palmerston North, New Zealand. [Proceedings to be published in *Pure Appl. Chem.* 1997].
27 1–6 September 1996. CHEMRAWN IX: World Conference on Role of Advanced Materials in Sustainable Development, Seoul, Korea. [Proceedings published by Korean Chemical Society, 1997].
28 1–7 September 1996. EUROANALYSIS IX, Bologna, Italy.
29 8–12 September 1996. 14th International Symposium on Medicinal Chemistry, Maastricht, Netherlands.
30 11–13 September 1996. International Symposium on Food Packaging: Ensuring Safety and Quality of Foods, Budapest, Hungary.
31 15–18 September 1996. 4th International Symposium on Characterization of Porous Solids, Bath, UK.
32 15–20 September 1996. 20th IUPAC International Symposium on the Chemistry of Natural Products, Chicago, USA. [Proceedings to be published in *Pure Appl. Chem.* 1997].
33 23–26 September 1996. International Symposium on Polycondensation Related Processes and Materials, Paris, France. [Proceedings to be published as a *Macromolecular Symposia* volume by Hüthig & Wepf Verlag, Basel, 1997].
34 30 September–4 October 1996. 7th International Conference on Multiphoton Processes, Garmisch-Partenkirchen, Germany.
35 13–16 October 1996. International Workshop on Pesticide Use and Environmental Safety in Latin America, Sao Paulo, Brazil.
36 4–8 November 1996. International Symposium on Industrial Applications of Mössbauer Effect, Johannesburg, South Africa. [Proceedings to be published in *Hyperfine Interactions*, 1997].

IUPAC Accounts for 1996

J.M. Ward

Treasurer's comments

There was an unexpected addition to the Union's funds from Baring Brothers Bank. 'Office Internationale de Chemie', part of the Union when it was created in 1919, had never closed its account with the Bank and so the money plus accrued interest has been paid to us as successors, a sum of USD 343 780. Accountancy rules demand that this sum should go through the Income and Expenses account, so that the accounts show a surplus for 1996 of USD 634 470. But without the 'windfall' the surplus is still USD 290.7k, 129.7k better than budget, a result brought about largely by a Publications surplus of USD 60.8k over budget and an underspend of USD 29.6k on the Affiliate Membership Programme, both results due mainly to a reduction in staff, and so staff costs, during the year. A healthy number of smaller contributions make up the balances.

In 1997 there will be considerable unbudgeted expenses arising from the move of the Secretariat to the Research Triangle Park in North Carolina, as well as recognized additional expenses coming from the extra meetings called to discuss the possible changes to our objectives and methods of working, arising from recent decisions by Council and Bureau. So the 1996 surplus will help to keep what might have been a heavy biennial deficit within reasonable bounds.

Our reserves have increased substantially in value over the year, partly due to the Baring's money and partly due to a good return on our investments. Excluding the Building Fund which now stands at USD 439 605 and the Southern Hemisphere Sinking Fund, the available reserves increased from USD 2451k to USD 3093k during the year. During 1997 another USD 50k will be transferred from the main reserves to the Sinking Fund. The capital needed to equip the Secretariat offices in North Carolina will also be taken from them. Even so, there are still substantial funds available for new initiatives of limited and defined lifetimes, which should arise from the current discussions. We should not be tempted to use the level of reserves as a reason for not keeping our national subscriptions in line with inflation as do all other organizations, companies and retailers.

In conclusion, the 1996 results fully confirm that our finances are now firmly under control and in sound order. We must all determine to keep them so and not slip back to what one might unkindly call the bad old ways.

Prof. J.M. Ward

Auditor's Report

The following is the Report of the Auditors to the IUPAC Executive Committee:

As auditors of the International Union of Pure and Applied Chemistry we have examined the books of account and accounts for the year ended 31 December 1996. Our audit was conducted in accordance with auditing standards promulgated by the profession. We confirm that we meet the legal requirements concerning professional qualification and independence.

Based on our examination, we conclude that the books of account and the accounts are in accordance with Swiss law and the requirements of the statutes.

We recommend that the accounts submitted to you be approved.

NEUTRA TREUHAND AC
Zurich, 19 March 1997

IUPAC Accounts

All amounts expressed in USD

Comparative Balance Sheet[1]

Liabilities	1996	1995
Capital Account	2608 453	2513 028
Accounts Payable[2]	27 811	34 632
Paulo Franzosini Fund	5659	5659
Provisions & Subaccounts[3]	173 155	87 376
Prepaid Subscriptions[4]	36 650	3900
Sundry Creditors	4962	6635
Capital Gains Realized[5]	–3561	–17 919

Unrealized Profit on Securities[8]	272 000	89 381
Excess of Income over Expenses	634 470	113 344
USD	3759 599	2836 036

Assets	1996	1995
Fixed Assets[6]	13 969	22 502
Cash in Banks[7]	261 843	407 228
Marketable Securities[8]	2830 876	2043 746
Building Fund[9]	439 605	302 942
Southern Hemisphere Sinking Fund	50 000	0
Accounts Receivable[10]	15 606	23 368
Subscriptions, etc., Outstanding[11]	147 700	36 250
USD	3759 599	2836 036

Summary of Income and Expenses

	1996	1995
General Expenses net	419 052	–40 849
Publications Income net	200 805	155 732
Affiliate Membership Programme Expenses net	14 613	–1539
To Capital Account USD	634 470	113 344

General Income and Expenses

Income	1996	1995
National Subscriptions[12]	646 010	630 712
Company Associate Service Charges[13]	7010	9000
Observer Country Service Charges[14]	800	1100
Associated Organization Service Charges[15]	1800	1550
Interest & Dividends Earned	115 835	107 854
Other Income	343 780	0
Debit to Capital Account	0	40 849
USD	1115 235	791 065

Expenses	1996	1995
Office Expenses[16]	265 184	290 907
Expenses IUPAC Bodies:		
Standing Committees	68 975	35 384
Divisions[17]	176 222	108 956
General Assembly	8003	329 411
Bad Debts Write Off[18]	0	–44
Bad Debts Provision	11 650	–10 888
Other Expenses[19]	79 896	88 899
Foreign Exchange Differences	–4328	5726
Depreciation	9778	18 786
Provisions: Committed Expenses	80 803	–76 072
Credit to Capital Account	419 052	0
USD	1115 235	791 065

Publications Income and Expenses

Income	1996	1995
Publications: Other Publishers	10 740	13 922
Publications: Blackwell	336 341	331 682
Publications: Secretariat	117	218
BS Support of Publication Activities	20 000	20 000
USD	367 199	365 822

Expenses	1996	1995
IUPAC Secretariat (Pubns.)	144 825	179 965
Chem. Intl. to Symposia	457	351
Miscellaneous Expenses[20]	21 112	29 774
Credit to Capital Account	200 805	155 732
USD	367 199	365 822

Affiliate Membership Programme Income and Expenses

Income	1996	1995
Contributions[21]	82 427	67 544
Royalties Blackwell	2371	3038
Ties & Scarves	58	580
Transfer from General Income & Expenses	0	10 800
Debit to Capital Account	0	1539
USD	84 856	83 501

Expenses	1996	1995
IUPAC Secretariat (AMP)	16 430	28 877
Chem. Intl. & Leaflets	48 935	51 686
Miscellaneous Expenses	4878	2938
Credit to Capital Account	14 613	0
USD	84 856	83 501

Notes to Accounts

1. Accounting Policies

a. Basis of Preparation of Financial Statements

The financial statements are prepared under the historical cost convention.

b. Tangible Fixed Assets and Depreciation

Tangible fixed assets are stated at cost less depreciation. Depreciation is provided on all tangible fixed assets at rates calculated to write off the cost less estimated residual value of each asset on a straight-line basis over its expected useful life as follows:

Fixtures and fittings—over 5 years

Computer hardware—over 5 years

c. Leasing Commitments

Rentals paid under operating leases are charged to the Income and Expenses account on a straight line basis over the period of the lease.

d. Foreign Currencies

Transactions in foreign currencies are recorded at the rate ruling at the date of the transaction. Monetary assets and liabilities are retranslated at the rate of exchange ruling at the balance sheet date. All differences are taken to the income and expenses account, except those incurred in investment transactions, which are taken direct to the balance sheet.

e. Investments

Interest on investment bonds is recognized on a receipts and not an accruals basis.

f. Committed Expenses

The IUPAC Council meets once every two years at the General Assembly to agree budgets for committee operations for the following two years. Starting in 1994, seventy per cent of the budgeted expenses is charged to the income and expenditure account in the first year following the General Assembly and thirty per cent in the General Assembly year.

g. Royalty Income

Royalty income is recognised in the income and expenditure account on a cash received basis.

h. Legal Status

The official headquarters of IUPAC are in Zürich, and the legal domicile of the Union is accepted by the Canton of Zürich as an association under Swiss Law. As such the Union is exempt from any taxation on any net income arising from its activities.

2. Accounts Payable	*1996*	*1995*
List Oxford	23 319	27 462
List New York	4492	7170
	27 811	34 632

3. Provisions and Subaccounts	*1996*	*1995*
Committed Expenses	80 803	0
Bad Debts	20 712	9062
CHEMRAWN Conference Loan Fund	429	7654
Neutra/Audit	9000	9000
Purchases from Blackwells	5832	500
Royal Society Contbn. to Dev. Activs.	9645	11 145
Kratos Grant	136	136
ICSU Grants	33 270	32 408
Lewis Publishers	3613	5004
UNESCO grants	2129	130
Organic Synthesis	1523	1523
Destruction of Chemical Weapons	2621	4621
Oxford University Press—Solubility Data Series	1711	6193
JCAMP-DX Data Standards Project	1731	0
	173 155	87 376

4. Prepaid Subscriptions	*1996*	*1995*
Czech Republic NAO 1997	1300	–
Hungary NAO 1997	3700	–
Netherlands NAO 1997	18 300	–
South Africa NAO 1997	11 500	–
ICC AO 1997	50	–
ISMAR AO 1997	50	–
China CAs 1997	800	–
Hungary CA 1997	450	–
Netherlands CAs 1997	350	–
South Africa CAs 1997	150	–
Croatia NAO 1996	–	1000
Czech Republic NAO 1996	–	1300
Eurachem AO 1996	–	50
ICCC AO 1996	–	50
IZA AO 1996	–	100
Egypt CA 1996	–	450
Hungary CA 1996	–	450
Hungary CA 1997	–	450
Hong Kong OC 1996	–	50
	36 650	3900

5. Capital Gains Realized	*1996*	*1995*
Capital Gains Realized	3383	–32 137
Gain on Building Fund	0	7993
Exchange Differences on Building Fund	–6944	6225
	–3561	–17 919

6. Fixed Assets	*1996*	*1995*
Fixed Assets	96 774	95 529
Depreciation of Assets over 5 Years	–82 805	–73 027
	13 969	22 502

7. Cash in Banks	*1996*	*1995*
USD	–2755	4190
GBP	37 237	15 999
East European Banks	0	17
Money Market Investments	227 361	387 022
	261 843	407 228

8. Marketable Securities

The Marketable Securities are stated at market value in 1995 following a decision by the IUPAC Finance Committee (Minute 4.1(ii)/96, Zürich).

	1996	*1995*
Book Value	3048 481	1954 365
Unrealized Profit	272 000	89 381
Market Value	3320 481	2043 746
comprising Building Fund		
Book Value	396 225	
Unrealized Profit	43 380	
Market Value	439 605	

and General (including Southern Hemisphere Fund of USD 50 000)

Book Value	2652 256
Unrealized Profit	228 620
Market Value	2880 876

9. Building Fund

On the recommendation of the IUPAC Council (Minute 7/91, 36th Meeting - Hamburg), part of the Union's assets have been moved into a building fund, to provide for the eventuality that the need for a permanent Secretariat building becomes pressing.

10. Accounts Receivable	*1996*	*1995*
List Oxford	15 606	13 485
List New York	0	9883
	15 606	23 368

11. Subscriptions, etc., Outstanding

	1996	*1995*
National Organizations	147 050	36 250
Observer Country Service Charges	0	0
Company Associates Service Charges	650	0
Associated Organization Service Charges	0	0
	147 700	36 250
National Organizations (1995)		
Argentina	–	1100
Chile	–	2800
Egypt	5800	5800
Greece	–	3500
Kuwait	–	700
Turkey	–	5650
USA	–	16 700
	5800	36 250
National Organizations (1996)		
Belgium	14 500	–
Brazil	8100	–
Egypt	4900	–
Egypt (CA)	400	–
France	35 100	–
Greece	3800	–
Israel	5000	–
Italy (CA)	400	–
Russia	30 400	–
Slovakia	1000	–
Turkey	3850	–
USA	33 800	–
	141 250	
Service Charges Company Associates (1996)		
Egypt	50	–
Italy	50	–
UK	550	–
	650	

12. National Subscriptions	*1996*	*1995*
Received	504 760	594 462
Outstanding	141 250	36 250
	646 010	630 712

13. Company Associate Service Charges

	1996	*1995*
Received	6360	9000
Outstanding	650	0
	7010	9000

14. Observer Country Service Charges

	1996	*1995*
Received	800	1100
Outstanding	0	0
	800	1100

15. Associated Organization Service Charges

	1996	*1995*
Received	1800	1550
Outstanding	0	0
	1800	1550

16. Office Expenses	*1996*	*1995*
IUPAC Officers	2933	9734
IUPAC Secretariat (Non-pubns.)	248 649	269 114
Audit, Bank Fees, Other Charges	13 603	12 059
	265 184	290 907

17. Expenses IUPAC Bodies	*1996*	*1995*
Administration Expenses	19 188	39 642
Meetings other than General Assembly	214 909	104 698
Transfer to CHEMRAWN Account	11 100	0
General Assembly	8003	329 411
	253 200	473 751

18. Bad debts write off	*1996*	*1995*
Bulgaria (AMP)	–	–44

19. Other Expenses	*1996*	*1995*
Contributions to ICSU	20 726	19 785
Representatives Other Organizations	8932	6560
IUPAC Handbook 1994–1995	0	15 654
Chem. Intl. for Members	21 692	21 481
Relocation of Secretariat	1736	0
Appointment of Executive Secretary	15 464	0
Appointment of Information Officer	0	3180
Internet running costs	1303	0
Miscellaneous Expenses	10 043	11 439
Transfer to Affiliates in Developing Countries	0	10 800
	79 896	88 899

20. Miscellaneous Expenses	*1996*	*1995*
BS Travel Grant	20 000	20 000
Other	1112	9774
	21 112	29 774

21. AMP Contributions	*1996*	*1995*
In USD	82 427	66 990
From East Europe	0	554
	82 427	67 544

Subaccounts not Affecting Current Year Income and Expenses

CHEMRAWN	1996	1995
Brought Forward from Balance Sheet	–7654	–15 839
Income from Committee Allocation	–11 100	0
CHEMRAWN IX Contribution	–3000	0
UNESCO Grant Income	0	–1000
Royalties from CHEMRAWN VII Monograph	–1463	–3660
Committee Expenses	22 789	12 844
Net Movement in the Year	7225	8185
Carried Forward to Balance Sheet	–429	–7654

Royal Society Contribution Towards Development Activities	1996	1995
Brought Forward from Balance Sheet	–11 145	–19 922
Income		0
Expenses	1500	8777
Net Movement in the Year	1500	8777
Carried Forward to Balance Sheet	–9645	–11 145

ICSU Grants	1996	1995
Brought Forward from Balance Sheet	–32 408	–35 184
Income	–30 200	–26 200
Expenses	29 338	28 976
Net Movement in the Year	–862	2776
Carried Forward to Balance Sheet	–33 270	–32 408

KRATOS Grant	1996	1995
Brought Forward from Balance Sheet	–136	–136
Income	0	0
Expenses	0	0
Net Movement in the Year	0	0
Carried Forward to Balance Sheet	–136	–136

Lewis Publishers & European Environmental Research Organization (EERO)	1996	1995
Brought Forward from Balance Sheet	–5004	–5004
Income	0	0
Expenses	1391	0
Net Movement in the Year	1391	0
Carried Forward to Balance Sheet	–3613	–5004

UNESCO Grants	1996	1995
Brought Forward from Balance Sheet	–129	0
Income	–2000	–23 000
Expenses	0	22 871
Net Movement in the Year	–2000	–129
Carried Forward to Balance Sheet	–2129	–129

Destruction of Chemical Weapons	1996	1995
Brought Forward from Balance Sheet	–4621	–6434
Income	0	0
Expenses	2000	1813
Net Movement in the Year	2000	1813
Carried Forward to Balance Sheet	–2621	–4621

Organic Synthesis	1996	1995
Brought Forward from Balance Sheet	–1523	–1523
Income	0	0
Expenses	0	0
Net Movement in the Year	0	0
Carried Forward to Balance Sheet	–1523	–1523

Oxford University Press—Solubility Data Series	1996	1995
Brought Forward from Balance Sheet	–6193	–2286
Income	–7719	–6193
Expenses	12 202	2286
Net Movement in the Year	4482	–3907
Carried Forward to Balance Sheet	–1711	–6193
Total from Balance Sheet	–68 814	–86 328
Total Income on Subaccounts	–62 482	–60 053
Total Expenses on Subaccounts	74 489	77 567
Total Net Movements in the Year	12 006	17 514
Total to Balance Sheet	–56 808	–68 814

Movements in Provisions for Year (General Income & Expenses)	1996	1995
Committed Expenses		
Balance Brought Forward	0	–76 072
Net Charge/Credit to Year	–80 803	76 072
Balance Carried Forward	–80 803	0
Bad Debt Write Off		
Balance Brought Forward	–9062	–19 950
Net Charge/Credit to Year	–11 650	10 888
Balance Carried Forward	–20 712	–9062
Neutra/Audit		
Balance Brought Forward	–9000	–8000
Net Charge/Credit to Year	0	–1000
Balance Carried Forward	–9000	–9000
Purchases from Blackwell		
Balance Brought Forward	–500	–564
Net Charge/Credit to Year	–5332	64
Balance Carried Forward	–5832	–500
Total provisions brought forward	–18 562	–104 586
Total provisions carried forward	–116 347	–18 562
Total provisions charges/credits	–97 785	86 024

Securities Account as at 31 December 1996

	Currency	Amount	Approx price %	Market value (USD)	Book value at cost	Profit/(loss) since purchase (potential)
Bonds						
6.5% Toyota—4.2.1997	USD	100 000	100.06	100 062.00	97 009.72	3052.28
4.25% General Electric—8.4.1998	USD	150 000	99.56	149 343.00	152 280.56	–2937.56
5.75% Osaka Gas 1993—26.5.1998	USD	100 000	99.69	99 687.00	104 428.40	–4741.40
7% Korea Development Bank—15.7.1999	USD	50 000	101.52	50 758.00	51 162.34	–404.34
7.75% USD Nip. Telegraph—18.11.1999	USD	100 000	104.25	104 250.00	109 652.78	–5402.78
7.25% Salomon Inc Notes—15.1.2000	USD	100 000	101.16	101 155.00	105 108.88	–3953.88
6.125% Southwestern Bell Tel—1.3.2000	USD	100 000	99.36	99 358.00	100 950.39	–1592.39
5 7/8% Euro Ciba–Geigy—23.3.2000	USD	100 000	99.56	99 562.00	100 260.00	–698.00
6.5% USD Abbey Natl Treas—12.5.2003	USD	100 000	100.56	100 562.00	107 913.89	–7351.89
Certificates of Deposit						
CD Bank of America NA Phoenix AZ	USD	90 000	99.87	89 883.00	90 008.98	–125.98
CD World Fin Netwk NB BE Whitehall Ohio	USD	100 000	100.03	100 032.00	100 000.00	32.00
Mutual Funds						
Haussmann Holdings	USD	423	905.04	382 831.00	285 803.81	97 027.19
ML Basic Value	USD	17 148	22.91	392 860.00	285 834.52	107 025.48
ML Euro Equity	USD	15 286	19.40	296 521.98	243 474.53	53 047.46
ML Pacific Equity	USD	25 310	10.37	262 464.00	256 331.96	6132.04
Aetna European Equity	USD	14 777	14.01	207 025.00	183 679.16	23 345.84
Meridian Global Government Fund	USD	9320	10.73	100 003.00	100 365.00	–362.00
Meridian US Emerging	USD	12 235	22.83	279 328.00	270 311.14	9016.86
Permal Asian Holdings	USD	122	1070.84	130 642.00	134 406.95	–3764.95
MLBS USD Fixed Income Portfolio	USD	6230	11.82	73 638.00	69 838.30	3799.70
ML Corporate High Income Portfolio	USD	10 728	9.37	100 516.00	99 659.89	856.11
Grand total securities				3320 480.98	3048 481.20	271 999.78

News

Commission on Biophysical Chemistry: An Introduction

The Commission on Biophysical Chemistry is a recent addition to the Physical Chemistry Division of IUPAC. It came into existence on 1 January 1996. As the chairman of this new Commission I welcome the opportunity to write an introductory note for Chemistry International. By way of introduction it is probably appropriate to give some historical background.

In 1975, IUPAC, IUB and IUPAB decided to create an inter-union Commission on Biothermodynamics. Ingemar Wadsö was chairman and G.T. Armstrong (USA), R.L. Biltonen (USA), J.T. Edsall (USA), H. Gutfreund (UK), W.P. Jencks (USA) and P. Privalov (USSR) were members of this commission. The aim of the commission was to produce guidelines for nomenclature and terminology in the field of biothermodynamics and to organize scientific meetings to this end. In 1985 the Commission on Biothermodynamics was replaced by a 'Working Party on Biophysical Chemistry' which somewhat later was renamed 'Steering Committee on Biophysical Chemistry' (SCBC). This committee was incorporated in the Physical Chemistry Division of IUPAC and given a wider range of responsibilities. It reported to the Physical Chemistry Division Committee, but remained independent in as much as it was not attached to any of the com-

Prof. Helmut Hauser

missions of the Physical Chemistry Division. Ingemar Wadsö, who chaired the former Commission on Biothermodynamics during most of the time of its existence, continued as chairman of the SCBC. Under his guidance a number of biophysically and biochemically oriented projects were initiated and successfully conducted. Working Parties were established to deal with diverse projects such as 'Electrochemical Biosensors' (coordinator: Katsumi Niki), 'Guidelines for Preparation, Characterization and Terminology Concerning Vesicles' (coordinator: Lisbeth Ter-Minassian-Saraga), 'Protein Stability' (coordinator: Brigitte Heinritz), 'Guidelines for Measurements of Redox Potentials of Proteins' (coordinated by Katsumi Niki and carried out as a joint project with the Commission on Electrochemistry), and 'Standardization of Data Bases on Protein Structures Determined by NMR in Solution' (coordinated by Kurt Wüthrich).

When Ingemar Wadsö resigned from the SCBC in 1991, the author was elected chairman of the SCBC. At that time lUPAC's role and service to the chemical society, both industrial and academic, was being questioned, sometimes criticized, and the need for reorientation and restructuring of the Union became clear and was recognized within IUPAC. It was easily foreseeable that the general trend of applying physics and chemistry to problems in biological areas would not only continue but would substantially increase in the future. The working party on 'Hot Spots in Physical Chemistry' created by the Physical Chemistry Division Committee in 1989 delivered two reports in 1991 emphasizing the importance of biophysical chemistry. As a mater of fact, biophysical chemistry was identified as one of the most importanat fields to focus on in the future. All the members of the SCBC were firmly convinced of this fact. We also knew that we were working on timely projects of immediate interest. Most of our members felt that this kind of effort should be stepped up and intensified within IUPAC in the future. The idea of converting the SCBC to an ordinary commission was born. At the General Assembly in Lisbon in 1993, the SCBC submitted a memo to Robert Alberty, then President of the Physical Chemistry Division, urging him to officially propose to the IUPAC Bureau the conversion of our Steering Committee to a regular commission. An official application was filed under Kozo Kuchitsu who succeeded Alberty as President. It took a great deal of effort, intuition, persistency and persuasion as well as the full support of Kozo Kuchitsu, Bob Alberty, Gus Somsen, Mostafa El-Sayed, lan Mills and other members of the Physical Chemistry Division Committee before our application was approved by the Council at the General Assembly at Guildford in August 1995 and the SCBC was eventually transformed to a regular commission in the beginning of 1996.

The objectives of this new commission, officially now called 'The Commission on Biophysical Chemistry' (Commission 1.7), as laid down in the terms of reference are:

1 To alert the scientific community to the importance of the application of physicochemical methods to biological problems.

2 To highlight areas related to biophysical chemistry where there is confusion regarding definitions, nomenclature, symbols, and related matters and to establish guidelines and recommendations.

3 To establish contacts with other IUPAC bodies with the aim of initiating interdisciplinary joint projects related to biophysical chemistry.

4 To promote communication between the Physical Chemistry Division and other bodies dealing with biology such as IUPAB and IUBMB that deal with biochemistry, biophysics and molecular biology.

5 To contribute to future IUPAC activities in biologically related areas.

These terms of reference were presented and approved of at the IUPAC General Assembly in Guildford in August 1995. The creation of a Commission on Biophysical Chemistry is undoubtedly based on the conviction that the effort within IUPAC on biologically oriented areas will be increasing in the future. Our members also identified the need of alerting other commissions of the Physical Chemistry Division and also other IUPAC Divisions to problems in biology, biochemistry and biophysics. The aim is certainly to help to initiate biological programmes within these commissions and/or as interdisciplinary joint projects between commissions, as proposed in points 3–5 of the terms of reference.

Our commission was created at times of financial constraints which is reflected in the limited number of Titular Members. To start with our commission had three Titular Members: Robert N. Goldberg (USA), who has been vice chairman and secretary, Helmut Hauser (Switzerland), who has been chairman, and Kurt Wüthrich (Switzerland), and six Associate Members: Martin Caffrey (USA), Athel Cornish-Bowden (France), David Eisenberg (USA), Wilfred van Gunsteren (Switzerland), Wolfram Saenger (Germany) and Akiyoshi Wada (Japan). Our proposal to raise the number of Associate Members to nine was granted by the IUPAC Bureau at the end of 1995. Accordingly, Teizo Kitagama (Japan), Terry R. Stouch (USA) and Daniel R. Thevenot (France) joined our commission as Associate Members in the beginning of 1996. Our commission competed successfully for pool Titular Members, and as a result Fred M. Hawkridge, Hans-Jurgen Hinz and Frederick P. Schwarz were assigned to our commission as short-term Titular Members beginning of 1996. Our request for an extension of the terms of these three Titular Members was granted by the IUPAC Bureau in September 1996 so that these three Titular Members will be associ-

ated with our commission until 31 December 1999.

Current activities of the Commission on Biophysical Chemistry are focused on the following IUPAC Programmes:

I 'Electrochemical Biosensors' is coordinated by Daniel Thevenot and a joint project with the Commissions on Electrochemistry and Biotechnology.

II 'Thermodynamics of Enzyme-Catalyzed Reactions' is coordinated by Robert N. Goldberg and Yadu B. Tewari and is a joint project with the Commission on Thermodynamics. The aim of this project was to provide a critical compilation of data on the thermodynamics of enzyme-catalyzed reactions. The data presented were limited to the results of direct equilibrium and calorimetric measurements performed on these reactions under in vitro conditions. This project led to the publication of three major reviews in the Journal of Physical and Chemical Reference Data: 'Thermodynamics of enzyme-catalyzed reactions: Part 3. Hydrolases', *J. Phys. Chem. Ref. Data* 1994, 23, 1035–1103; 'Thermodynamics of enzyme-catalyzed reactions: Part 4. Lyases', *ibid*. 1995, 24, 1669–1698; and 'Thermodynamics of enzyme-catalyzed reactions: Part 5. Isomerases and Ligases', *ibid*. 1995, 24, 1765–1801.

III The project 'Terminology in the Field of Lipid Vesicles (Liposomes): Preparation and Essential Characterization' was initiated and, as mentioned before, originally coordinated by Lisbeth Ter-Minassian-Saraga. After her retirement from the SCBC in 1991 it has been coordinated by Helmut Hauser and run as a joint project with the Commissions on Colloid and Surface Chemistry including Catalists and Biotechnology.

IV 'Standardization of Data Basis on Protein Structures Determined by NMR in Solution' has been coordinated by Kurt Wüthrich. The final document entitled 'Recommendations for the Presentation of NMR Structures of Proteins and Nucleic Acids' is scheduled to appear in the August issue of *Pure and Applied Chemistry*.

V 'Measurements of Redox Potentials of Proteins' is being carried out in collaboration with the Commissions on Thermodynamics and Electrochemistry. It is coordinated by George S. Wilson and Frederick M. Hawkridge, one of our short-term Titular Members.

VI The project 'A Nomenclature for Lipid Mesophases' was initiated at the General Assembly in Lisbon and is coordinated by Martin Caffrey.

VII 'Recommendations for the Measurement and for the Presentation of Results obtained on Biological Substances with Scanning Calorimetry' was initiated as a joint project with the Commission on Thermodynamics 1994. It is coordinated by Fred P. Schwarz and Hans-Jurgen Hinz who were assigned to this project from the pool of short-term Titular Members.

The first publication submitted recently by our new commission is Kurt Wüthrich's document on the presentation of NMR solution structures. To my mind this project is an example of good and timely service to the chemical community. Solution-state NMR spectroscopy has become an important method of structure determination. Richard Ernst and Kurt Wüthrich of the Swiss Federal Institute of Technology are responsible for the development of the methodology in this field, and needless to say that Kurt Wüthrich is an acknowledged authority in the structure determination by NMR. The method has been used widely in the last decade to determine the structures of peptides, proteins and nucleic acids as well as complexes of peptides and proteins with nucleic acids and other molecules such as, for instance, drugs. A certain consensus has evolved concerning the presentation of NMR solution structures. This has been helped along by issuing guidelines for depositing primary data as well as final structures in protein and nucleic acid data banks and by conventions used by abstracting services. Considering the ever-increasing number of NMR solution structures published in the 1980s, the time appeared to be ripe for the development of generally accepted guidelines for unified nomenclature and reporting standards. With these goals in mind Kurt Wüthrich organized a Working Party (Task Group) as an IUPAC/IUBMB/IUPAB inter-union venture. The project has been supported financially by ICSU and CODATA. The final result of the project is a set of recommendations pertaining to the presentation of NMR data and structures in scientific journals and to the storage of this information in computer-accessible form. This information, in standardized formats, will be freely available to the scientific community. The standardization is important since it is a prerequisite for data exchange. In the course of this project initiated in 1989 the Task Group of eight people has been reviewing previous recommendations of the Nomenclature Committee of IUBMB and IUPAC-IUBMB Joint Commission on Biochemical Nomenclature *(Newsletter* 1992, *Biochem. Int.* 1992, **26**, 567–575) and the Commission on Molecular Structure and Spectroscopy *(Pure Appl. Chem.* 1972, **29**, 627–628, and *Pure Appl. Chem.* 1976, **45**, 219) and has then extended these recommendations in the light of recent developments in the field of biomolecular NMR spectroscopy. This work resulted in several drafts of the recommendations to be issued. These drafts were examined critically by about 50 experts in the field, and were then subjected to two rounds of extensive changes. Modifications and amendments were introduced by the Task Group according to the criticisms and suggestions made by these experts to produce the final document of recommendations.

Regarding the future prospects of our commission we feel that an important assignment given to the members of this commission is to participate in future IUPAC activities in biologically related areas and to contribute to these activities (point 5 of the terms of reference). In this respect our commission may play more than just an ad-

visory role. I believe that the Commission on Biophysical Chemistry is very well equipped for this important task. Our members are chemists who have spent a significant proportion if not a lifetime on research in biological areas. It is this experience that counts and makes all the difference. Future recruitment of members will certainly take care of this point. We need scientists with hand-on experience in research in the life sciences. As the chairman of the Commission on Biophysical Chemistry I would prefer to work on fewer projects in the future than is customary at the moment. I am convinced that what may be called alibi project is not only questionable in terms of usefulness, but is really counterproductive. It is our aim to focus on projects which are very carefully selected and thoroughly screened for what they are worth to the chemical society. To work on fewer projects ensures that our limited resources remain carefully focused. We look forward to close and fruitful contacts and collaborations with other IUPAC bodies. After completing a IUPAC project we regard it as a good sign if the people involved in the work have a convincing and good answer to the final question: Who cares?

IUPAC-IUBMB Joint Commission on Biochemical Nomenclature (JCBN) and Nomenclature Committee of IUBMB (NC-IUBMB)

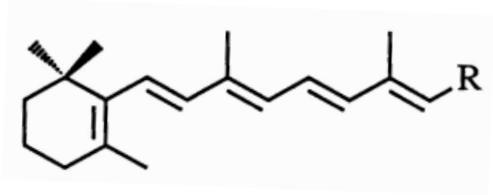
The following are extracts taken from the JCBN and NC-IUBMB joint 1996 newsletter, prepared for publication by Prof. Claude Liébecq, Université de Liège, Belgium.

Vitamin A and retinoids

A document has been prepared by Fritz Weber in consultation with Henry B.F. Dixon and other members of our committees. It has already been published by Fritz Weber (chairman of the former Committee II.1 on Nutritional Terminology of the International Union of Nutritional Sciences) and Athel J. Cornish-Bowden (chairman of our committees) (*Br. J. Nutr.* **74**, 869–870). It is reprinted by permission of the chairman of the Editorial Board of the *British Journal of Nutrition.*

The term ‘vitamin A’ has been defined as the generic descriptor for all C_{20}-β-ionone derivatives that exhibit qualitatively the biological activity of *all-trans* retinol. The term ‘provitamin A’ for the carotenoids giving rise to vitamin A is retained.

Chemically, vitamin A belongs to the ‘retinoids’, defined as a class of compounds consisting of four isoprenoid units joined in a head-to-tail manner. These recommendations also contain the statement: all retinoids may be formally derived from a monocyclic parent compound containing five carbon–carbon double bonds and a functional group at the end of the acyclic portion (Formula I).



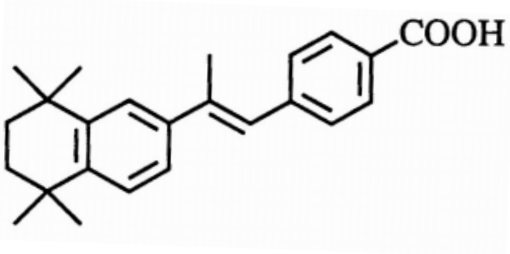
Formula I: Structure of the parent compound of retinoids

The two definitions do not contradict each other. There are, however, certain implications in the words ‘vitamin A’ and ‘retinoids’ that should be considered when using the terms.

‘Vitamin A’ means a group of substances (retinol, retinyl esters, and retinal) with defined biological activities. Further, there are certain metabolites of vitamin A, such as *all-trans* and *cis*-isomeric retinoic acids, that can perform some, but not all, of the biological functions of vitamin A; they are incapable of being metabolically converted into retinol, retinal, etc.

Retinoic acid and some of its isomers and derivatives, together with a number of structurally modified retinoids, have been shown to control cell differentiation in many epithelial tissues and to prevent metaplasia. Some of these substances are used in the treatment of various types of keratinization disorders. Such compounds cannot substitute for vitamin A; indeed some of them even act as vitamin A antagonists.

The term ‘retinoids’ is widely employed for this class of compounds. This practice arose from an earlier proposal to use the name ‘retinoids’ collectively for both natural forms and synthetic analogues of vitamin A that are capable of preventing the development of cancer. General usage of this term is, however, misleading for two reasons. Firstly, the customary practice gives the name ‘retinoids’, which has an agreed definition based on chemical structure, to a class of compounds defined by their biological activity. Secondly, many synthetic members of this class of compounds, the so-called ‘arotinoids’ or ‘retinoidal benzoic acid derivatives’ as well as others, are not chemically retinoids. They contain, e.g. aromatic rings replacing either the basic β-ionone type ring structure or unsaturated bonds of the



Formula II: Structure of an ‘arotinoid’

tetraene side chain of the retinoid skeleton (Formula II).

We now suggest that the compounds that control epithelial differentiation and prevent metaplasia, without possessing the full range of activities of vitamin A, should be termed 'retinoate analogues'. Although they are usually called 'retinoids', we discourage their designation by a term that has a defined, but different, meaning.

A new term for the group of substances with such antimetaplastic activities may be desirable, especially if it is based on their biological activity. It should not imply a chemical structure because of heterogeneity among the compounds. Proposals for such a term are welcome.

Glycosaminoglycans and proteoglycans

Nomenclature (including abbreviations and acronyms) of glycosaminoglycans (GAG) and proteoglycans (PG) is *ad hoc*.

Older terms such as chondroitin sulfates A, B, or C define major tissue components, but difficulties now occur as hybrid polymers from many tissues do not fit in this system; domain structures present in many tissue GAG are not recognized, and the spectra of modifications due to sulfation and 5-epimerization of D-glucuronic acid (D-GlcA) provide no basis on which to distinguish between, for example, chondroitin and dermatan sulfates (CS and DS). If 10% iduronate (L-IdoA) qualifies chondroitin sulfate to be called dermatan sulfate, are chondroitin sulfate containing 9% iduronate and dermatan sulfate containing 11% iduronate different species?

It is proposed that terminology be based on disaccharide units, which are readily accessible to quantitative analysis, via enzymic digestion. These units are of unambiguous composition and can, for example, be represented by logical abbreviations.

Polymer abbreviations could be two-letter codes, e.g. CS, DS, HS (heparan sulfate) and KS (keratan sulfate). If there is no sulfation, Ch, De, Hp and Ke could be used. They are defined in terms of disaccharide units, thus Ch (chondroitan) is the disaccharide polymer [-4GlcAβ1-3GalNAcβ1-]$_n$, where GlcA is D-glucuronate and GalNAc is *N*-acetyl-D-galactosamine.

DS (currently an abbreviation for dermatan sulfate) consists of not only chondroitin sulfate disaccharides, containing D-glucuronate, but also its 5-epimer, L-iduronate. Probably all 'DS' contains chondroitin sulfate units. In order to avoid confusion about definitions of dermatan sulfate, which imply the complete epimerization of D-GlcA to L-IdoA, the term 'dermochondan sulfate' is proposed, indicating that 'DS' preparations are co-polymeric. The abbreviation 'DS' could be retained for these polymers.

Keratan sulfate consists of repeating -3Galβ1-4GlcNAcβ1- units, sulfated to various extents and in different positions. It belongs to the same polymer group as chondroitin sulfate.

Heparan sulfate is the sulfated polymer of heparan (Hp). Heparan consists of a polymer of the following two disaccharides: -4GlcAβ1-4GlcNAcα1- and -4IdoAα1-4GlcNAcα1-. It is therefore analogous to dermchondan sulfate in containing two uronic acid epimers. There are no names analogous to dermatan or chondroitin in this GAG family.

The abbreviation PG for proteoglycan is in wide use. A rational system should convey information about the protein and the glycan parts. Single names purporting to describe both are certain to confuse, since one part is a gene product and the other is introduced by a post-translational modification. They do not necessarily occur together. It is consistent to use proteochondroitan sulfate (PCS), proteokeratan sulfate (PKS), and now proteodermochondan sulfate (PDS) as abbreviations for proteoglycans with chondroitin sulfate, keratan sulfate or dermatan sulfate chains, respectively. If more than one type of glycosaminoglycan chain is attached to the protein, it is expressed, for example, as P(CS,KS) or P(CS,HS), the dominant GAG being written first. This convention can include quantitative or semi-quantitative information about the GAG, accommodating information on numbers of GAG chains attached to the protein, e.g. P(CS_{70-100}, KS_{10-20}, DS_{7-10}).

Protein cores may be viewed as gene products, as amino-acid sequences, as functioning units, or as characteristic shapes (sizes).

Names such as decorin, lumican, aggrecan, syndecan, etc., have been given over the past few years to molecules whose chemistry was known in detail. The names lack chemical information, are inconsistent and should only be used to name the direct gene product.

To emphasize their connection with the gene, rather than with the glycan, the ending 'on' (as in exon, intron, codon) could replace existing 'an', etc. Thus decoron, lumicon, aggrecon, syndecon. A proteoglycan is indicated by adding appropriate GAG abbreviations, e.g. decoron DS, lumicon KS, aggrecon CS,KS.

This complex area of biochemistry would benefit from a structured attempt to rationalize the nomenclature. Comments on the ideas presented here and other suggestions would be welcomed by the nomenclature committees and by John E. Scott of the Department of Chemical Morphology, University of Manchester, Oxford Road, Manchester, M13 9PL, UK (Fax: +44 161 275 4598. E-mail: scott@fs1.ed.man.ac.uk).

The use of 'biochemical equations'

A panel on biochemical thermodynamics, sponsored by JCBN and convened by Robert A. Alberty, has produced a series of recommendations for nomenclature

and tables in biochemical thermodynamics. This report emphasizes the distinction between 'chemical equations', in which the full ionic states of all reacting species should be given in a balanced equation, and 'biochemical equations'. The full charges are often omitted from the equations in routine biochemical presentations. For example, an equation of the form

ATP + acetate = acetyl phosphate + ADP

is commonly used in biochemistry. It makes no attempt to show the full ionization or complexation states or the reactants or to balance charges. It has the advantage that it is written in terms of sums of species and leads directly to the expression for the apparent equilibrium constant K'

$$K' = \frac{[\text{acetyl phosphate}][\text{ADP}]}{[\text{ATP}]\,[\text{acetate}]}$$

which is a function of pH and magnesium ion concentration, as well as T, P and ionic strength. In the above biochemical equation, ATP, ADP and acetyl phosphate are obviously sums of species and, if K' is determined at low pH values, acetate represents the sum of the anion and undissociated acetic acid.

Similarly, it has become common to use NAD^+ and NADH in equations, although both of these are in fact negatively charged at normal physiological pH values, without any attempt to balance charges and hydrogen atoms on other species in the equation. This may make it hard to tell whether a chemical equation or a biochemical equation is intended. In view of such difficulties, the panel has recommended that all indications of charges be removed from biochemical equations and that the full chemical equations, which are written in terms of individual species which may be charged (e.g. H^+, Mg^{2+}, $RCOO^-$, etc.) should be used for those specific cases where thermodynamic behaviour is to be considered.

In writing biochemical equations, it is necessary to use symbols that suggest sums of species and avoid symbols for only one of the species that may be present. Since both chemical equations and biochemical equations are need in biochemistry it is important that the reader should be able to distinguish between these two types of equations at a glance. Failure to make such a clear distinction can lead to hybrid equations that do not have corresponding equilibrium constant expressions and have incorrect stoichiometry. For example, the hydrolysis of 1 mol of ATP to ADP at approximately pH 7 does not produce 1 mol of H^+, as suggested by the equation

$$ATP + H_2O = ADP + \text{phosphate} + H^+$$

but about 0.6 mol. Thus it is recommended that hybrid equations, in which some charges but not others are given, should be avoided as misleading.

The implementation of such recommendations would have substantial implications for the way we have become accustomed to present equations in biochemistry. The views of readers on the desirability of these proposals are being sought.

Development of the enzyme list

Changes in the format: In the future, it is intended that references will be cited at the end of each entry with full title and pagination. In the past, the earliest available reference to a specific enzyme has usually been cited. It is hoped in the future, and starting with new additions to the list, to give more complete and up-to-date references. Good reviews on the properties of any specific enzyme would be particularly valuable citations.

We intend to expand the Comments section for individual enzymes to include information on metabolic significance, relation to other listed enzymes, possible isoenzymes, codification of enzymes of specific interest to clinical chemists, sequence database information, etc. Suggestions for material to include for individual enzymes are always welcome.

Work for the provision of enzyme nomenclature in database format is in progress.

Links with other relevant databases: Several other nomenclature systems and databases are in existence. These include the World Health Organization (WHO) list of International Nonproprietary Names (INNs), the QU number system of the Committee on Nomenclature, Properties and Units (C-NPU) for classifying enzymes of relevance to clinical chemistry, the ReBase of restriction enzymes, etc.

The Enzyme nomenclature database must link to these and the most appropriate ways of doing this are under discussion. Comments and suggestions are welcome.

Deficiencies in the list of enzymes: Advice and suggestions concerning deficiencies or omissions are always welcome. Problems in the classification of monooxygenases, protein kinases/phosphatases, restriction enzymes and other nucleases, are obvious and it would be most helpful if expert groups could be formed to advise on how these might best be classified and unambiguously named.

Submission of new enzymes and corrections to existing enzymes: These can be made on forms available from Keith F. Tipton, Biochemistry Department, Trinity College, Dublin 2, Ireland. Fax: +353 1 677 2400. E-mail: ktipton@mail.tcd.ie

Submissions concerning peptidases should be sent to Alan J. Barrett, Peptidase Laboratory, Department of Immunology, Babraham Institute, Babraham, England

CB2 4AT. Fax: +44 1223 83 7952. E-mail: alan.barrett@bbsrc.ac.uk

Catalytic antibodies: Like enzyme nomenclature, it is proposed that the nomenclature of catalytic antibodies should be based on the reaction catalysed, rather than on structural features. As more than one different 'abzyme' catalysing the same general reaction may be produced, there is clearly a possibility for confusion. However, the catalytic behaviour and specificities may not be identical. Several possibilities are under discussion: they may be included in the Comments section for existing enzymes where they catalyse similar reactions, they might be given EC numbers of they might be given an 'AB' numbering system in a separate list based on the enzyme nomenclature classes. Comments on these possibilities and on the general value of such a listing would be most welcome.

Other catalytic molecules: As in the case of catalytic antibodies the listing of natural and artificial catalytic nucleotides and engineered enzymes with novel specificities could be of use. Advice and comments as to how this could be most helpfully effected are invited.

Other issues covered in the Newsletter include: Naming proteins; Terminology in immunology; Allergen nomenclature; Receptor nomenclature; and Current and future activities.

For further information on the 1996 Newsletter, contact: Prof. Claude Liébecq, Université de Liège, Quai Marcellis 14/011, B-4020 Liège 2, Belgium.

JCBN and NC-IUBMB on the World Wide Web

A Home Page on the World Wide Web has been established for the two committees. This can be found at: http://www.chem.qmw.ac.uk/iupac/jcbn

The Home Page explains the role of the committees and lists its publications, including a WWW full-text version of the recommendations on amino-acid and peptide nomenclature, on steroid nomenclature, on carbohydrate nomenclature and on enzyme nomenclature.

If you have any problems accessing this page, send an E-mail message to: g.p.moss@qmw.ac.uk

Safety Evaluation of Pesticide Residues in Food

The following are three short papers on current issues prepared by the IUPAC Commission on Agrochemicals and the Environment

The aim of the IUPAC Commission on Agrochemicals and the Environment is to critically examine important issues raised by the use of pesticides as related to the health of mankind and the safety of the environment. Topics examined include fundamental aspects of the chemistry of pesticides, their fate in food and the environment; methods of trace analysis; metabolism in animals, plants, water and soil. The Commission works through:

1 Projects which are developed to provide the consensus views of a panel of experts on particular aspects of pesticide chemistry. The reports from these projects are generally published in *Pure and Applied Chemistry*. Large reports are published as monographs. These reports include recommendations for future action either in research fields or in government regulations.

2 Acting as scientific sponsor for the IUPAC Congresses on Pesticide Chemistry which are held every four years.

3 Organizing workshops in developing nations (China, 1988; Thailand, 1992; Brazil, 1996).

4 Liaison with bodies such as WHO, FAO and UNEP to strengthen international collaboration.

The Commission membership comprises up to 18 elected prominent scientific experts. A balance in membership is sought to cover geographical interests, professional affiliations (academic, government research/regulation, commercial R&D) and particular skills in pesticide chemistry. The various nations affiliated to IUPAC can also nominate National Representatives.

The following three short papers summarize current approaches and issues on the safety evaluation of pesticides in relation to their use on human food. The areas of pesticide metabolism and toxicology are subject to stringent government regulation. The testing procedures now followed do give a high degree of assurance that undesirable effects will not occur under worst-case exposure situations. Dietary intake studies are an important means of evaluating the degree to which the population is exposed to pesticides. The more sophisticated current approaches to these studies recommended by IUPAC do provide a high degree of

assurance that the diet is generally very safe with respect to pesticides.

For further information on the Commission and copies of its reports contact: Secretary: Dr Patrick Holland, The Horticulture & Food Research Institute of New Zealand Ltd, Ruakura Research Centre, Private Bag 3213, Hamilton, New Zealand. Tel.: +64 (7) 856 2835; Fax: +64 (7) 838 5085.

I. Metabolism of pesticides in plants and livestock

The use of pesticides to control pests and disease is important for the production of sufficient quantities of safe and affordable food. However, the use of these agents sometimes leaves residues (the pesticide or its degradates) in/on plant parts used as human food or animal feed commodities. These residues may enter the human food chain either directly—through the consumption of treated foods, e.g. grain or fruit, or indirectly—through the transfer of residues to milk, eggs and meat products. To answer the question: 'What is the nature of the chemical residue in/on food or feed items resulting from the use of the pesticide?', plant and animal metabolism studies are carried out. This paper describes the aims and conduct of these studies.

Use of radiolabelled pesticides

The term metabolism generally refers to the chemical transformation of the pesticide which results from natural (metabolic) processes in the biological system under investigation. To measure the total residue, and to provide a means of selectively tracing products derived from the pesticide in the presence of biological material, the studies are carried out using radiolabelled pesticides. The radiolabel, usually carbon-14 or hydrogen-3, is incorporated into a metabolically stable portion of the compound. The use of the radiolabel requires that studies are carried out in controlled areas; for plants this can be either in small field plots or in pots housed in suitable growing environments. This restriction in scale implies that these studies are qualitative and, at best, a semi-quantitative estimate of the fate of pesticides under large scale field conditions.

Plant metabolism

In plant studies, the term 'metabolism' is used in a wider context, to include the formation of all products (degradates) of the pesticide in or on the plant, regardless of whether they result from internal plant metabolic processes, from chemical reactions (hydrolysis and photolysis) or biological processes which occur outside the plant (e.g. microbiological degradation in soil). A plant metabolism study is usually carried out on crops typical of those to which the pesticide will be applied. If the metabolism of the pesticide is the same in plants from three different crop groups, e.g. root, cereal, top fruit, then no further studies are conducted. If different metabolic routes are revealed then studies in a wider range of crops will be initiated. The radiolabelled chemical is formulated and applied to the crop in a similar manner to that used in actual agricultural practice. To define the amount and nature of residues that may be found in rotated crops grown in soil where a previous crop was treated with the pesticide, crop rotation studies are carried out. In these studies, the soil is treated with the radiolabelled pesticide and crops sown 30, 120 and 365 days after treatment. The crops are harvested at maturity and other intervals appropriate to normal agricultural practices, e.g. immature cereals which are fed to livestock as forage or silage.

Livestock metabolism

Studies are carried out in agricultural livestock whenever a pesticide is applied directly to animals or when treated plant commodities are used for animal feed. Typically, the most important species in agriculture are ruminants and poultry, however if the use pattern of the pesticide targets other species then studies would be carried out accordingly. Metabolism studies are carried out in representative species from these groups; usually lactating goats or cows and laying hens are the species of choice. Treatment is carried out to closely approximate expected exposure.

(a) For ingested residues—oral dosing is usually carried out over a period of several days to allow the residues in tissues, milk, and eggs to reach a steady state. The dosing (test) material should reflect the major component of the terminal residue in treated crops. This is frequently the parent compound, however where the parent is not the major component of the residue the test material may consist of a single metabolite, a synthetic mixture of metabolites or plant material resulting from the metabolism studies.
(b) For dermal applications, the radiolabelled chemical is applied, formulated, in a way that reflects the proposed use pattern.

The size of the dose given to the animals is often more than that expected from normal agricultural practice to facilitate the detection, isolation and characterization of metabolites. Samples of milk, eggs and excreta are taken throughout the dosing period. The animals are usually sacrificed within 24 h after the final dose and tissues are taken *post mortem*.

Animal studies must be carried out according to Good Laboratory Practice (GLP) principles (*cf.* the accompanying paper 'The Role of Toxicology in the Evaluation of New Agrochemicals').

Measurement and characterization of the residue

In the case of compounds with a complex structure it may be necessary to conduct two or more metabolism studies with the radiolabel located in different parts of the compound. The use of radiolabelled materials facilitates monitoring of the distribution of the residue throughout the system and provides an estimate of the total residue. By linking radioactive detection with chromatographic separation systems and spectral analysis the individual components of the residue can be isolated, characterized and identified. From this information, the fate of the compound in the test system, i.e. the biotransformation pathway, can be defined.

How the data are used

Once the amount of the total radioactive residues has been determined and the structures of the major metabolites are known, the toxicological significance of the residues can be assessed. If the plant metabolism data indicate that the metabolites formed are both qualitatively and quantitatively similar to those formed in mammals the plant metabolites may be considered to have been tested in animals in the same studies as those performed on the parent compound. If significant qualitative or quantitative differences are found between plant and animal metabolites, additional toxicological data concerning the plant metabolites in animals may be required. The nature and extent of the additional toxicity studies will depend on the nature of the metabolite involved. Using the information from the radiolabelled studies, analytical methods are developed to determine as much of the terminal residue as possible and particularly for those components which are considered of toxicological interest. The development of analytical methods is facilitated using samples from the metabolism studies to optimize the efficiency of the extraction and clean-up procedures.

Conclusions

It is essential that metabolism studies provide an accurate description of the composition of the terminal residues in food and feed items. The nature of the individual components of the terminal residue must be defined before analytical methods, residue levels and toxicity data can be generated. An adequate metabolism study fulfils at least three main purposes;

(i) to identify the composition of the terminal residue in all plant commodities and livestock tissues, milk and eggs.

(ii) to indicate the distribution of the residues, i.e.
(a) in plants, whether the residues are absorbed through roots and foliage or are entirely surface residues and whether the residues are translocated,
(b) in livestock, to indicate the distribution of residues in tissues, eggs and milk and to provide evidence of storage or accumulation in tissues.

(iii) to provide a basis for determining the efficiency of extraction and clean up procedures used in the development of analytical methodologies.

Michael W. Skidmore

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Further reading:

Pesticide Metabolism: extrapolation from animals to man. Monograph: Blackwell Scientific Publications, Oxford, 1988 (120 pp).

Use of isolated cells to study the metabolism of agrochemicals in animals. *Pure Appl. Chem*. 1993, **65**, 2299–2312.

Detection and significance of active metabolites of agrochemicals and related xenobiotics in animals. *Pure Appl. Chem*. 1995, **67**, 1487–1532.

II. The role of toxicology in the evaluation of new agrochemicals

The widespread use of agrochemicals as crop protection agents, wood preservatives, vector control agents or industrial/medicinal disinfectants, may result in exposure of man, animals and the environment to these chemicals. Humans may be exposed during production or application and to a lesser extent as consumers of food products which may contain trace levels of residues.

The purpose of this paper is to demonstrate that currently used toxicological test methods and safety assessment procedures safeguard humans against potential adverse effects of agrochemicals. Particular emphasis will be on the assessment of exposure of humans to pesticide residues in foods.

The World Health Organization (WHO) and the Food and Agricultural Organization (FAO) have conducted programmes designed to protect the health of the consumer for more than 35 years. Since 1961 experts from governments and academia have evaluated approximately 230 pesticides (Joint Meetings on Pesticide Residues, JMPR). Monographs are annually issued containing detailed reviews of studies relevant to the establishment of maximum permitted levels of pesticide residues in foods. It should be noted that foods containing residues at the maximum permitted levels are safe for consumption, but the permitted levels are not safety limits.

Strategies of toxicity testing

General principles

All substances exert some degree of toxicity to various forms of life, depending on the exposure level of the

substance. Toxicity studies are focused on the characterization of the precise nature and extent of toxic effects and on the determination of dose levels which do not exert adverse effects (No Observed Adverse Effect Level, NOAEL). Data are generally obtained from experiments with laboratory animals and cultured cells. Occasionally data from occupational or accidental exposure of animals and man to agrochemicals may be used to supplement laboratory animal data. Based on these data and using extrapolation or uncertainty factors, an Acceptable Daily Intake for humans (ADI) may be calculated, i.e. the amount of a substance which may be consumed by humans on a daily basis during the entire life span, without appreciable risk for the occurrence of adverse effects. Comparison of these values with potential exposure of humans to a compound in the environment, including dietary exposure or intake from all foods, will indicate whether the use of an agrochemical may be permitted. Approaches to estimate the dietary intake of pesticide residues in food are described in an accompanying paper 'Dietary Intake of Pesticide Residues'.

Animal studies

The purpose of toxicity studies primarily carried out in laboratory animal species, is to characterize the toxicological profile of a test compound. Choice of the appropriate animal test species is important and ideally species are chosen which respond to a toxic stimulus in a way similar to that expected for humans. Usually rodents (rats, mice, guinea-pigs), dogs and non-human primates are used. The choice of the test animal species depends also on practical considerations such as availability, ease of handling and housing, and availability of background data.

Animal studies must be carried out according to Good Laboratory Practice (GLP) principles. This internationally accepted set of guidelines describes requirements for test facilities, the design of a study protocol and the conditions for performance of experiments, procedures for data recording and reporting, responsibilities for management of a study, and quality assurance procedures. These guidelines are continuously updated according to the latest developments in toxicology and chemistry.

Prior to animal experimentation, test compounds must be characterized with respect to chemical identity, purity and stability. Different types of toxicological studies have been designed in order to characterize a compound:

Pharmacokinetic and metabolism studies—These studies are performed to determine the 'fate' of a compound upon entering the animal body, i.e. absorption, distribution and elimination. In many cases foreign compounds may be converted into substances (metabolites) which are more readily eliminated from the body than the original compound, and therefore information must be obtained concerning the nature of these metabolites. Furthermore, information must be obtained whether a test compound or metabolite accumulates in the body at specific sites and whether the compound interferes with biochemical pathways. Studies of the metabolism of pesticides in plants and livestock are described in the companion paper 'Metabolism of Pesticides in Plants and Livestock'.

(Sub)acute toxicity studies—(Sub)acute studies are performed to screen for potential toxic effects resulting from (unexpectedly) high exposure to a compound. Animals treated with a single or multiple dose of the test compound via the oral, dermal or inhalation route are examined for signs of acute toxicity, skin or eye irritation or sensitization. These studies are of particular relevance for humans involved in the production or application of agrochemicals. These data are used for classification and labeling of compounds.

Long term toxicity studies—These studies are designed to investigate the effects induced by a chemical in animals exposed during a substantial part of their normal life span. Extensive analyses are carried out during and upon termination of the experiment. Blood and urine are analyzed, food and water intake and changes in body and organ weights are recorded, organ functions evaluated, and histopathological analysis of tissues and organs is performed. Insight in the mechanisms of observed toxicity may be obtained from these studies. These studies when properly conducted should provide information on toxic responses caused by increasing dose levels of the test compound and may demonstrate a dose level which does not produce observable adverse effects (NOAEL).

Reproduction studies—Reproduction studies are performed in order to verify that agrochemicals do not affect the reproductive capacity of male and female animals nor affect new borns or young animals. To this end, one or multi-generation studies may be performed with specific attention to potential adverse effects on male and female fertility, incidence of resorptions and abortions, litter size, sex ratio, birth weight and growth of new borns.

Carcinogenicity studies—Of great concern is the potential of certain chemicals to interfere with replication processes of cells, which may lead to the formation of tumours. Specific animal studies are designed to screen for the potency of a test compound to induce tumours. These studies are usually carried out in two rodent spe-

cies orally exposed to various dose levels of the test compound during most of the entire lifespan. Besides evaluation of physiological, clinical and histopathological parameters, tumours are identified on the basis of their histogenic origin. Carcinogenicity studies are performed when:

(i) relevant amounts of residues of a pesticide may be expected in foods,
(ii) structural similarity of the test compound or its metabolites with other known carcinogens has been noted,
(iii) experimental evidence suggests that the test compound may induce early signs of carcinogenicity,
(iv) the test compound has been shown to interact with cellular DNA or chromosomes (mutagenic effects) or
(v) the test compound exhibits new structural characteristics.

Mutagenicity studies—Specific tests have been designed to screen for the genotoxic potency of compounds, i.e. the capacity of a substance to react with the genetic material of living cells (DNA, chromosomes), which may lead to tumour formation or heritable defects. Usually a combination (battery) of different tests is used with bacteria, animals and cells from animal and human origin to detect these types of adverse effects. Results from these studies are used as supplementary information for the establishment of the carcinogenic potential of a compound.

Specialized toxicity studies—Special studies have been designed to assess the potential adverse effects of a chemical on the immune and neural system, and to test for skeletal malformations and other alterations induced by chemicals in foetuses during the period of organogenesis (teratogenic effects). These studies are carried out when the structural properties of a compound or data from toxicity studies indicate potential adverse effects, or in case of compounds with completely new structures.

In-vitro studies—The use of isolated cells, subcellular fractions, or perfused organs and tissues derived from different animal species has become common practice when the toxic properties of agrochemicals are studied. In particular the use of isolated liver epithelial cells (hepatocytes) has been successful in identifying the biotransformation profiles of compounds, and for rapid screening of their toxic potency. Proper use of these systems may complement and reduce whole animal experimentation.

Evaluation of data

The available data provide the basis for the safety assessment of compounds and should include NOAELs for the most sensitive animal species. Knowledge on the comparative metabolism of compounds in animals and man, and on differences in responses to toxic effects of substances, is taken into account when the NOAEL is established. From the NOAEL, normally expressed as mg/kg body weight per day, the Acceptable Daily Intake (ADI) for humans may be calculated, i.e. the amount of a pesticide residue in food and drinking water which can be ingested daily over a lifetime by humans without appreciable health risk:

$$\frac{\text{NOAEL animal studies (mg/kg body weight)}}{\text{SF (safety factor)}} = \text{ADI for humans (mg/kg body weight/day)}$$

In order to extrapolate results from animal studies to humans, safety factors (SF) are applied to allow for potential differences in toxic responses between animal species and man, and to account for possible differences in sensitivity within the human population. Normally a safety factor of 100 is used: 10 (extrapolation between animal species) $\times$ 10 (differences in sensitivity within the human population). However, depending on the available data and their quality, lower or higher factors may be chosen.

The US EPA approach to assess the risks of chemicals is similar to the one described above. Instead of an ADI, a Reference Dose (RfD) is defined derived from the NOAEL by consistent application of uncertainty factors (UF) and of modifying factors (MF). The RfD is a reference point from which potential effects of a chemical at other doses may be estimated. Tenfold UFs are used for extrapolation of experimental results and a MF less than or equal to 10, to reflect scientific uncertainties with respect to completeness of the data base.

Short-term exposure to acutely toxic pesticides such as the organophosphorus or methyl carbamate insecticides, whose toxic action is based on acetylcholinesterase inhibition may not be covered appropriately with the traditional ADI-approach, which assumes a daily exposure to a chemical throughout life. In these cases WHO proposes 'short-term ADIs' or acute Reference Doses (acute RfD), using the same basic principles and methods as for traditional ADIs or RfDs. A NOAEL would be identified on the basis of single or short-term dosing of a chemical.

The ADI concept is not applicable to every type of compound. For instance ADIs cannot be established for those compounds which are slowly eliminated from the body and thus may accumulate. For certain biological effects, such as irreversible bone marrow damage, or genotoxicity a NOAEL may not be identified. In these cases a quantitative risk analysis is made in order to estimate an acceptable risk for the human population.

Since the mechanisms of carcinogenicity are not fully understood, a prudent approach is chosen for the as-

sessment of an ADI. The biological activities of a specific compound are taken into account, and in particular knowledge on the comparative metabolism of the compound in test animal species and humans may facilitate extrapolation of animal carcinogenicity data to humans.

In some cases data on exposure of humans to agrochemicals during production or application or through accidents may be of additional value for the safety evaluation. However in many cases exact exposure levels of chemicals and duration of the exposure are not known.

Conclusions

Principles for the toxicological assessment of pesticide residues in food are based on animal experimentation and other relevant data and are accepted world-wide as the basis for safety evaluation. The ADI concept can be considered as a 'safety-first' approach. Usually large safety factors are applied in establishing the ADI-value, which provides additional assurance that exposure exceeding the ADI-value for short time periods will probably not result in adverse effects. Application of large safety margins is recommended, since humans in practice are exposed to low levels of mixtures of foreign chemicals present in the environment. The experience gained to date indicates that human safety upon exposure to agrochemicals is sufficiently protected. Dietary exposure of humans to residues of pesticides in food resulting from uses according to label instructions is too low to induce adverse health effects in humans. It is important to note that since 1982 established ADIs are being re-evaluated and where necessary revised based on new toxicity data developments in methods of detection, and in improvement of models to evaluate the toxicity of chemicals.

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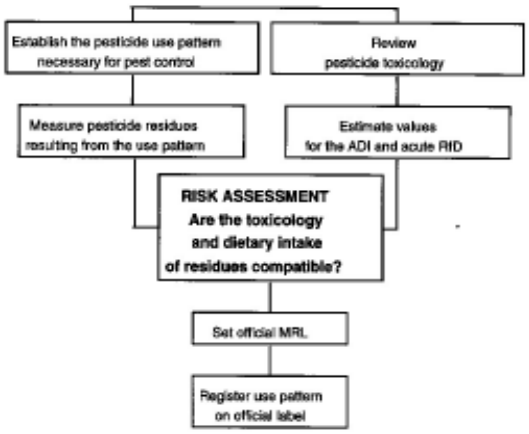
Further reading

Principles for the Toxicological Assessment of Pesticide Residues in Food. Environmental Health Criteria 104, WHO-IPCS (1990)

III. Dietary intake of pesticide residues

Decisions on the levels of pesticide residues in foods and the amount of residues likely to be consumed are part of the pesticide evaluation and approval process. The results of two important sets of studies, toxicology studies and studies on likely residues in foods arising from the use of the pesticide, must be reconciled before pesticide uses are approved. Reconciling dietary intakes of residues likely to occur in practice and acceptable intakes derived from toxicology studies is known as the risk assessment process. The place of risk assessment in the pesticide approval process is shown in the simplified diagram (other aspects such as environmental and occupational health aspects are not included here). The conclusions from the toxicological studies and the residue studies must be based on sound science and valid data obtained using convincing experimental methods and should satisfy critical scientific review. An ADI (acceptable daily intake) can be established if the toxicological data are sufficient and valid. The place of toxicology is described in a companion paper 'The Role of Toxicology in the Evaluation of New Agrochemicals'. Estimates of dietary intake of a pesticide residue on a food are obtained by multiplying the level of residue in that food prepared for eating by the weight of that food consumed. The dietary intake of a pesticide residue is then the sum of intakes for those foods where residues of that pesticide occur. Dietary intake assessment of pesticide residues is a difficult task, but is best approached in a scientific manner. We should aim to provide the most realistic estimates possible making the best use of available data. This approach will assist the recognition of genuine problems.



The evaluation process.
***ADI (acceptable daily intake):* estimate of the amount of a pesticide in food and drinking water which can be ingested daily over a lifetime by humans without appreciable health risk.**
***MRL (maximum residue limit):* maximum concentration of a residue that is legally permitted or recognized as acceptable in, or on, a food, agricultural commodity or animal feedstuff as set by Codex or a national regulatory authority.**

Pesticide residues in food

A pesticide residue in food is any substance or mixture of substances in the food resulting from the use of a pesticide, and includes products of biological and chemical breakdown and impurities.

Supervised residue trials are designed to produce reliable data on residues occurring in food and feed commodities under normal commercial practice. The trial conditions are chosen from the efficacy studies, which demonstrate the use pattern (application rate, method, timing, etc) necessary for pest control, but using no more pesticide than necessary.

Because the supervised trials are intended to generate residue data to support the establishment of MRLs (maximum residue limits) we choose the conditions from the efficacy studies which will be the maximum allowable conditions on the registered label. The supervised trials also provide the basic residue data for dietary intake estimation. For dietary intake purposes we are most interested in the residues likely to be present in the edible portion of the food prepared for eating. For enforcement purposes pesticide residue standards (MRLs) are established on the commodity of trade, which may not be the same as the portion which is eaten. A very simple example is fruit with inedible peel such as bananas. The standards of trade are set on the whole fruit, but dietary intake estimates must be made on the residue in the banana pulp. For many pesticides discarding the banana peel also discards most of the residues which might be on the banana. Common household processes such as rinsing and wiping fruit and vegetables remove considerable amounts of surface residues and some pesticides are present mainly as surface residues. However, it is difficult to take this information into account in dietary intake estimations because the degree of cleaning, if any, will be very uneven between households. Vigorous cleaning is often an early step in commercial food processing, e.g. in the milling of wheat and the juicing of apples or tomatoes. If residues are depleted or removed during commercial cleaning or during other parts of the process intake estimations should allow for the reduced residue levels in processed commodities. Some pesticides are destroyed by cooking. Intake estimations make use of this information for commodities such as potatoes, which are always cooked, and for processed food such as canned fruit, vegetables or juices, which are also cooked.

Experience has shown that many pesticide residues concentrate in wheat bran and deplete in flour when wheat is milled. In this example we need to know the consumption of bran and flour (as bread, noodles, etc) separately to make use of such information in the estimation of dietary intake of residues. Metabolism and toxicology studies suggest which of the parent pesticide and its metabolites comprise the residue of concern for dietary intake purposes. This residue is not necessarily identical to the residue used for enforcement purposes on food commodities of trade, but usually the two are identical. The residue for enforcement purposes should be kept as simple as possible because of the difficulties and costs of complex chemical analysis. If the parent pesticide or a metabolite is the main component of the residue it is the best choice for enforcing regulations such as ensuring that a pesticide has been used according to the label. Metabolites of toxicological concern should be included in analyses for total diet studies and for supervised trials being used for intake assessment, even when inclusion is not necessary for enforcement.

Cases occur where cooking produces an undesirable degradation product from the parent pesticide. An example is the production of ethylene thiourea (ETU) from the ethylenebisdithiocarbamate fungicides during heating and boiling phases of food processing. Dietary intake estimations should take into account ETU levels in the processed food even though ETU is not present in the raw commodity. Vigorous washing and cleaning at an early stage of the process substantially reduces the levels of the parent fungicide and the opportunity for ETU production during subsequent cooking.

Chronic and acute intake

Estimates of chronic dietary intake of a pesticide residue on a food are obtained by multiplying the expected or typical level of residue in that food prepared for eating by the average weight of that food consumed daily. The chronic dietary intake of a pesticide residue is then the sum of residue intakes of those foods where residues of that pesticide occur. For chronic intake the long term average or most likely residue in the edible portion is the preferred starting point. In practice the median residue (in the edible portion) from a set of supervised residue trials at the approved use pattern is taken as the starting point estimate of the likely residue for chronic intake. The chronic intake of pesticide residues on minor food commodities is usually insignificant for the reason that, on average, the weight of a minor food consumed is small. It is legitimate to raise the question about large consumption of a food item, particularly a minor food item, on a single occasion, or at least, over a few hours. The question is better answered with the methodology of short term intakes and acute reference doses.

Estimated chronic intake should be compared with the ADI. Estimated short term consumption should be compared with an acute reference dose (acute RfD). The acute RfD should be derived from the toxicology database relating to acute exposure and effects. For acute intake estimates the highest residue in the edible portion from the supervised trials is the best starting point. Residues in individual pieces of fruit or vegetables may need to be considered in some situations because for acute intake the consumer is eating a specific piece, not the average in the consignment.

Chronic intake

= sum of (average consumption of food item x typical residue in food ready to eat)

Compare estimated chronic intake with ADI.

Acute intake

= large portion weight × maximum expected residue in food ready to eat

Compare estimated acute intake with acute RfD

Diets

WHO has information on five cultural diets which may be used in dietary intake estimates at the very broadest level. The five cultural diets are the Middle Eastern, Far Eastern, African, Latin American and European type diets. These cultural diets are based on FAO Food Balance Sheets, which are compiled from a country's food production, imports and exports. Individual countries have much more detailed information derived from specific food consumption surveys on a large number of households or individuals. Food consumption data are then classified according to age, sex, geographic distribution and ethnic background and are available to be used in more accurate dietary intake estimates of pesticide residues for these groups of people.

Individual consumers may eat large portions of specific food items and the food consumption surveys should also capture this information which is needed for the acute or short-term intake estimates.

Total diet studies

The IUPAC Commission on Agrochemicals and the Environment defines a total diet study as pesticide residue monitoring to establish the pattern of residue intake by a person consuming a defined diet. Primary sampling is as for a market basket survey but the samples are further processed as for domestic consumption ie. further trimming and cooking as appropriate to local practice.

Properly conducted total diet studies give the most accurate estimate of pesticide residue intake in the diet. In the total diet study residues in food prepared for eating are measured by chemical analysis. Intakes are calculated from the chemical analysis data and the various relevant diets.

Total diet studies have consistently shown that dietary intakes of residues are well below ADIs. However, total diet studies are limited in their scope because of their cost and complexity. Obviously, they also do not apply to pesticides only recently introduced to the market, or about to be marketed.

Conclusions

The risk assessment of pesticide residue dietary intake is a complex and developing discipline at the centre of the pesticide approval process. It is the link between the toxicology and residue studies. It has become more formalized and has attracted increasing attention in recent years.

Copious quantities of data are available on modern pesticides and we should use the data to make the most realistic estimates for residue dietary intake. We should also recognize that problems as they arise are best solved according to open scientific examination.

Denis Hamilton

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Further reading

Effects of storage and processing on pesticide residues in plant products. *Pure Appl. Chem.* 1994, **66**, 335–356.

Optimum use of available residue data in the estimation of dietary intake of pesticide residues. *Pure Appl. Chem.* 1997, in press (June issue).

Names and Addresses

Full details (names, addresses, telephone/telex/Fax numbers and E-mail) of the officers of IUPAC bodies were published in The *IUPAC Handbook 1996–1997*. The IUPAC Secretariat has been notified of the following changes:

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Conference Reports

CHEMRAWN IX

World Conference on the Role of Advanced Materials in Sustainable Development, Seoul, Korea, 1–6 September 1996

The UN Conference on Environment and Development held in Rio de Janeiro in 1992 alerted world-wide attention to the effective and wasteless use of materials and energy, zero emission and zero-waste production, and systematic recycling for sustainable development. These strategies are now having a significant impact on the environmental policies of governments and are bringing about change in industrial and economic structure as well as to international trade.

In Korea, the need for reconsideration of mass production at any price and for sustainable development to preserve the environment has been widely felt. CHEMRAWN IX was organized to offer a chance to examine industrial and economic activities of the present day world and to search for effective ways of achieving zero emission and zero waste production.

The CHEMRAWN IX World Conference was held at the Sheraton Walker Hill Hotel, Seoul, Korea, 1–6 September 1996. The Conference consisted of four sessions: Communication, Transportation, Construction and Energy. Academics, scientists and industrialists came to examine and analyze current production technologies and their impacts on the environment. Recycling methods, development of ecologically friendly materials, improving production processes, exchanging information and policy making were all discussed.

Organizing Committee Chairman Dr Min Che Chon gave the opening address, which was followed by congratulatory speeches by Dr A. Hayes, Chairman of the IUPAC CHEMRAWN Committee, and Prof. Saburo Nagakura, President of the Kanagawa Academy of Science & Technology, welcoming remarks by Prof. Sang Chul Shim, President of the Korean Chemical Society, and a Future Actions Committee report by Prof. Young Bok Chae, Chairman of the CHEMRAWN IX Future Actions Committee.

Among the distinguished lecturers were Sir John Meurig Thomas of the Royal Institute of Great Britain and Peterhouse, University of Cambridge, UK, who lectured on 'The Crucial Role of Catalysis in Sustainable Development'; President Jun-ichi Nishizawa of Tohoku University, Japan, who lectured on 'Needs and Seeds for Revolutionary Technology Towards Sustainable Society; the former IUPAC President Prof. C.N.R. Rao of the Advanced Scientific Research & Indian Institute of Science, who lectured on 'The Impact of New Emerging Areas of Solid State Science on the Development of Advanced Materials: Three Case Studies'; and President Charles O. Holliday of DuPont Asia Pacific, who talked about 'Policy and Practical Issues in Sustainable Development: an Industrial Perspective on Opportunities and Responsibilities'.

Among speakers from Korea, President Chung Wook Suh of Korea Mobile Telecommunication talked about 'Wireless Telecommunications in Korea'; Vice-President Sang Bok Hong of Pohang Steel Corporation spoke about 'The Korean Steel Industry and Development'; Dr Han Jung Kim, Director of the Research Institute, Korea Electricity Corporation, talked about 'Issues in Materials Research for Electric Power Generation and Distribution—Perspective of Korea Electric Power Research Institute'; Vice-President Chong Gil Lee of Samsung Electronics talked about 'The Present and Future of the Korean Semiconductor Industry'; and Dr Dae Un Lee, Director of the Research Institute, Hyundai Automobile Corporation, spoke about 'The Automobile Industry of Korea and Sustainable Development'.

Perspectives and Recommendations, a report produced by the Future Actions Committee (FAC) in conjunction with all CHEMRAWN conferences, is distributed to all leaders and policy makers in world politics, economics, science and industry, for their use and reference. The CHEMRAWN IX Perspectives and Recommendations, now available from the IUPAC Secretariat at Oxford, identifies seven key findings and makes six recommendations for future actions, as outlined on page 128.

The CHEMRAWN Committee

Seven key findings

1 There is a need for increased understanding and use of life-cycle assessments in making decisions on materials and technologies supporting the objectives of sustainable development.

2 Ways to recycle complex manufactured goods containing advanced materials need to be developed. Designing such goods for recycling may be a top priority.

3 The importance of conservation of and development of adequate water supplies for agriculture and human consumption cannot be underestimated. Shortages will be the source of major conflicts in the future.

4 There are opportunities in the upgrading of locally available materials with small amounts of other materials or processing technologies from outside the region.

5 The opportunities to improve many traditional materials (steel, cement...) are consistent with the goals of sustainable development.

6 A number of advances in energy production can contribute to sustainable development.

7 Catalysis research offers the potential for routes to sustainable production techniques.

Six key recommendations for future action

The Future Actions Committee (FAC) made the following six key recommendations for future action:

1 We should create a 'materials for sustainable development' research and development agenda to guide national funding agencies.

Action: A team from the FAC will develop a special message and background details from the President of IUPAC to National Adhering Organizations urging that the local organizations approach funding agencies with these priorities. The FAC team will also seek other ways to communicate this message (for example, develop a research agenda to take to a funding agency; develop a research partnership between organizations in developed and developing countries; discuss with the Carter Center, Atlanta, Georgia, UNESCO, UNIDO, UNDP and the International Center for Evaluation of Technology. FAC team 1: C.N.R. Rao, P.M. Norling, J. Nishizawa, S.J. Park, A. Hayes, Y.B. Chae and F. Kuznetsov.

2 The FAC supports the need to contribute to the ready transfer of environmental technologies across industries, across nations and across public/private sectors; to increase the focus from control and remediation technologies to avoidance and resource conservation.

Action: To include urging from the IUPAC President as in Recommendation 1. FAC team 1.

3 We urge the protection of Intellectual Property Rights in a way that acts as an important driver for the introduction of advanced material and process technologies that can further sustainable development rather than as a hindrance to increased collaboration for sustainable development.

Action: FAC Team 1 will include this issue in the letter to be developed under Recommendation 1.

4 We plan to develop a programme of technical education related to sustainable development that can be included in future CHEMRAWN conferences.

Action: Follow up in CHEMRAWN X and propose supporting educational efforts of material societies, UNESCO and UNIDO. FAC team 2: The CHEMRAWN X Organizing Committee and selected members of the CHEMRAWN Committee: R. Pariser, P. Moyna and R. Hamelin.

5 We should urge experts to define (in writing) the needs and opportunities in advanced materials to build a better awareness amongst the public of the contributions of chemistry and advanced materials to our society and to sustainable development.

Action: An FAC team will explore a series of IUPAC monographs 'Chemistry in the 21st Century' using materials from papers presented at CHEMRAWN IX. There is also the possibility of a column or articles in selected magazines or periodicals. FAC team 3: Y.B. Chae, Y.S. Sohn, J.M. Thomas, F.A. Kuznetsov and M.C. Chon.

6 We will urge that where awards are given, special recognition be given to advances in developing materials that contribute to sustainable development.

Action: The FAC will develop a plan to: (i) approach existing award groups and make nominations; (ii) propose that organizations establish such awards; (iii) raise awareness within IUPAC (and other groups) of the existence of such awards. FAC team 4: K. Taylor, J. Economy and A. Tcheknavorian-Asenbauer.

Min Che Chon
Chairman of the Organizing Committee
IUPAC CHEMRAWN IX

Dr Min Che Chon

Copies of the CHEMRAWN IX: Technical Proceedings may be ordered from the Korean Chemical Society, 703 Korea Science & Technology Center, 635-4 Yeogsam-Dong, Kangnam-Gu, Seoul 135-703, Korea.

ACS/IUPAC/CMA/EPA Collaborative Symposium, San Francisco, California, USA

The 213th National Meeting of the American Chemical Society (ACS) held in San Francisco included a collaborative symposium between the ACS, IUPAC, the US Chemical Manufacturers Association (CMA), and the US Environmental Protection Agency. It was held at the San Francisco Hilton and Towers Hotel on 14–15 April 1997 and entitled *Green Chemistry/Environmental Sustainable Manufacture as a Competitive Advantage*.

San Francisco is a fine city on the Western seaboard of the USA. In American standards, it is petite, only 7 miles in length. This city, by the Pacific Ocean Bay, is a town bursting at the seams. Within its watery boundaries lie many neighbourhoods, all with their own charms, peculiarities and even weather conditions.

The Hilton Hotel, the base for this symposium, is at the geographic 'Grand Zero' in the heart of the city's luxury shopping and hotel district.

The symposium was attended by about 150 delegates. It took the form of a number of high-level addresses which were followed by six sessions. These sessions were opened by moderators, and were followed by a panel discussion from three or more internationally respected experts which concluded with an audience, question-and-answer period.

Purpose

The purpose of the symposium was to ensure society of a standard of living acceptable to an increasingly industrial world without danger to the environment or risk to worker health and society. It focused on manufacturing activity and not agricultural activity, except for agriculture as a consumer.

The principal objectives included:

- Encouragement and suggestions for development of environmentally sustainable processes;
- Proposals for competing in the domestic and global market place; and
- Recommendations to government, international and professional agencies, on ensuring safety and environmental protection.

Overview

With the rapid development of new and changing technologies, industrial products and practices inevitably generate materials potentially hazardous to public health and the environment.

Regulation is designed to balance the progress of the chemical and allied industries with the life-sustaining needs of the environment. This concept of sustainable manufacture has become one of the most important challenges for the chemical process industry and has offered the potential for some of the greatest rewards in an increasingly competitive market.

The chemical process industry has often perceived environmental and health regulation as a barrier to productive research and development (R&D). The symposium discussed the relevant issues and recommended methods by which regulations may serve as an aid to competition. Regulation can be viewed as both an incentive and disincentive world-wide.

The symposium was based on six moderated sessions:

- Product development in the chemical industry;
- Risk-based decision-making;
- Business needs in environmentally sustainable manufacture;

San Fransisco hosted the 213th National Meeting of the American Chemical Society

- Human health and environmental health issues;
- Governmental incentives and disincentives; and;
- Implementation in industry.

Keynote lecture

This was delivered by Profs Frank Sherwood Rowland and Mario Molina, 1995 Nobel Prize recipients. They described Atmospheric Chemistry with particular reference to chlorofluorocarbons (CFCs), which were formerly used as a replacement for ammonia and sulfur dioxide in domestic (and other) refrigerators. One part in 10^{12} can cause ozone layer depletion.

The basic chemistry involved is:

$$CCl_3F + UV\ (light) \rightarrow Cl + CCl_2F$$
$$CCl_2F + UV1\ (light) \rightarrow Cl + CClF$$
$$Cl + O_3 \rightarrow ClO + O_2$$
$$ClO + O \rightarrow Cl + O_2$$

Summing $O + O_3 \rightarrow O_2 + O_2$

Ozone deficiency was first observed in the Antarctic in the early 1980s.

In the early 1990s the Montreal Protocol was adapted by a number of Governments but was much too weak and has now been strengthened.

There are considerable problems with developing countries; where the situation has been assisted greatly by the UN Agencies by careful use of multilateral funds. The UN also provides the much needed technical assistance, especially in the least developed countries which have recently introduced domestic refrigerators.

Prof. Molina concluded by saying that unless we make far better use of the limited resources we shall need a planet of three times the size of the Earth.

Prof. Frank Sherwood Rowland gave a very rapid outline of the chemistry involved stressing the importance of the Dobson Spectrometry. He stressed that ozone depletion was first observed in October 1984. The Antarctic vortex has on many occasions now stretched as far as South America, and this is most likely to cause DNA absorption of UVB. This leads to thiamine coding errors due to the formation of cyclobutane pyridine dimers. In countries such as Hawaii, direct sunlight exposure should now only be four minutes instead of the previous twelve minutes.

The revised Montreal Protocol is now offering effective solutions but the effects from CFCs will be present until at least the end of the 21st century. This will lead to effects on all biological species.

For the future, Governments and the UN agencies will need to react far more quickly to give higher priority to such early warning of adverse effects having the magnitude of ozone depletion.

Prof. Mario Molina

Keynote industrial address

The first item of the Industry Forum Breakfast attended by the moderators, panelists and invited guests was the keynote address delivered by Victoria Haynes, Chief Technical Officer of BF Goodrich.

She stressed the need for 20-20 vision and that both sustainability and the need to invest heavily in research and developments were assets for the chemical industry and that these were major corporate matters.

Excellent customer and supplier relations were essential. Sustainability leads to increased productivity and to enhance economic values.

Green Chemistry is a market issue as it leads to, amongst other issues, low waste generation; the chemical industry, including that in the developing countries, cannot be involved in another issue such as Love Canal.

Companies need to comply with the Responsible Care Programmes initiated by the CMA and CEFIC, Montreal Protocols, etc. Developing countries also need to take advantage of the assistance available from the UN Agencies, in particular UNIDO.

Victoria Haynes continued by stressing the importance of the real status of endocrine disrupters and the need for a well balanced report by a well-recognized international body.

There are major technical challenges to be won, including those in chemical science, manufacturing and engineering.

Major products, even in 1997, are manufactured largely by classical methods. There should now be sustainable processes and products using new synthetic procedures, e.g. catalysis, biotechnology, etc. Novel synthesis involving biology and physics were essential.

She highlighted the need for partnerships between academia and industry and to make more with less; and to know more about manufacturing processes and hence to undertake complex syntheses with far fewer synthetic stages.

Allan M. Ford

There was a requirement in processing chemistry to have improvement in engineering and real time control.

The need for recycling and re-use was paramount and the chemical industry needed to seek far more discriminating activities. Such sustainability activities would increase shareholder returns, especially via good and meaningful Intellectual Property Protection and thus achieve competitive advantages.

The opening remarks were given by:

- **Allan M. Ford**, ACS Division of Environmental Chemistry, in formally opening the conference and who thanked both the organizer Mr Scott Stoogenke and the contributors, stressing that it was very much an IUPAC event.
- **Edward Callahan**, representing the Committee on Chemistry and Industry, gave high regards to the current President of IUPAC, Prof. Albert Fischli, and stressed the importance of the conference organized by the American Chemical Society, IUPAC, CMA and the EPA.

This was the third such conference, the first being held in Basle, Switzerland in 1990 [*Chem. Intl.* 1991, **13**(2), 50]. The second in Japan in 1993 [*Chem. Intl.* 1994, **16**(2), 41]; a fourth would be organized in a Pacific Rim country probably in two years time.

Edward Callahan

Mr Callahan stressed growing importance of biochemistry and sustainability. There were many problems in sustainable development with a considerable number of problems to solve, one of which was the chemical description of the oceans in terms of environmental chemistry.

The chemical community needed to be able to tackle environmental chemical problems when they were initially observed and to ensure that potential input would be achieved much sooner than, for example, the influence of CFCs on atmospheric chemistry. This was a challenge for academia, Governments, chemical manufacturers, the UN Agencies, and not least the professional chemical societies and IUPAC.

The IUPAC address was presented by Prof. Albert Fischli, President of IUPAC

Prof. Fischli delivered a masterful and concise account of the history of IUPAC. In the area of environmental chemistry and sustainability he stressed the importance of the recent collaboration between UNESCO and IUPAC. IUPAC was the only International Union with a Committee on Chemistry and Industry, and hence there was a direct route for academia to collaborate with industrial chemists.

He gave due acknowledgment to IUPAC collaboration with various UN Agencies, including UNESCO, International Programme on Chemical Safety (IPCS) and not least the UN Industrial Development Organization (UNIDO). Due emphasis was given to the sterling work being undertaken by Division VI—Chemistry and the Environment Division.

There was a growing requirement for globalization for a greater activity in industrial rather than pure chemistry within IUPAC. This was achievable with collaboration with UNIDO.

Great emphasis was given to the overwhelming response that had been received from the 'White Book on Chlorine' [*Pure Appl. Chem.* 1996, **68**(9), 1683–1824]. As a future topic of growing public concern, Prof. Fischli indicated that endocrine disrupters would be the subject of a forthcoming 'white book'.

Within developing/industrializing countries, there was an immediate need for training and this should be achievable by IUPAC's ongoing collaboration with UNESCO and UNIDO.

Session A—Product development in the chemical industry

Moderator: Joseph Coates (Coates and Jarratt Inc.).
This symposium explored the broad trends influencing the future of chemistry as a science and its reduction to practical applications. Speakers dealt with individual aspects of the future of the chemical industry in terms of sectorial developments, industrial developments and

some product developments as well as market changes over the next decades. Special attention was given to the very important role of environmental considerations in shaping the future of the industry.

The moderator and three panelists, in developing these topics, stressed the need for the merging of chemical disciplines, e.g. inorganic with organic chemistry and with other natural sciences, in particular biology and physics.

In the future they foresaw major developments being gained from genetics, computer imaging, catalysis, especially the use of enzymes developed from extremeophiles, gas hydrates and hydrogen, as a prime power source, intelligent materials, especially in composites, lubricants and polymers, new fertilizers with micro delivery systems, and the use of nanotechnology.

In outlining Project 2025 they considered that information technology, material technology, genetics, energy technology and environmentalism to be areas for development. There had to be a drive by science and technology to decrease the usage of toxic chemicals.

A competitive advantage was achievable by the use of ISO 14000. There was an increasing public demand in the environment and the non-specialist should be able to gain information via information technology, e.g. the Internet.

The public has a right-to-know in material accounting and its effect on air and water and this was achievable through the chemical industry with IUPAC assistance via libraries and schools.

In this way, increasing accountability in sustainable development was achievable to give competitive advantages.

Session B—Risk-based decision making (co-sponsored by CMA)

Moderator: David Sigman (Exxon Chemical)
This covered:

1 Need for risk and benefit-cost legislation
2 Wise application of judicial review of regulation
3 Improving risk-based data bases
4 Enhancing federal risk guidance
5 Development of comparative risk methodology
6 Development of risk principles
7 Interpretation and application of the precautionary principle

The points stressed by the moderator and three panelists included the priority being given by the CMA in law and policy and the importance of risk assessment and risk management. In view of the growing number of chemicals being synthesized, greater use had to be given to priority setting.

In risk management greater input was required from the informed public. This in turn required improvements in risk communications.

There was a need for basic research, especially the mechanisms by which chemicals react with the environment and interaction with human health.

One of the topics of current concern was endocrine disrupters and the CMA was funding research over the next two years. During the discussion period, the concern for these was highlighted, especially that the chemicals elicited to exhibit endocrine disrupters should be considered very carefully and their criteria specified. There was a very urgent need for the development of a reliable chemical or biochemical test procedure.

The panelists stressed the need for ecological assessment research, especially to support the risk reduction strategies identified within Chapter 19 of Agenda 21.

Session C—Business needs in environmentally sustainable manufacture

Moderators: Balasubramanyan Sugavanam and Ralph (Skip) Luken (UNIDO)
This covered:

1 Definition of Environmentally Sustainable Manufacture
2 Importance of chemicals vs. impact on environment
3 Source reduction vs. end of pipe treatment (Cleaner production)
4 Self regulation vs. enforcement
5 Environmental justice and its relevance
6 Tools used for environmentally sustainable manufacture:
(a) Responsible care
(b) Control of substances hazardous to health and environment (COSHHE)
(c) Life cycle analysis
7 Monitoring:
(a) Eco-labeling
(b) Ecotoxicity
(c) ISO 14000

Balasubramanyan Sugavanam

8 Accountability:
(a) Corporate responsibility
(b) Government responsibility
(c) Responsibility of international organizations
(d) Responsibility of non-governmental organizations
(e) Public role

9 Recommendations

The points stressed by the moderators and three panelists included environmental sustainability, its management and difficulties, especially in the least developed countries. Greater emphasis was needed in upstream environmental sustainable manufacture. Regrettably the concern for the environment, particularly in a number of developing countries, had progressed from bad to worse.

A video demonstrated very clearly the considerable successes that UNIDO had achieved in sustainability in a number of developing countries, emphasizing the achievements in economy, environment and employment.

Major equity concerns need to be addressed, especially as poverty induced poor environmental conditions. With the support of experts having wide international experience, UNIDO was working actively and with an excellent success rate in environmental impact assessment, the use of new technologies and techniques, leading to successful environmental and integrated management procedures.

This was being achieved through life cycle studies, vision, action and eco-efficiency, in turn resulting in an impressive reduction in illness rates and increases in process and product safety.

Session D—Human health and environmental health issues

Moderator: Fred Hoerger (formerly Dow Chemical)
This covered:

1 New Priorities:
(A) Global
(i) Climate change
(ii) Restoration of fisheries
(iii) Biodiversity
(a) Loss of rain forests
(b) Loss of habitat
(B) National
(i) All inclusive health and environmental benefits
(ii) Equitable opportunity for achieving economic environmental, and social well being
(iii) Use, conserve, protect, and restore natural resources
(C) Local (regional, community)
(i) Stop the loss of prime farmland
(ii) Redevelop 'brown' urban areas
(iii) Protect, enhance habitats and biodiversity
(D) Conflicts
(i) Agreement on priorities and allocation of resources between sectors and within sectors
(ii) Reliance on trade-offs and comparative risks and benefits instead of absolute risk and benefit in decision making

2 New Framework for Action:
(A) Research
(i) New priorities and international agenda setting
(a) Long-term approaches
(b) Emerging global problems
(c) Relation between human and natural systems
(d) R&D to improve risk assessment and cost-benefit analysis
(ii) Trends and status of the environment
(iii) Interdisciplinary, international collaboration
(B) Regulatory
(i) Performance-based standards
(ii) Stewardship
(iii) Market-based incentives
(iv) Enhanced product responsibility programmes
(C) Education
(i) Health, environmental content of curriculum
(ii) Accessibility of information
(iii) Lifelong learning
(D) Cooperative, open planning and action at the community level
(E) Information collection, management, distribution
(i) What is needed?
(ii) What is the nature of the system?
(iii) Who funds and manages the system?

3 There is Momentum to Solve the Issues

4 Issues Related to Implementation:
(A) What type of information is needed about important air contaminants?
(B) How do we establish what are the important contaminants in drinking water and ground water and their sources?
(C) Within the framework of NAFTA, what are the important trans-boundary human health problems that need to be addressed?
(D) On a societal basis, how does one balance the priorities for clean air and clean water with the priorities which relate more to ecosystem health (e.g. comparing the priority for decreasing ambient air contaminants to preserving wildlife habitat)?
(E) Can comparative risk studies provide insight for the regulatory/legislative arena, or is the trade-off strictly political?
(F) How can health related agencies and professionals interact with and coordinate their efforts with ecologically oriented agencies and professionals?

The moderators and five panelists reviewed a number of topics of current concern including test methodologies for estrogen mimics, risk assessment methodology and needs for benefit–risk appraisals.

One conclusion was that we were slowly evolving towards a new environmental paradigm—but an evolution which is hampered by existing institutions and counter political and social priorities. Current activities are still hampered by the laws, regulations and mentality of the past two decades and only a small overlap with the vision of sustainable development. The current focus needs included protecting humans from the environment and equally the environment and the ecosystems from humans. There was a need to gain expertise in how to ask the right questions to provide meaningful answers. Increased attention was needed in pragmatic and attainable environmental legislation with an input from the public. This was now achievable through the activities of the International Forum on Chemical Safety (IFCS), the current presidency being held by Canada.

There was a need to achieve sustainability by interaction between environment and societal activities.

One of the panelists reported on a serious area of lack of sustainability, namely warfare in the environment. Whilst the media accentuated human suffering, the dramatic and often irreversible effects to the environment were neglected by the media, mediators and politicians. UNIDO had been active and successful in assisting Croatia by sending an international expert during the conflict to observe, report and recommend remedial action.

Considerable discussion was held on the need for meaningful environmental monitoring, especially in the least developed countries or in areas depredated by warfare. It was recognized that generic testing, such as the use of *Vibrio fisheri* (the Microtox test) had much to offer. Of greater importance was the need for developing/industrializing countries and in particular countries in transition to ensure that their environmental legislation was pragmatic in such a manner as to ensure it was geared to both the country's capabilities in environmental monitoring (and hence the use of generic techniques) and the capability and training of scientists to be able to undertake risk assessments, risk management, leading to risk reduction, and hence chemical safety.

UNIDO had been very active and successful in such areas. One notable example being the establishment of a regional ecotoxicology laboratory in Islamabad, Pakistan, serving the requirements for South-East Asia.

UNIDO also had the foresight to engage the services of a high-level scientist in 1995 to travel to a number of Central and Eastern European countries and selected Arab Stages to report and provide recommendations on Environmental Monitoring of Industrial and Domestic Pollutants and Chemical Safety.

This major assignment led to the implementation of a number of projects on sustainable manufacture with competitive advantages. Funding of these projects was of concern and the meeting was asked to invite tax payers in every country to assist the UN Agencies and, in particular UNIDO, to build on these firm foundations to persuade their Governments to support the sterling work of these Agencies, which over 150 Governments ratified at the Rio Summit (UNCED) in June 1992. This commitment has to be supported to the fullest.

With such provision, real strides forward can be taken to the maximization of risk reduction procedures and sustainability as we enter the 21st century.

Session E—Governmental incentives and disincentives

Moderator: Jean-Jacques Salzmann (Novartis)
This covered:

1 Introduction:

(A) Goal of business and government is a sustainable economy

(i) Balance between growth, competitiveness, employment, and the limited carrying capacity of the environment

(ii) Balance requires shared responsibility between producer, consumer, and legislator

(B) Questions

(i) Is industry willing to improve its environmental performance in the direction of sustainable development?

(ii) Are the financial markers, which press business to maximize shareholder value, open to consider sustainable criteria?

(iii) Are the legislators capable of introducing rules and incentives adapted to the purpose of sustainability?

(iv) Are the consumers willing to change their attitude and behaviour to the needed level of environmental responsibility?

2 Thesis 1:

(A) As long as the environment is still considered as a free and common good, legislation will be necessary.

(B) As long as industry is striving for 'compliance only', new incentives to go beyond and towards sustainability are necessary.

(C) Recommendations

(i) Industry and legislators should enter into a pro-active dialogue.

(ii) They should become partners for solutions towards sustainable regulations and incentives.

(iii) Industry should break down and allocate the environmental costs to their products (Cost-allocation would lead to an internal regulatory instrument).

(iv) Environmental regulations should always be based on a scientific risk assessment and the cost-benefit relation should be demonstrated beforehand.

(v) The 'precautionary principle' should not be misused to prescribe techniques or to ban/phase out products.

3 Thesis 2:

(A) There is a strong discrepancy between the global environmental problems and the political decisions on the local level.

(B) Local environmental protection decisions too often ask for large investments for business with a marginal effect on improving the quality of the environment.

(C) Recommendations

(i) Environmental regulations should be harmonized on an international or at least on a regional level.

(ii) 'Joint implementation' procedures should be enhanced, whereas efforts and investments should be made in these (geographical) areas, where the environmental yield per dollar can be maximized.

4 Thesis 3:

(A) Command and control legislations have only limited effectiveness.

(B) In setting not only the environmental objectives, but also in prescribing the means to reach the objectives, these legislations are hindering innovations and are often unsustainable.

(C) Innovation is for business the main driving force to improve its environmental performance.

(D) Recommendations

(i) The use of a 'policy mix' should be advocated.

(ii) Besides command and control regulations, market oriented instruments and enforceable (negotiated) agreements, which allow a sustainable use of scarce resources and production factors should be used.

(iii) Environmental quality objectives should be set.

(iv) The corresponding regulatory instruments should not only be focused on specific industrial sectors but they should encompass all potential pollution sources.

The moderator and three panelists referred to whether regulations were of assistance or hindrance to the manufacturing industry. It was vital to receive cooperation and not enter into confrontation.

Eco-efficiency was now an achievable goal through training on emissions or discerning use of taxation.

The achievement of wealth and value creation through environmental sustainability was stressed, but it was pointed out that the financial market works against environmental sustainability and investors on the whole do not appreciate environmental issues. Hence, there was a need to convince accountants of the importance and monetary benefits to be attained from environmental sustainable development.

There were requirements for joint projects.

Governments must think globally, especially when dealing with environmental issues, as pollutants do not recognize national boundaries.

There was a need to have far less command and control from government. There was a considerable opportunity for cooperation between industry and regulators with major inputs from bodies such as the CMA, IUPAC and the UN Agencies, leading to trust and cooperation through negotiated agreements, products at the right price, exhibiting eco-efficiency, thus providing shareholders with demonstrable value.

Session F—Implementation in industry

Moderator: Earl Beaver (Monsanto)

The moderator and four panelists reviewed many of the key points from the previous five sessions.

There were needs to be imposed upon the chemical industry from an historic viewpoint; the vision 2020 projects and industrial needs, leading to an objective path forward.

Cost and product quality were key factors for the 21st century.

Competition was of increasing importance, but at the same time, much greater attention had to be given to processes involving toxic and hazardous substances.

Many chemical companies had been very successful in achieving considerable reduction in waste and this was likely to continue in the future.

By 2020 the chemical industry would be a world leader.

Particular aspects of success could be in the enhancement of health, safety and the environment and modeling, especially eco-efficiency models, product development cycles, leading to greater value added products and integration of data bases which was currently not feasible.

Much greater emphasis would need to be given to identification of priority, research, funding, leading to technological transfers. These aspects would take into account full cognizance of environmental, social and financial impacts. This would be achievable through increased interaction between inter-industrial sectors, industry and academia, industry and government, taking into account inputs from the UN Agencies and other active role players, such as IUPAC.

As is now the case in Japan, there needs to be an appreciation of integration of the environment and business.

In countries in transition pragmatic implementation of environmental legislation was a problem requiring expert input. This was achievable as industry in such countries adopted the principle of Responsible Care, the needs for improvements in cost accounting and many of the other aspects of Green Chemistry discussed during this symposium.

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Fate and effects of contaminants in soils as influenced by natural organic material

This article summarizes the essentials of a symposium held at the Fraunhofer-Institute for Environmental Chemistry and Ecotoxicology 16–18 September 1996 under the auspices of IUPAC, the Commission on Water and Soil Chemistry and the Gesellschaft Deutscher Chemiker, Fachgruppe für Umweltchemie und Ökotoxikologie.

In recent years processes of interactions between contaminants and physical as well as chemical soil parameters have been intensively studied to achieve advances in the hazard and risk assessment of contaminants in soils. As regards soil organic matter major research areas have been sorption and binding processes. A more recent area includes the influences of natural organic matter (NOM) and the dissolved part (DOM) on mobility, bioavailability and toxic effects of heavy metals and organic contaminants.

The role of dissolved natural organic compounds in the field has been identified to be a major one both with respect to the analytical facet of the problem as well as regards modifications in fate and effects of contaminants.

Formation and characterization of soil organic matter

Depending on the use of the soils (e.g. forest, pasture, agriculture) the amount, composition and properties of the litter and plant residues (roots and leaves) are the dominant factors for humification in the terrestrial environment. Since soil organisms, especially the microbial biomass (the micro-organisms themselves and their excreta) play an important part in the carbon cycle, they are also involved in the humification processes.

From a physical chemical point of view, the formation of soil organic matter proceeds as:

- the formation of particulate organic matter originating from larger sized parts of the litter resulting in stabilized organic matter particles of high binding capacities like lignite but with a slow migration of pollutants into their inner pore system;
- humification of natural high and low molecular substances and coating of soil mineral particles by this organic material; and
- formation of dissolved organic matter in the soil solution.

The soil organic matter in layers below the A-horizon should be taken into consideration especially concerning the behaviour of organic contaminants in soil. The long-term behaviour of soil organic matter is another important topic. In this context only information on the classical differentiation of soil organic matter into fulvic and humic acids and insoluble humins is routinely available. More information is needed for the classification of organic matter with respect to its stability and binding and mobilization processes of pollutants.

New concepts and their modelling require the distinction of soil organic matter in its functions within the carbon-cycle in soil. Upon the decay processes the plant residues will lead to structure carbon, metabolic carbon, active carbon, slow degradative soil carbon and passive soil carbon. From a scientific point of view the characterization of solid soil organic matter also includes the differentiation of the soil particle sizes since it influences OM quantity and quality.

Separation of agricultural top soils according to their particle sizes resulted in more than 40% of the organic matter in the clay fraction demonstrating that soil particles are coated during the formation of the insoluble organic matter. The particulate and dissolved humic substances are refractory due to the structure of the organic matter and due to the building of organic-mineral complexes.

For the classification and characterization of organic matter different highly sophisticated methods are available or under development. One recently often used technique is NMR spectroscopy to elucidate the chemical composition of humic substances with respect to carboxylic carbon, aromatic carbon, o-alkyl carbon and alkyl carbon. Pyrolysis-GC/MS and pyrolysis-GC/AED are methods aiming for the analysis of building blocks of isolated organic matter, enabling polymers of natural and anthropogenic origin to be distinguished. The information content on building blocks and their binding state in the organic matter backbone can be enhanced by thermally-assisted hydrolysis and methylation. FTIR and ^{1}H-NMR spectroscopy are used for recognizing origin, building blocks and degree of humification of organic matter.

The splitting-off of functional groups and the breakdown of the polymer network upon organic matter degradation can be traced effectively by TG-MS and TG-FTIR. The pyrolysis-MS studies performed with organic matter at both atmospheric pressure and high vacuum (insource mode) indicate a high proportion of pyrolysis residues (about 40 wt%) upon heating to 750 °C. The released pyrolysis products include mainly

nonspecific, low molecular-weight compounds which are at present of limited value for characterizing the polymeric network. The TG-FTIR coupling turned out to be only useful in recognizing low molecular compounds such as H_2O, CO_2, CO, H_2S, COS, CH_4 and NH_3 which show distinctive absorbance patterns. The use of these techniques for OM characterization thus is still open.

Regarding residue analysis in soils, soil organic matter has not only an important influence on amount and quality of non-extractable residues in soils but also on the kind and amount of clean-up procedures required prior to analysis. The recovery of contaminants depends on the quantity and quality of the solid soil organic matter and on the quantity and quality of the dissolved organic matter in soil solution. An influence of the soil pH is also given. If the co-extracted organic matter is not carefully removed it will interfere with proper separation and quantification of pollutants. On the other hand these clean up steps may lead to a substantial loss of the pollutants. Especially the content of dissolved organic matter should be taken into consideration when interpreting analytical results of environmental samples.

Interactions of contaminants with SOM

Affinity capillary electrophoresis (ACE) has been used to investigate the binding processes between s-triazines and soil as well as water extracted fulvic and humic acids (FA and HA). The distribution coefficients of the s-triazines between the dissolved humic substances and the water phase were found to be a function of the degree of ionisation of both s-triazines and ligands, indicating both ionic and hydrogen bonding types of interactions. Furthermore, micellar electrokinetic chromatography (MEKC) experiments showed that the interactions of the s-triazines with HA could be described as a partitioning of the s-triazines between water and the dissolved organic humic phase. Similar to surfactants, humic acids behaved like ionic micelles in the aqueous buffer at concentrations higher than a defined 'humic critical micellar concentration' (HCMC). The low molecular weight acidic fulvic acids (FA) behaved the same way but showing higher HCMC. These results confirm the micellar properties of HS and the hydrophobic type of interaction of the s-triazines with hydrophobic sites of humic and fulvic ionic micelles.

The use of solid phase microextraction (SPME) in combination with headspace-GC/MS or GC/AED techniques was applied to investigate the sorption process of polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), chlorinated pesticides and tin organic compounds to humic organic matter (HOM). These techniques were used to investigate the sorption kinetics and to determine partition coefficients (K_{OC}). The results showed that hydrophobic, nonpolar interactions dominate the sorption process of PAH, PCB and chlorinated pesticides to HOM. However further experiments have to elucidate whether HOM coats the fibres to an extent that will change the sorption properties and kinetics.

Stationary and time-resolved laser-induced fluorescence (LIF) and fluorescence quenching studies were used for the investigation of humic substances (HS) and their interactions with polycyclic aromatic compounds (PAC). Aqueous solutions of HS of different origin (e.g. aquatic, soil or peat HS) were investigated with these techniques both with and without the presence of PAC. The fluorescence quenching efficiencies, expressed by the Stern-Volmer constants (K_{SV}), depend on the fluorophor (PAC) as well as on the HS. From the temperature and pH dependencies of the K_{SV}-values, information on structural variations of HS and on the thermodynamics of PAC/HS interactions was obtained. The suitability of these sophisticated techniques was demonstrated in soil column experiments, but has to be further improved.

Desorption kinetics vary considerably dependent on the experimental procedure used, e.g. column experiments may lead to different results compared to flask-shaking experiments. Time-resolved column leaching procedures provide information useful for the understanding of the organic matter to pollutant interaction. They allow to distinguish between spontaneous desorption and a subsequent diffusion controlled steady-state. The extent of both processes is closely related with each other. The desorption kinetics and amounts are significantly dependent on the composition of the eluent. In general, the stronger eluents (e.g. $Na_2H_2PO_4$) provoke distinct desorption peaks, indicating a strong alteration of the organic phase by the eluent, while the elution profile of weak eluents (e.g. $CaCl_2$) are quasi-constant and appear, thus, to be governed by slow diffusion processes from inner spheres of the particulate matter towards the surface.

However, column studies have the disadvantage that they are difficult to standardise with respect to flow rate, desorption solution and homogeneity of the soils (homogeneous water flow through the soil column is essential).

The dependence of the association between a sparingly soluble organic contaminant and DOM can also be shown by batch techniques. Results confirm that the sorption of contaminants strongly depends on:

- the origin and composition of the organic matter;
- the physico-chemical characteristics of the pollutants; and
- the solute chemistry (e.g. pH-value, salt content and composition (ionic strength).

The origin of humic matter and its sorption properties also influence the sorption of organic substances to

sewage sludges. It was shown that the sorption capacity as related to the organic carbon content of the sewage sludges is comparable to that of agricultural top soils. This example demonstrates that appropriate and simple methods are needed which can be routinely used for a characterization of the dissolved and particulate organic matter with respect to their sorption potential.

Enhancement of mobility by dissolved organic matter

Measurements of PAH-concentrations in different soil horizons show the migration of the hardly soluble PAHs from the topsoils of a high organic matter content to subsoils. This migration can only be explained by a co-transport with DOM. Model experiments with DOM fractions from composts show that the binding capacity of high molecular DOM fractions is significantly higher than those of low molecular fractions. Nevertheless DOM fractions of a molecular size below 1000 D showed also interactions with PAHs. For the DOM fractions two types of interactions can be postulated. Sorption of hydrophobic substances on hydrophobic regions within the macromolecules and interactions of the substances with hydrophobic sites and amphoteric low molecular weight DOM molecules. The solubilizing effect is correlated with the hydrophobicity of the substances, with the sorption to the soil matrix and it also depends on the composition and origin of the DOM and the overall chemical composition of the solution. As regards the importance of the origin of DOM it could be shown that fungal metabolic products significantly enhance the solubility of hydrophobic organic chemicals.

For an assessment of ground water pollution which may be caused by a mobilization of hardly soluble toxic substances sorption and desorption processes in the three phase system soil–DOM–water, the properties of the DOM and its sorption to soils need to be considered. Mathematical models are under development to simulate these processes. First results show that:

- a three-phase model provides satisfying simulation results.
- an *a priori* prediction of HOC mobility based on the three-phase partition models is possible.
- the identification of relevant processes is impossible with 'classical' experimental designs.
- inverse modeling might result in misinterpretation of experimental data sets.
- nonlinearity is an important fact in HOC sorption.

Numerical simulations confirm the observations, that DOM influenced mobility of HOC in porous media is

- increased due to co-transport.
- reduced due to co-sorption and/or cumulative sorption, and;
- controlled by site-specific physicochemical properties.

Effects of natural organic matter on the fate of substances

Binding of xenobiotics to humic matter influences their degradation in soil. Führ *et al.* investigated the effect of straw amendment on the formation and translocation of residues of ^{14}C-methabenzthiazuron with laboratory and lysimeter experiments. The lysimeter experiments performed with an orthic luvisol (pH 7.2; 1.2% OC; 6.4% sand; 78.2% silt; 15.4% clay) showed that the amendment of straw to the plough layer according to agricultural practice resulted in a significant increase of the degradation and mineralization of methabenzthiazuron but also in the formation of bound residues. In the fraction of bound residues larger amounts of radiocarbon were found in fulvic and humic acids compared to the radioactivity in humines. The enhancement of microbial activity, mineralization and degradation rate were comparable to laboratory experiments. Increasing amendment with straw material resulted in an even more rapid formation of bound residues. Additionally, the amount of methabenzthiazuron in the leachate was affected. Although the amount of leachate was the same in the lysimeters with and without straw amendment, the total amount of transferred methabenzthiazuron was considerably lower in the lysimeter with straw amendment.

Upon addition of wheat straw, lucerne leaves and farmyard manure in experiments with ^{14}C-labelled isoproturon different ratios between dissolved organic carbon and dissolved radioactive material as well as different metabolite patterns in percolates of small-scale column experiments were observed. The amount of bound residues increased with time and differed dependent on soil treatment. Generally, the quality and not the quantity of the added organic matter was decisive for the results in these experiments.

The binding behaviour and the nature of binding of the fungicide anilazine and the herbicide amitrole to dissolved organic matter was investigated by Spiteller *et al.* Using ^{13}C-NMR-spectroscopy one type of linkage of anilazine to humic matter was characterized as a covalent ether-bonding in soil, compost and lake water. This was underlined by experimental breaking the bond using TMSCl and the identification of the corresponding trimethylsilylether-derivate. A postulated covalent linkage of amitrole to humic matter was also investigated and confirmed by ^{15}N-NMR-spectroscopy. However, besides covalent binding also hydrogen-bonding and/or charge-transfer complexes have to be considered. In the case of amitrole an inhibitory effect on plant growth was observed due to remobilized amitrole, identified in DMF/TMSCl-extracts of the incubated plants.

Bioavailability and ecotoxicity

The ecotoxicological potential of a soil is determined by investigation of soil organisms (terrestrial ecotox-tests) or as a substitute with limited evidence by the use of aquatic ecotox-tests for example with daphnids, algae, luminescent bacteria using soil extracts.

To achieve realistic interpretation of each ecotox-test its limitations have to be taken into account. Tests with soil organisms give information about the habitat function of a soil. With aquatic ecotox-tests toxic bioavailable contaminants are determined. Contaminants are detected which can be eluted from the soil. Therefore information on the retention function of the soil and on possible contamination of groundwater are obtained. There is general agreement that for an intensive assessment of a soil the different exposure paths of the investigated organisms have to be considered.

Soil organisms—The results of several studies with earthworms indicate that soil organic matter content has an important influence on the accumulation and toxicity of a range of chemicals (metals and non-polar compounds). However, the availability and hence the effects of these two groups of chemicals are additionally modified by other co-variable factors. For metals, e.g. soil pH plays a major role for free metal ion concentrations in the soil pore water, while for non-polar compounds the lipophilicity of the compound is the most important co-determining factor. As organic matter reduces the uptake and the toxic effects of a range of pollutants by organisms it can be concluded that the maintenance of high levels of organic material in contaminated soils is important.

The uptake and transfer of plant available heavy metals from soil into plants furthermore depends on plant specific factors based on genetic differences with respect to the properties of the root system, selectivity against different metals, inner plant translocation mechanisms, transpiration rate etc. Last but not least the general growing conditions (climatic conditions, nutrient supply, duration of the vegetation period) also influence the heavy metal transfer from soil into plants. The evaluation of several experiments elucidates that generally SOM has a relatively low influence on the uptake of heavy metals by plants. The direction of this influence is still controversially discussed. May be that a further differentiation of SOM as shown for example by Kögel-Knabner *et al*. is necessary to show any clear dependency of parts of the SOM on the transfer of heavy metals from soil into plants. Even if relationships between parts (fractions) of the SOM and the uptake of heavy metals by plants will be elaborated it will be difficult to put this knowledge into administrative rules. For practical purpose the use of neutral salt extractions is the best solution because the different influences of soil specific parameters can be sufficiently considered. Furthermore NOM seems to influence the biomass weight

Problems with Ecotoxicological Tests / Outdoor/Field Investigations

Test System	Advantage	Potential Disadvantages/Problems
acute aquatic tests	• quantification of the toxicity via dilution series	• preparation of eluates • correction of pH-value? • at least partially low sensitivity (only high concentrations can be detected) • coloring of the extract • Interference of the test systems/organisms with micro-organisms, which had been extracted • fairly soluble substances cannot be detected
chronic aquatic tests (algae test)	• quantification of the toxicity via dilution series	• see acute aquatic tests • nutritional problems
terrestrial tests (added organisms)	• (in)direct statements/conclusions in regard of habitat functions • different exposure pathways can be determined to a certain extent	• uncontaminated control often not available, consequently dilution series cannot be carried out • ⇒ only severe impacts are detectable (plant test) • due to the chemical-physical and pedologic conditions the habitat may not be optimal for the test organisms
terrestrial investigations (soil endogenous organisms)	• direct statement in regard of habitat functions • determination of different exposure pathways	• uncontaminated control often not available, consequently dilution series cannot be carried out • ⇒ only severe impacts are detectable • abundances/activities for important organisms must be determined depending on soil substrates and land use (so far very few data are available)

of roots and shoots. Both inhibition and stimulation have been observed, presumably depending on plant species.

Tests with aquatic organisms—When using aquatic tests with soil extracts a precise measurement of the dissolved contaminants or exclusion of particles is necessary. Design of the tests and the chemical exposure analyses should provide for the definite distinction between aquatic and particulate exposure, in order to avoid totally misleading results with soil extracts.

Specific and conclusive experiments investigating the influence of DOM on toxicity of chemicals have been so far mainly performed with aquatic organisms. Depending on experimental design not only enhancement of toxicity (phototoxicity) but also masking of toxicity were observed. In one experiment, e.g. the daphnia, toxicity of lindane and pendimethalin could be reduced to 'not measurable' upon addition of natural DOM.

Conclusion

Available evidence clearly shows a significant influence of dissolved organic matter in soils and waters on the fate and effects of chemicals. This role of natural organic carbon in environmental compartments is in addition and partly directly contrary to the conventional role which has been thoroughly investigated and considered in legislation. In order to quantify and elucidate the significance of dissolved organic matter in the real environment with respect to risk assessment of contaminants, systematic, well-targeted investigations are needed.

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Dedicated to Prof. Werner Klein on the occasion of his 60th birthday

Provisional Recommendations

IUPAC seeks your comments

In this section we publish synopses of IUPAC's latest provisional recommendations on nomenclature and symbols. All comments on these recommendations are welcome and will be taken into consideration. The final revised versions are published in *Pure and Applied Chemistry* and synopses of these are published in *Chemistry International* as recent reports.

If you would like to comment on the provisional recommendations please write to your nearest national/regional centre requesting a copy of the full report. Copies are not available from the IUPAC Secretariat. The most recent list of the national/regional centres appeared in *Chemistry International* 1995, **17**, 141.

Names for Inorganic Radicals

Radicals are important in a variety of catalytic processes and in the atmospheric gas and liquid phases; furthermore a substantial number of inorganic radicals have been observed in interstellar gas clouds.

In biology, the interest in radicals increased after the discoveries that superoxide and nitrogen monoxide are formed *in vivo*; these radicals play an important role in cell–cell signalling, the immune response and disease.

Rules have been developed to name inorganic radicals in a systematic manner.

It was found that for inorganic radicals coordination nomenclature yielded unique names that are descriptive of composition and structure (where known).

The strategy to name a radical is to select a central atom and name all other atoms (or groups of atoms) as ligands, or, if the name ends in '-yl' and the Ewens–Bassett number. As an example, CO_2- is named 'dioxidocarbonate-yl(1-)'.

These rules are intended to replace those found in Section I-8.4 of *Nomenclature of Inorganic Chemistry, Recommendations 1990*, Blackwell Scientific Publications, Oxford, 1990 (the 'Red Book').

Comments on these recommendations are welcome and should be sent by 30 November 1997 to: Prof W.H. Koppenol, Laboratorium für Anorganische Chemie, Eidgenössiche Techniche Hochschule, Universitätstrasse 6, CH-8092 Zürich, Switzerland. Tel.: +41 1 632 2875; Fax: +41 1 632 1090; E-mail: koppenol@inorg.chem.ethz.ch

Recommendations for the presentation of NMR structures of proteins and nucleic acids

During the past several years the determination of NMR solution structures of small proteins has found widespread application, and the NMR method is being used increasingly for structural studies of nucleic acids and their complexes with proteins, drugs and other molecules. In the course of this development, a certain con-

sensus has developed on the presentation of NMR solution structures. This has been helped indirectly by guidelines established for depositing primary experimental data and resulting structures in databanks such as the Protein Data Bank, BioMagResBank, Nucleic Acid Database, and by conventions used for abstracting services, for example, *Macromolecular Structures*, Current Biology, London, UK, 1991ff. In consideration of making good future use of the experience accumulated during the past few years, the present Task Group has been convened as an IUPAC/IUBMB/IUPAB Inter-Union venture, which was also supported by ICSU and CODATA. The group has gone through formal examinations of the reporting conventions of biomolecular NMR used in the past. The present recommendations also build upon earlier rules for biochemical nomenclature and for the presentation of proton and non-proton NMR data. Consultation with a large fraction of the leading research groups in the field of NMR structure determination with biological macromolecules indicates that these guidelines will be widely accepted by the community.

Comments on these recommendations are welcome and should be sent by 30 November 1997 to: Prof. Kurt Wüthrich, Institut für Molekularbiologie und Biophysik, ETH-Hönggerberg HPM, CH-8093 Zürich, Switzerland. Tel.: +41 1 633 24 73; Fax: +41 1 633 11 51; E-mail: wuethrich@mol.biol.ethz.ch

Comments

The work of IUPAC has featured recently on the 'Editor's Page' of both *Chemistry in Britain*, published by the Royal Society of Chemistry, UK, and *Chemical & Engineering News*, published by the American Chemical Society. The two articles are reproduced below.

An editor's lot is not always a happy one…

***…*observes Richard Stevenson, Editor of *Chemistry in Britain* and Chairman of the Association of British Science Writers.**

'What's in a name? That which we call a rose, by any other name would smell as sweet.' And certainly brimstone smells as pungent whether it is called sulphur or sulfur—but try telling that to some chemists. A number of eagle-eyed readers noted that last month's *Chemistry in Britain* carried the cover line 'Chemistry of sulfur'. Innocent enough in all conscience, but a hanging offence according to one correspondent, who wrote: 'I look to the Royal Society of Chemistry to uphold standards in our subject and feel that you have failed to do this'.

Yet when IUPAC (in 1990) and the RSC (in 1992) adopted 'sulfur' as the correct spelling for element 16, *Chemistry in Britain* hung back—only to be told off by other correspondents, one of whom wrote: 'We try to persuade students that they must abandon old habits and move with the times...our efforts are not aided when they open their *Chemistry in Britain*'.

Readers who are interested enough can look up the correspondence we published at the time (*Chem. Br.*, April 1992, p. 324; July 1992, p. 604), but suffice it to say that I promulgated the doctrine that *Chemistry in Britain,* being aimed at a wider audience than the RSC's primary and secondary journals, would continue to use the familiar 'sulphur', at least until general usage began to reflect the change.

However, last year I was persuaded by the *Chemistry in Britain* Editorial Board to relax this ruling, so that dyed-in-the-wool sulfur chemists could spell their element that way if they so wished. This is not the only case where *Chemistry in Britain* allows two forms of nomenclature to run in parallel. For example, the nomenclature rules adopted by the Association of Science Education mandate the use of 'ethene' and 'ethyne', which would be unrecognisable to their industrial colleagues used to making and selling ethylene and acetylene. Even IUPAC accepts these two trivial names. Being pragmatic, *Chemistry in Britain* accepts whichever an author prefers, though leaning towards the spellings familiar to our predominantly industrial readership.

Industry, of course, can be slow to move: an academic acquaintance tells the story of visiting—not all that many years ago—a petrochemical plant and asking what the labels 'OV' and 'MA' meant on two of the site's pipelines. 'Oil of vitriol and muriatic acid', he was told. A former colleague—who as a subeditor had been a punctilious user of the education world's 'ethene' and 'ethyne'—joined that same petrochemical company as a press officer. A few weeks into the job she telephoned me on the QT to ask what 'muriatic acid' was, because she didn't want to appear stupid. Humphry Davy identified and named chlorine as far back as 1810, yet the fertiliser industry does still sometimes refer to 'muriates'

not chlorides.

One argument for rigid nomenclature is that searches on computers with massive memories but very little intelligence will not pick up references to sulfur if you key in sulphur. Yet I recently saw a scientific paper on 'diatom–diatom interactions' and had to read a lot further before I could be sure the authors meant reactions between H_2 molecules and not relations between little silica-walled algae in ponds. What is a dumb computer to make of that?

The 'ultras' of chemical nomenclature will not have it, of course. Off with decadent Sulphur's head! Etymologically correct Citizen Sulfur is to take over the kingdom. My pragmatism in allowing dual standards will see me reviled by both sides, while my comrades in the ranks of scientific editors (for whom House Style Rules OK!) will have me cashiered and my red pen broken before my eyes.

I am still waiting for my US colleagues to face up to IUPAC's ruling that 'aluminum' and 'cesium' are wrong.

Reprinted from Chemistry in Britain *(May 1997) with the permission of its Editor.*

The antiscience cancer

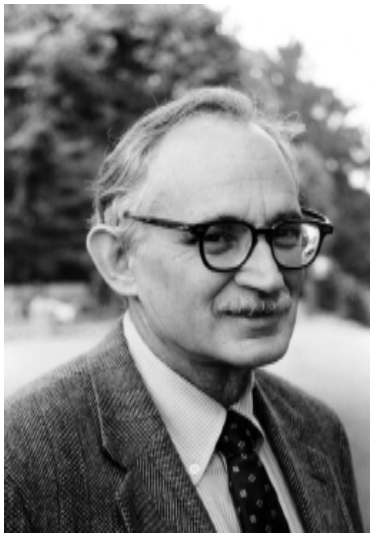
A guest editorial by Allen J. Bard, Norman Hackerman-Welch Regents Chair in Chemistry at the University of Texas, Austin, Editor of the *Journal of the American Chemical Society* and President of IUPAC during 1991–1993.

In February, NBC televised a movie called 'Terminal' about a physician who had discovered the cure for a particular form of cancer. Rather than revel in his discovery, he sought out wealthy patients who were in the hospital for other ailments, surreptitiously infected them with this form of cancer (which he apparently could induce to appear in days like a bad cold) and then came to their rescue with his cure. These patients were so grateful that they showered him with funds to support his research. Even more scurrilous than this far-fetched story, however, were the postmortem comments shown with the credits. These claimed that scientists were competing for the monetary rewards that will come with the discovery of a cure for cancer and that 'so far they have only discovered how to cause cancer'.

The antiscience flavor of this movie is only one example of the attack on science in the US from all sides. From the left, the postmodernists declare that science does not really deal with facts and that accepted models only represent the opinion of the scientific establishment. Those with a particular social agenda rewrite the history of science and create scenarios that have little connection with reality and actual science. For example, the notorious 'Baseline Essay on Science' adopted by the Portland, Ore., Public Schools seeks to promote multiculturalism by proposing fantastic contributions of ancient inhabitants of Africa (*Phi Delta Kappan*, November 1993, p. 266). These include knowledge about the moons of Jupiter, acquired in pre-telescope days through parapsychological powers. This essay also proposes that melamin can convert light to knowledge and also absorb the wave energy of magnetism. On the right, creationists want to teach religious concepts as science. On other fronts, a large fraction of the populace believes in ghosts, angels, ESP, astrology, and magic crystals.

Scientists usually respond to such attacks and anti-intellectualism from a defensive posture. We try to explain the fallacies in the arguments and hope that better education will undo the attackers. This approach has not worked very well in the past, and it will be a disaster to wait the length of time it would take to produce an educated populace to deal with these immediate problems. Seventy years after the Scopes trial and the widespread teaching of evolution, school districts still are under attack by fundamentalists, and a law punishing teachers of evolution came close to passing in late March in the Tennessee legislature.

It is time for scientific societies to take the offensive and attack the pseudoscience and misinformation eating away at our profession. For example, they could establish offices and member networks to respond quickly to antiscience attacks and to aid groups fighting creationism and pseudoscience in their school districts. If the TV movie had the equivalent racial or sexual overtones, NBC would have been inundated with letters and protests, supported by a number of organizations. Yet we sit by and passively watch and hope that people will recognize the fantasy in the presentation.



Prof. Allen J. Bard

Scientists also should confront the sociologists and philosophers at their institutions who are attacking the foundations of science. Presumably, tenure decisions and promotions at universities are based on scholarship, and academic scientists must take an interest in the academic decisions in other departments on campus. This is not a question of academic freedom, but rather one of competency. We should expose political correctness and fundamentalism that lead to misinformation about science.

We also should clean our own house and speak out when scientists overplay their findings or promise more than they can deliver. We must be totally honest when discussing the impact of our work in real world situations and in differentiating unsupported opinion from conclusions drawn from sound research. Shoddy work and bad science should be exposed. However, if the mainstream scientific organizations, like ACS, the American Association for the Advancement of Science, the National Academy of Sciences, the Council on Chemical Research, and the International Union on Pure and Applied Chemistry just sit back and watch, the future of science, at least in the US, is bleak indeed.

Reprinted from Chemical & Engineering News *(22 April 1996) with the permission of the American Chemical Society.*

Letter to the Editor

In the November 1996 issue of *Chemistry International,* Dr John Duffus of Heriot-Watt University, Scotland, challenged the previous publication (*Chemistry International*, May 1996) of a figure showing the toxicity of various chemical elements taken from the set of teaching aids, DIDAC-1, produced by Agfa-Gevaert. Two members of the DIDAC working group at Agfa-Gevaert who were co-responsible for the contents as well as the illustrations of the teaching aids respond:

(1) The aim of Prof. P. De Bièvre's article in *Chemistry International* 1996, **18**(3), 96, was to report about the initiative taken by the Belgian National Committee for Chemistry to celebrate IUPAC's 75 years, coinciding incidentally with the 100th anniversary of Agfa-Gevaert N.V.

(2) As a present to the Belgian teachers of chemistry a package of teaching aids for chemistry containing 63 full-colour transparencies, a black-and-white copy of each transparency for easy photocopying and distribution to pupils and an accompanying explanatory text available in Dutch, French or English was made available to every participating teacher. Prof. P. De Bièvre mentioned this in his report. The IUPAC secretariat, at its own initiative, selected a transparency from the series and added it to the article of Prof. P. De Bièvre as an illustration, of course without the accompanying explanatory text available to the teacher.

(3) No doubt, the comments of Dr J. Duffus on the illustrative transparency as such (the black-and-white version) are correct. Unfortunately, the text accompanying the transparency is missing: '...it can be demonstrated that certain elements which are listed as harmful or toxic, are also essential for the metabolism of living beings. In this apparent contradiction lies the answer to the question: when is a chemical substance harmful or dangerous? It all depends on the type and degree of exposure to the substance and the amount absorbed by the living organism. Danger is a relative concept.' Moreover the published transparency is to be used in conjunction with another related transparency, demonstrating the abundance of the elements in living organisms.

Thus it can be concluded that the comments of Dr. Duffus and the explanatory text in DIDAC-1 present the same ideas.

In the meantime we are pleased to let you know that DIDAC already contains three volumes and that the volumes 4, 5 and 6 are in preparation. The working group is composed of about 20 high-level research people of Agfa-Gevaert and authorities of our five Flemish universities, whose aim is to make chemistry lessons attractive to young people in order to stimulate further learning and simultaneously eliminating the often misunderstood image and role chemistry has.

Yours sincerely,

Jan De Roeck & Eddy Michiels,
Agfa-Gevaert N.V.,
On behalf of the working group DIDAC

New Publications

Kemisk Ordbog

A Danish handbook of IUPAC nomenclature has been authored by the Nomenclature Committee of the Danish Chemical Society. Dr Ture Damhus, Principal Scientist at Novo Nordisk A/S, Member of the Nomenclature Committee, writes:

Just before Christmas 1996, a book was published in Denmark which aims to become the source of IUPAC nomenclature rules for everyone interested in expressing chemistry and chemistry related matters in a consistent way in Danish.

The Nomenclature Committee of the Danish Chemical Society was revitalized a few years ago and took on the responsibility for providing a comprehensive reference document for chemical nomenclature in Danish, something which had not really existed before. The basic idea was to translate loyally the newest IUPAC rules so that, in principle, the only thing we would have to do was to change the names of elements and parent compounds into their Danish counterparts.

The task was not entirely trivial, however. The *spelling* of chemical names has been the subject of heated debate in Denmark, on and off, since the days of the late Prof. K.A. Jensen (known in IUPAC circles from his period as Chairman of the Commission on Nomenclature of Inorganic Chemistry and for his broad interest in all chemical nomenclature issues and in linguistic matters in general). Prof. Jensen argued that the spelling in Danish should be as close to international (i.e. English) spelling as possible whenever the chemical names were the same, whereas his opponents—including *Dansk Sprognaevn,* an official body given the authority to decide on correct spelling in Danish in general—insisted on a traditional Danish spelling. Examples under debate included: calcium/kalcium; chlor/klor (for chlorine); chrom/krom (for chromium); ether/aeter; iod/jod (for iodine); methyl/metyl; phosphor/fosfor (for phosphorus); phenol/fenol; quinin/kinin (for quinine). Also, certain elements had special Danish names.

Interestingly, when starting our work on Kemisk Ordbog, we found that, in practice, the debate about the spelling and choice of element names had been resolved quietly by two very influential sectors of the chemical community. One, Danish gymnasium (high school) teachers had decided on the international spelling when writing completely new series of textbooks in connection with a restructuring of the school system around 1990—textbooks that were not likely to be replaced for many years. The other area where a clear stand had already been taken in the 1980s, with the spelling debate still raging, was in administration dealing with environmental and occupational health and safety laws, i.e. laws regulating the use of chemicals and thus encompassing extensive lists of names of chemical substances.

With official laws and educational text books formulated with international spelling, it was quite clear that we also should go for this choice in the new nomenclature book, and so we did.

It must be said that there were other problems unrelated to internal Danish quarrels. Merging the recommendations of all the available IUPAC nomenclature sources, as we endeavoured to do, is not easy, e.g. prescriptions in the Red Book and the Macromolecular Nomenclature compendium are in a number of cases at variance with those found in the Blue Guide (partly due, of course, to the different publication dates of these various recommendations). Hopefully, we have found reasonable compromises and judged correctly what will become the future IUPAC names in cases of present inconsistency.

Kemisk Ordbog starts with a list of almost 10 000 names of individual chemical compounds and names of structurally defined classes of compounds. The explanations for these entries are corresponding 'Danish IUPAC names' and definitions of the class names in terms of structure, respectively. Trivial names and obsolete spellings and names are included as entries, but the reader is, in principle, always directed from these to IUPAC names.

The second part of the book consists of text chapters dealing with the IUPAC nomenclature rules and also with related subjects such as etymology and principles for constructing INN (International Non-proprietary Names) for drugs.

The third part of the book consists of a number of tables in the spirit of the tables in the Red Book and the Blue Guide, giving the element names, multiplicative prefixes, collections of parent hydride structures, lists of substituent group names and so on.

Nomenklatura Chromatograficzna

A Polish edition of Nomenclature for Chromatography recommended by IUPAC [*Pure Appl. Chem.* 1993, **65**(4), 819] has been prepared by the Commission of Chromatographic Analysis of the Committee of Analytical Chemistry of the Polish Academy of Sciences.

***Nomenklatura Chromatograficzna**, edited by Zygfryda Witkiewicza, Edwarda Soczewinskiego & Zdzislawa Suprynowicza, is published by Polski Narodowy Komitet, Warsaw 1996, ISBN 83 901844 4 3.*

World Health Organization Publications—Environment

This catalogue provides bibliographic and descriptive information for some 50 WHO publications concerned with the ways in which protection of the environment can promote human health. Publications are grouped according to the following topics: environmental analysis; environmental health promotion; environmental policy; water supply, sanitation; wastewater; air quality; ultraviolet radiation; natural disasters; nuclear power; hazardous wastes; vector control; urbanization; radiation protection; the WHO Environmental Health Criteria series.

Several of these books describe national and international policies intended to protect the environment and the human life it sustains. Others consolidate world knowledge on the best technologies for meeting the fundamental need for safe water and safe methods of waste disposal—whether involving garbage collection in urban slums or the 'recycling' of precious water resources. Still others establish environmental standards that can guide efforts to monitor pollution, ascertain the safety of air and water, or protect against exposure to hazardous chemicals and pesticides. In line with WHO policy, the catalogue also features several practical training guides that can help communities understand the links between environmental conditions and health - and take appropriate action.

***World Health Organization Publications—Environment,** March 1997, is available from WHO Distribution and Sales, 1211 Geneva 27, Switzerland. Fax: +41 22 791 4857.*

Conferences

International Symposium on Calorimetry and Chemical Thermodynamics, Universidade Estadual de Campinas, Campinas, SP, Brazil, 5–9 April 1998

IUPAC
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This conference, sponsored by IUPAC and the Instituto de Quimica, Universidade Estadual de Campinas, will focus on the recent advances in the field of calorimetry and its application to studies dealing with chemical and biological systems. Other approaches to the determination and discussion of thermodynamic aspects in such systems are also welcome. It aims to be a truly international conference, with the participation of the experts in these fields, and is also intended to be an opportunity for Latin American scientists of these areas, especially younger ones, to meet their colleagues from other parts of the world.

The scientific programme is based on four sessions, dealing with basic and applied aspects of the following subjects: biological systems (living and non-living), solutions (reactive and non-reactive systems), solids and interfacial systems, applied thermodynamics (with special emphasis on biotechnology) and other related topics. A workshop on 'Molecular and Reaction Energetics' organized by Prof. J.A. Martinho Simões, Portugal, will also be part of the programme.

The meeting schedule will include plenary lectures, invited lectures, oral presentations and a poster session.

There is a proposal for organizing an electronic version of this Symposium (a Virtual Conference). It would allow the submission of complete versions of the oral and poster presentations which would be accessible and open for discussion during a certain period. Participation is voluntary and open for those who did not attend the Symposium. Its realisation will depend on the responses to the First Circular.

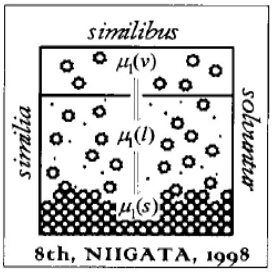
The registration fee is USD 200 before 1 December 1997, USD 250 after 1 December 1997, for scientific participants, and USD 100 before 1 December 1997, USD 120 after 1 December 1997, for students/young scientists. This fee includes the conference material, morning and afternoon coffee/tea, a cocktail reception, a Brazilian barbecue and daily transportation between the hotels and the conference centre.

For further information, please contact: Dr. Watson Loh, Instituto de Quimica - UNICAMP, Caixa Postal 6154, 13083-970 - Campinas - SP - Brazil. Tel.: +55 19 239 7881; Fax: +55 19 239 3805; E-mail: wloh@iqm.unicamp.br

More information about the conference, its location and tours is available at the conference Home Page (http://www.iqm.unicamp.br/~wloh/conf). This information will be routinely updated.

8th International Symposium on Solubility Phenomena, Niigata, Japan, 5–8 August 1998

IUPAC
SPONSORED



This international symposium, sponsored by IUPAC and the Japan Society for Analytical Chemistry, will be concerned with many aspects of solubility phenomena and related areas of chemistry. The scientific programme includes plenary and invited lectures, oral communications and poster presentations in the following fields:

1 Chemistry of crystallization and dissolution.
2 Analytical chemistry related to phase transfer.
3 Thermodynamics and kinetics in solution.
4 Biomineralization.
5 Solubility phenomena of pollutants and environmental chemistry.
6 Compilation and evaluation of solubility data.

The registration fee is ¥ 35 000 before 15 March 1998, ¥ 45 000 after 15 March 1998, for scientific participants, and ¥ 10 000 before 15 March 1998, ¥ 15 000 after 15 March 1998, for students.

A second circular, with call for papers, registration and accommodation forms, will be mailed in the autumn of 1997.

To receive the second circular, please contact: Kiyoshi Sawada, General Secretary of the 8th ISSP, Department of Chemistry, Faculty of Science, Niigata University, Niigata 950-21, Japan. Tel.: +81 25 262 6265; Fax: +81 25 262 6116; E-mail: issp@sc.niigata-u.ac.jp

Conference Calendar

1997

Ionic polymerization

7–11 July
International Symposium on Ionic Polymerization. Paris, France.
Symposium Secretariat, Chantal Iannarelli, Congrès Scientifiques Services, 2 Rue des Villarmains, F-92210 Saint-Cloud, France. Tel.:+33 (1) 47 71 90 04. Fax: +33 (1) 47 71 90 05.

Recycling of polymers

14–17 July
38th Microsymposium on Macromolecules, Recycling of Polymers. Prague, Czech Republic.
P.M.M. Secretariat, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, 162 06 Prague 6, Czech Republic. Tel.: +42 (2) 360341; Fax: +42 (2) 367891; E-mail: sympo@imc.cas.cz

Vacuum microbalance techniques

16–18 July
27th International Conference on Vacuum Microbalance Techniques. Lublin, Poland.
Dr P. Staszczuk, Department of Physical Chemistry, Faculty of Chemistry, Marie Curie-Sklodowska University, M. Curie-Sklodowska Sq. 3, 20-031 Lublin, Poland. Tel.: +48 (81) 5375646/+48 (81) 5375784; Fax: +48 (81) 5333348; E-mail: piotr@hermes.umcs.lublin.pl/ rdobrow@hermes.umcs.lublin.pl

Organometallic chemistry

20–25 July
9th International Symposium on Organometallic Chemistry Directed Towards Organic Synthesis. Göttingen, Germany.
Prof. A. de Meijere, Chairman OMCOS 9, Institut für Organische Chemie, Georg-August-Universität Göttingen, Tammannstrasse 2, D-37077 Göttingen, Germany. Tel.: +49 (551) 39 32 32; Fax: +49 (551) 39 9475; E-mail: ucoc@uni-goettingen.de

Interfacial phenomena

21–24 July
17th Discussion Conference on Macromolecules, Surface and Interfacial Phenomena in Macromolecular Systems. Prague, Czech Republic.
P.M.M. Secretariat, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, 162 06 Prague 6, Czech Republic. Tel.: +42 (2) 360341; Fax: +42 (2) 367891; E-mail: sympo@imc.cas.cz

Bioinorganic chemistry

27 July–1 August
8th International Conference on Bioinorganic Chemistry. Yokohama, Japan.
Prof. M. Hidai, Department of

Chemistry & Biotechnology, Graduate School of Engineering, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113, Japan. Tel.:+81 (3) 38122111 ext. 7261; Fax: +81 (3) 58006945

Medicinal chemistry

29 July–1 August
AIMECS'97: AFMC International Medicinal Chemistry Symposium. Seoul, Korea.
Dr H. Park, Secretary General, AIMECS 97, c/o The Korean Chemical Society, #703, The Korean Science & Technology Center, 635-4, Yeogsam-Dong, Kangnam-Gu, Seoul 135-703, Korea. Tel.: +82 (2) 34534019; Fax: +82 (2) 5696673; E-mail: hpark@kistmail.kist.re.kr

Interfaces against pollution

10–13 August
International Conference on Interfaces Against Pollution. Wageningen, Netherlands.
IAP97, PO Box 8038, 6700 EK Wageningen, Netherlands. Tel.: +31 (317) 482279; Fax: +31 (317) 483777; E-mail: iap97@fenk.wau.nl

How to apply for IUPAC sponsorship

To apply for IUPAC sponsorship, conference organizers should write to the IUPAC Secretariat (see inside back cover for address) requesting an Advanced Information Questionnaire (AIQ). Completed AIQs should be returned to the Secretariat preferably 2 YEARS and at least 12 months before the conference. Late applications will not be considered. Further information on granting of IUPAC sponsorship was published in *Chem. Intl.* **14**, 203 (1992).

Plasma chemistry

18–22 August
13th International Symposium on Plasma Chemistry. Beijing, China.
Dr Lin He, Chinese Society of Theoretical & Applied Mechanics, 15 Zhong Guan Cun Road, Beijing 100080, China

IUPAC Congress

18–22 August
36th IUPAC Congress. Geneva, Switzerland.
AKM Congress Service, PO Box 37, CH-1218 Le Grand-Saconnex/GE, Switzerland. Tel.: +41 (22) 7611661. Fax: +41 (22) 7611662

IUPAC General Assembly

23–30 August
39th IUPAC General Assembly. Geneva, Switzerland.
The IUPAC General Assembly is not open for general participation but restricted to members of IUPAC bodies that meet on this occasion

Coordination chemistry

24–29 August
32nd International Conference on Coordination Chemistry. Santiago, Chile.
Prof. J. Costamagna, Departamento de Química, Facultad de Ciencia, Universidad de Santiago di Chile, Casilla 307, Santiago-2, Chile. Tel.: +56 (2) 6811644; Fax: +56 (2) 6812108; E-mail: jcostama@lauca.usach.cl

Polymers

25–28 August
12th Bratislava Conference on Polymers: Modified Polyolefins for Advanced Polymeric Materials. Bratislava, Slovak Republic.
12th Bratislava International Conference on Polymers, Polymer Institute of the Slovak Academy of Sciences, Dúbravská cesta 9, 842 36 Bratislava, Slovak Republic. Tel.: +42 (7) 3782198. Fax: +42 (7) 375923. E-mail: upolebor@savba.sk

Solution chemistry

26–31 August
24th International Conference on Solution Chemistry, Centre Omnisport, Vichy, France.
Prof. P. Turq, Laboratoire d'Electrochimie, Université Pierre & Marie Curie, Case courier 51, 4 place Jussieu, 75252 Paris Cedex 05, France

Electron transfer processes

3–7 September
International Symposium on Electron Transfer Processes and Reactive Intermediates in Macromolecular and Organic Chemistry. Zabre, Poland.
Prof. Z.J. Jedlinski, Institute of Polymer Chemistry, Polish Academy of Sciences, ul. Marii Curie Sklodowskiej 34, 41-800 Zabrze, Poland. Tel.: +48 (32) 1716077; Fax: +48 (32) 1712969; E-mail: polymer@usctoux1.cto.us.edu.pl

Colloquium spectroscopicum internationale

21–26 September
30th Colloquium Spectroscopicum Internationale 1997. Melbourne, Australia.
The Meeting Planners, 108 Church Street, Hawthorn Victoria 3122, Australia. Tel.: +61 (3) 98193700; Fax: +61 (3) 98195978.

Emulsions

23–26 September
2nd World Congress on Emulsions: Industrial Applications of Emulsions. Bordeaux, France.
Mr A. Le Coroller, Directeur-Général, CME, 50 place Marcel Pagnol, 92100 Boulogne-Billancourt, France. Tel.: +33 (1) 47617689; Fax: +33 (1) 47617465 .

Green chemistry

28–30 September
International Conference on Green Chemistry: Challenging Perspectives. Venice, Italy.
Conference Secretariat, Green Chemistry: Challenging Perspectives, Consorzio Interuniversitario Nazionale 'La Chimica per l'Ambiente', Facolta di Scienze Matematische, Fisiche e Naturali, Calle Larga S Marta 21.37, 30123 Venezia, Italy.

Macromolecule–metal complexes

6–10 October
7th International Symposium on Macromolecule-Metal Complexes (MMC-7). Noorwijkerhout, Netherlands.
Prof. J. Reedijk, Leiden Institute of Chemistry, PO Box 9502, 2300 RA Leiden, Netherlands. Tel.: +31 (71) 5274459. Fax: +31 (71) 5274451; E-mail: reedijk@rulgca.leidenuniv.nl

Visas

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

Biodiversity and bioresources

23–27 November
International Conference on Biodiversity and Bioresources—Conservation and Utilization. Phuket, Thailand.
IUPAC Biodiversity Conference, National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency Building, 73/1 Rama VI Road, Bangkok 10400, Thailand. Tel.: +66 (2) 6448150-4, ext. 505, 532, 534; Fax: +66 (2) 6448107-8; E-mail: iupacconf@biotec.or.th

1998

Polymer sciences and technology

5–10 January
International Symposium on Advances of Polymer Sciences and Technology. Madras, India.
Dr K.S.V. Srinivasan, Deputy Director & Head, Polymer Division, Central Leather Institute, Council of Scientific & Industrial Research, Adyer, Madras - 600 020, India.

Calorimetry and chemical thermodynamics

5–9 April
International Conference on Calorimetry and Chemical Thermodynamics. Campinas, Brazil.
Prof. C. Airoldi, Instituto de Química, UNICAMP - CP 6154, Universidade Estradul de Campinas, 13081-970 Campinas sp, Brazil.
http://www.iqm.unicamp.br/wloh/conf/

Trace element speciation

4–7 May
1st International Conference on Trace Element Speciation in Biomedical, Nutritional and Environmental Sciences. Neuherberg, Munich, Germany.
First Speciation Conference, c/o Ulla Schrödel, GSF-Forschungszentrum, Congress Service, Postfach 1129, D-85758 Oberschleissheim, FRG. Tel.: +49 (89) 31873030 (2669); Fax: +49 (89) 31873362.

Degradation processes in the environment

24–28 May
International Conference on Degradation Processes in the Environment. Dubrovnik, Croatia.
Dr A. Sabljic, Institute Boskovic, POB 1016, HR-10011 Zagreb, Croatia

Organic synthesis

28 June–2 July
12th International Conference on Organic Synthesis. Venice, Italy.
Depha Congress SRL, Viale Majno 21, 20122 Milano, Italy. Tel.: +39 (2) 76008190; Fax: +39 (2) 782400; E-mail: dephadue@mbox.vol.it

Chemistry in Africa

6–10 July
7th International Chemistry Conference in Africa (7th ICCA). Durban, South Africa.
The Secretary, 7th ICC & 34th SACI Convention, Department of Chemistry & Applied Chemistry, University of Natal, Durban 4041, South Africa. Tel.: +27 (31) 3603090. Fax: +27 (31) 2603091; E-mail: 7icca@che.und.ac.za

Macromolecules

20–23 July
18th Discussion Conference of Macromolecules: Mechanical Behaviour of Polymeric Materials. Prague, Czech Republic.
P.M.M. Secretariat, c/o Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, Heyrovského nám 2, CZ-162 06 Prague 6, Czech Republic.

Tel.: +420 (2) 360341; Fax: +420 (2) 367981;
E-mail: sympo@imc.cas.cz

Chemical thermodynamics

26 July–1 August
15th International Conference on Chemical Thermodynamics. Porto, Portugal.
Prof. M.A.V. Ribeiro da Silva, Department of Chemistry, Faculty of Science, Rua do Campo Alegre 687, P-4150 Porto, Portugal.

Pesticide chemistry

2–7 August
9th International Congress on Pesticide Chemistry. London, UK.
Dr John F. Gibson, Secretary (Scientific), Royal Society of Chemistry, Burlington House, London W1V 0BN. Tel.: +44 (171) 4378656; Fax: +44 (171) 7341227.

Novel aromatic compounds

2–7 August
9th International Symposium on Novel Aromatic Compounds, Hong Kong.
Prof. H.N.C. Wong, Chairman, Local Organizing Committe, 9th International Symposium on Novel Aromatic Compounds, Department of Chemistry, Chinese University of Hong Kong, Shatin, New Territories, Hong Kong.

Solubility phenomena

5–8 August
8th International Symposium on Solubility Phenomena. Niigata, Japan.
Prof. H. Akaiwa, Faculty of Engineering, Gunma University, Kiryu 376, Japan.

Physical organic chemistry

16–21 August
14th International Conference on Physical Organic Chemistry, Santa Catarina, Brazil.
Prof. E. Humeres, Universidade Federal de Santa Catarina, Departamento di Química, 88040-900 Florianópolis S.C. Brazil.

Coordination chemistry

30 August–4 September
33rd International Conference on Coordination Chemistry. Florence, Italy.
33rd ICCC Secretariat, Department of Chemistry, University of Florence, Via Gino Capponi 7, 50121 Firenze, Italy. Tel.: +39 (55) 2757549. Fax: +39 (55) 2757555.

Medicinal chemistry

6–10 September
25th International Symposium on Medicinal Chemistry. Edinburgh, Scotland.
Dr John F. Gibson, Secretary (Scientific), Royal Society of Chemistry, Burlington House, London W1V 0BN. Tel.: +44 (0)171 437 8656; Fax: +44 (0)171 734 1227.

Natural products

11–16 October
21st IUPAC Symposium on the Chemistry of Natural Products. Beijing, China.
Prof. Xibai Qiu, Secretariat of ISCNP-21, c/o Chinese Chemical Society, PO Box 2709, Beijing 100080, China. Tel.: +86 (10) 62568157 or 62564020; Fax: +86 (10) 62568157; E-mail: qiuxb@infoc.3.icas.ac.cn

2000

Macromolecules

9–14 July
MACRO 2000: International Symposium on Macromolecules. Warsaw, Poland.
Prof. S. Penczek, Centrum Badan Molekularnych i Makromolekularnych, Polskiej Akademii Nauk, ul. Sienkiewicza 112, PL-90-363 Lodz, Poland. Tel.: +48 (42) 819815; Fax: +48 (42) 847126.

Biotechnology

3–8 September
11th International Biotechnology Symposium. Berlin, Germany.
Prof. G. Kreysa, DECHEMA e.V., PO Box 15 01 04, D-60061 Frankfurt am Main, Germany.