40th IUPAC General Assembly, 7–14 August 1999, Berlin, Germany

There were 642 registered participants at the IUPAC General Assembly. Of that number, 518 were members of IUPAC bodies, 82 were invited Observers, and there were 100 Council Delegates. The individual totals are greater than the overall total because a number of delegates were also Members of IUPAC bodies. A summary of the actions taken by the Council and Bureau follows, including the results of the elections for IUPAC Officers and Bureau Members. This material and additional background material are available on the IUPAC web site, http://www.iupac.org.

Highlights of IUPAC's 72nd Bureau—40th Council—73rd Bureau, held 11–14 August 1999 in Berlin, Germany are summarized below.

Election Results

1. Prof. P. S. Steyn was elected Vice President and President Elect. The election results were as follows:

Steyn	71
Sydnes	43
Kratochvil	19

2. Dr. C. Buxtorf was elected Treasurer. The election results were as follows:

For	125
Against	0
Abstain	8

3. Dr. E. D. Becker was reelected Secretary General. The election results were as follows:

For	119
Against	4
Abstain	10

4. Prof. N. Moreau and Prof. O. Nefedov were elected to the Bureau. Prof. H. Ohtaki and Prof. G. Schneider were reelected. The election results were as follows:

Chandrasekharan	54
Kratochvil	48
Leigh	68
Moreau	90
Nefedov	100
Ohtaki	91
Schneider	81

IUPAC: 2000 and Beyond

The IUPAC Council took an historic step in Berlin when it confirmed the holistic, integrated program adopted by the Bureau a year ago to improve the quality, relevance, international impact, and effectiveness of the Union's scientific work. The decision by the Council to convert IUPAC from an organization dependent largely on a rather static Commission structure to a more dynamic project-driven system will permit us to address the challenges of serving chemistry in the modern world.

The Bureau and Council made it very clear that in modifying its structure and ways of operating, IUPAC is not in any way interrupting or discontinuing the activities in nomenclature, critical data evaluation, and other areas on which the international reputation of the Union has been established. Also, the discontinuance of all the current Commissions after 2001 does not mean the termination of work for many scientific volunteers around the world on whom IUPAC depends. In fact, the new project-driven system, together with the IUPAC Fellows program, will make it easier for active workers to continue service to the Union without arbitrary time limits. Concurrently, the new system opens up participation to the entire worldwide community of chemists. I anticipate that the competition of ideas for new projects and the influx of new workers to join more experienced IUPAC veterans will improve the vitality and relevance of our work in coming years.

The last two years have been very productive for IUPAC, as I described in my State of the Union message, published in *Chemistry International* in September. I am particularly pleased that the Strategic Plan adopted last year has set out a broad road map for IUPAC and that the structural changes now provide the means for effectively carrying out our work. The challenge now for all of us is to channel our efforts into the most useful, productive, and appropriate activities for IUPAC to benefit the chemical sciences.

Professor Joshua Jortner
President of IUPAC

5. Prof. L. Sydnes was elected to the Executive Committee by the Bureau.

Council Actions

1. Approved the change of Bylaw 4.307 (see Attachment 1). The results of the ballot were as follows: For: 123; Against: 3; Abstain: 7.
2. Approved the continuation of all existing Commissions until 2001 under Bylaw 4.302, and their termination after 2001. The results of the ballot were as follows: For: 101; Against: 6; Abstain: 26.
3. Approved the Membership and Terms of Reference of the Project Committee and the Evaluation Committee as Standing Committees.
4. Approved the changes in the Terms of Reference of the Joint Committee on Biochemical Nomenclature proposed by the International Union of Biochemistry and Molecular Biology.
5. Approved that the Chairman of the CTC be made an *ex officio* (nonvoting) member of the Bureau, joining the Chairmen of COCI and CHEMRAWN.
6. Approved the appointment of Batchelor, Tillery and Roberts as the Union's Auditors for 1997–2000.
7. Approved the budget and National Subscriptions as proposed by the Treasurer. The results of the ballot were as follows: For: 85; Against: 18; Abstain: 26.
8. Approved the transfer of the Commission on Biotechnology to Division III.
9. Approved the change of the name of Division III to the Division of Organic and Biomolecular Chemistry.
10. Approved the change of the name for those organizations currently known as Observer Countries to Associate National Adhering Organizations.
11. Approved the continuation of the Affiliate Membership Program, subject to a biennial report by the Secretary General to Council.
12. Approved the dates and location of the 41st General Assembly and 38th Congress: 29 June–8 July 2001, Brisbane, Australia.
13. Approved the dates and location of the 42nd General Assembly and 39th Congress: 8 August–17 August 2003, Ottawa, Canada.
14. Approved the application of the Turkish Chemical Society for National Adhering Organization status.
15. Approved the application of the Bulgarian Academy of Sciences for National Adhering Organization status.
16. Approved the recommendations on nomenclature and symbols approved by IDCNS in the previous biennium.
17. Established an IUPAC prize for recent Ph.D.s. There will be up to four prizes per year of USD 1 000. The winners for each biennium will also be brought to the IUPAC Congress.
18. Approved a program to provide support of up to USD 10 000 for up to two conferences per year in developing and economically disadvantaged countries.
19. Approved the change in the National Adhering Organization for the United Kingdom from the Royal Society to the Royal Society of Chemistry.
20. Approved the Division Officers elected at the General Assembly (see Attachment 4).

Bureau Actions

1. Issued a Policy Statement on National Representatives (see Attachment 2).
2. Issued a Policy Statement on Continuity in Scientific Activities (see Attachment 3).
3. Asked the President to establish an Ad Hoc Committee on Future IUPAC Strategy for Chemical Nomenclature.
4. Asked the Vice President to chair an Ad Hoc Committee on the Relationship of IUPAC with Chemical Industry.
5. Asked the President to establish an Ad Hoc Committee on Strategy for the Union's Education Activities.
6. Classified the current Standing Committees as follows: The Committee on Chemistry and Industry (COCI), CHEMRAWN Committee, and Committee on Teaching of Chemistry (CTC) are designated as Operational Committees. The Executive Committee, Finance Committee, Committee on Printed and Electronic Publications (CPEP), Interdivisional Committee on Nomenclature and Symbols (IDCNS), Project Committee, and Evaluation Committee are designated as Advisory Committees.
7. Discharged, with thanks, the Ad Hoc Interdivisional Committee on Biomolecular Chemistry.
8. Approved the following subscription rates for *Pure and Applied Chemistry* and *Chemistry International* proposed by the Committee on Printed and Electronic Publications:

PAC

Institutional	USD	1 166 (unchanged)
Institutional (3-year subscription)	USD	999 per year (new)
Individual	USD	99 (reduced from USD 130)

CI

Institutional	USD	99 (reduced from USD 122)
Personal	USD	45 (reduced from USD 49.50)

9. Recommended to CPEP that *Chemistry International* be sent free to all subscribers to *Pure and Applied Chemistry*.
10. Approved a fund of up to USD 25 000, to be matched by the local organizers, to support the participation of scientists from developing and economically disadvantaged countries in the 38th Congress in Brisbane.

Attachment 1. Text of Bylaw Change, Council Agenda Item 16

Current:
B4.307 Titular Members of Commissions have the right to receive contributions towards travel and subsistence expenses from funds of the Union as authorized by the Treasurer acting on behalf of the Union. Contributions may be made to Associate Members or members of subcommittees on recommendation of the Division or Section President and with the agreement of the Treasurer.

New:
B4.307 Members of IUPAC bodies may receive contributions towards travel and subsistence expenses from funds of the Union, as authorized by the Treasurer. The Bureau shall establish procedures and guidelines for the approval of such expenses.

Attachment 2. National Representatives: A Policy Statement by the Bureau, 12 August 1999

The Bureau has discussed the role of National Representatives, particularly in relation to the integrated program approved by the Bureau in September 1998 to improve the organization and management of IUPAC's scientific activities. Bylaw 4.305 provides for the nomination and appointment of National Representatives, but defines their role solely by stating that they may attend Commission meetings. In fact, National Representatives participate in a range of activities within Commissions and Standing Committees, particularly the Committee on Teaching of Chemistry. The program approved by the Bureau envisions the termination in 2001 of current Commissions and ultimate reliance on a much smaller number of Commissions, together with a large number of Task Groups formed to carry out specific projects.

One of the aims of the new program is to open participation in IUPAC activities to the worldwide chemistry community. Any individual or group in any country or countries may submit a proposal for an IUPAC project and recommend people to carry out the project. The project-driven system thus has the potential to broaden participation internationally. However, the Bureau believes that each National Adhering Organization should have assurance that its scientists can participate in the full range of the Union's activities. The program approved last year specified that a limited number of National Representatives may be named to Division Committees, which will become the focus of the scientific activities. Although the size of each Division Committee must remain relatively small in order to carry out its business efficiently, the Bureau believes that some flexibility in numbers of National Representatives should be allowed.

Several NAOs have indicated that they would be able and willing to recommend candidates for Task Groups. In addition to such names being considered as part of the core membership of the Task Group, the Bureau believes that each NAO should be able to nominate National Representatives in much the way that they have nominated such Representatives to Commissions. Since each Task Group is to be devoted to a specific project, a National Representative must clearly be qualified and be willing to participate in the project.

The Bureau has adopted the following policies:

A National Representative, as defined in Bylaw 4.305, may be appointed as a nonvoting member of a Division Committee on nomination by a National Adhering Organization (NAO) and approval by the Division Committee. Normally the number of National Representatives on each Division Committee will be limited to six, but the Executive Committee may approve a larger number if requested by a Division Committee. A National Representative to a Division Committee is expected to participate (usually by e-mail) in the work of the Committee, including the provision of advice, where appropriate, concerning proposals for projects and Task Groups. The term of appointment is two years, renewable once. Exceptional circumstances must be established and approval of the Executive Committee must be obtained for appointment of a National Representative from a country that already has a Titular or Associate Member on the Committee.

A National Representative may be appointed to a Task Group on nomination by a National Adhering Organization and approval by the chairman of the Task Group. [In some instances the Division President or Chairman of the Task Group may suggest to the NAO the nomination of a specific person.] The appointment will normally run for the duration of the Task Group. A National Representative to a Task Group is expected to have expertise in the subject of the Task Group's project and to contribute (normally by e-mail) to the work of the Task Group.

Travel and subsistence expenses of National Representatives are normally not paid by IUPAC. National

Adhering Organizations are encouraged to provide funds or to seek outside funds to permit occasional participation of National Representatives in meetings of Division Committees and Task Groups.

The Bureau has asked the Secretary General and the Secretariat to remain in close contact with NAOs and with Division Officers to ensure that these provisions are fully implemented and that National Representatives are given an opportunity to participate actively.

Attachment 3. Policy Statement by the Bureau, 12 August 1999

The Bureau is aware of the concerns expressed by a number of members of IUPAC bodies regarding continuity in scientific activities with implementation of the two actions requested of Council in Agenda Items 16 and 17.

The Bureau wishes to emphasize that it is not the intention of the changes that it has proposed to discontinue nor even to interrupt those activities, such as the collection and critical assessment of useful data, the work on atomic weights and isotopic abundances and on chemical nomenclature, on which the international reputation of the Union has been established. The proposed changes will provide more flexible and effective structures within which these activities will continue. The two-year interval until 2001 is intended to give adequate time for all our activities to be reviewed and for the putting in place of the most appropriate structures, including some new commissions, to carry forward the work of the Union.

Attachment 4. Division Officers for 2000–2001

Division	President	Vice President	Secretary	Past President
I	G. Wilson	J. Ralston	G. M. Olofsson	T. Cvitas
II	J. Corish	G. M. Rosenblatt	To Be Named	NA
III	T. Norin	T. T. Tidwell	D. Black	U. K. Pandit
IV	R. Gilbert	R. Stepto	W. J. Work	NA
V	F. Ingman	D. S. Moore	H. K. Powell	NA
VI	W. Klein	K. Racke	P. T. Holland	J. Miyamoto
VII	C.-G. Wermuth	A. Kallner	B. Heinzow	NA

NA=Not Applicable

Newly Elected IUPAC Officers and Bureau Members

Prof. P. S. Steyn, Vice President and President Elect, has been an Elected Member of the Bureau and the Executive Committee since 1996. His past IUPAC service also includes the following: 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 V1.1 (1979–1987); Vice Chairman of the 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 (1996–1999); Member of the Editorial Advisory Board of Chemistry in the 21st Century (1991–1997); 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), Paris (1985), Tokyo (1988), Mexico City (1992), and Rome (1996); Chairman of scientific sessions at most 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 En-

Prof. Pieter S. Steyn

vironment—National and International Perspectives, Pretoria, December 1996; Organizing Chairman of the IUPAC/AAPAC Workshop on the Role of Chemistry in the Development of Africa, Durban, 11 July 1998; Member of the South African Delegation to IUPAC Council Meetings at Munich, 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); Geneva, Switzerland (1997); and Berlin, Germany (1999).

Dr. C. Buxtorf, newly elected Treasurer, is currently Head of the Production and Technology Division of Novartis Crop Protection. Dr. Buxtorf is a member of the Executive Committee and president of some of the boards in Novartis Crop Protection.

Dr. Edwin D. Becker

Dr. E. D. Becker, reelected as Secretary General, has been Secretary General of IUPAC since 1996. As secretary general, Dr. Becker has spearheaded many programs to strengthen IUPAC and has established international networks to bring the global chemistry community together to work toward a common goal. Dr. Becker has been active in IUPAC during the last 26 years, including service as Member, 1973–75, and Chairman of the Commission on Molecular Structure and Spectroscopy, 1975–81; Member, 1977–81, and Secretary of the Physical Chemistry Division, 1981–85; Member, 1986–88, and Chairman of the Committee on Publications, 1988–94; and Member, 1979–84, and Chairman of the United States National Committee for IUPAC, 1984–86. He has served on a number of other committees and boards; of special note is his tenure as Chairman of the Committee on International Activities of the American Chemical Society from 1993–96.

Prof. Nicole J. Moreau

Prof. N. Moreau, newly elected Bureau Member, has served as Vice President of the French National Committee for Chemistry (IUPAC NAO) since 1994 and as a Member of the French National Committee of Chemistry Delegation at IUPAC since 1995.

Prof. Oleg M. Nefedov

Prof. O. Nefedov, newly elected Bureau Member, has regularly participated in all IUPAC General Assemblies since 1981. He also takes part in many IUPAC and other international conferences on organic chemistry, physical organic chemistry, organosilicon chemistry, and organometallic chemistry as a plenary or invited lecturer and as a member of international advisory committees. Prof. Nefedov previously served as Titular Member of the Commission on Physical Organic Chemistry (III.2), 1981–91, and Associate Member of the Commission on Physical Organic Chemistry, 1991–93.

Prof. Hitoshi Ohtaki

Prof. H. Ohtaki, reelected Bureau Member, is currently a Bureau member of IUPAC, as well as a member of the Executive Committee. He was a member of the Commission on Equilibrium Data (V.6) of the Analytical Chemistry Division of IUPAC from 1975 to 1993 (Associate Member, 1975–79; Titular Member, 1979–85; Secretary, 1981–83; Chairman, 1983–85; National Representative, 1985–89; and Co-opted Member of the Division 1989–93). Prof. Ohtaki was also a Member of the Inorganic Chemistry Division from 1987 to 1991.

Prof. Gerhard M. Schneider

Prof. G. Schneider, reelected Bureau Member, has been an IUPAC Bureau member since 1996. Previously,

Prof. Leiv K. Sydnes

he has been a Member (1973–77), Secretary (1977–81), and Chairman (1981–85) of the Commission on Thermodynamics (I.2). He has also been a Member (1981–85) and Secretary (1985–87) of the Physical Chemistry Division Committee and Vice President (1987–89) and President (1989–91) of the Physical Chemistry Division.

Prof. L. Sydnes, elected to the Executive Committee by the Bureau, has been a Bureau member since 1994 and a member of the IUPAC Subcommittee on Organic Synthesis since 1998. Prof. Sydnes served on the IUPAC Strategy Development and Implementation Committee (SDIC) from 1997–1998 and as an Associate Member of the IUPAC Organic Chemistry Division Committee from 1998–1999. He also continues as a Member of the Project Committee of the IUPAC Bureau from 1999–2001.

37th IUPAC Congress—27th GDCh General Meeting, 14–19 August 1999, Berlin, Germany

This extremely successful event, held at Berlin's International Congress Center (ICC) with the general theme "Frontiers in Chemistry: Molecular Basis of the Life Sciences", celebrated the 80th anniversary of the founding of IUPAC and the 50th anniversary of the refounding of the Gesellschaft Deutscher Chemiker (GDCh) after World War II. More than 2 400 participants (most from outside Germany) from 55 countries had the opportunity to attend about 350 talks (in up to 12 parallel sessions) and to view about 1 200 posters. Over 250 attendees from developing or economically disadvantaged countries were sponsored, at least in part, by substantial reductions in registration fees.

Eight plenary lecturers, including four Nobel Prize winners, headlined an array of leading chemists from around the world reporting on their latest research findings in medicine, agriculture, nutrition, and the environment. The first plenary speaker, Prof. Dr. Thomas R. Cech (1989 Nobel Prize winner) of the Department of Chemistry and Biochemistry, University of Colorado, Boulder, CO, USA, discussed "RNA in Catalysis: Ribozymes and Telomerase". He showed how some RNA molecules called ribozymes fold to form active sites for biochemical reactions in the complete absence of proteins, while other cellular catalysts are ribonucleoprotein (RNP) particles that contain essential protein and RNA components. He used as an example the crystal structure of the *Tetrahymena* ribozyme to show how RNA can fold to form a preorganized active site, much like a protein enzyme. His recent work has extended the scope of RNA catalysis via use of *in vitro* selection–amplification and a combinatorial library of RNA sequences to find ribozymes that catalyze (10^6-fold) peptidyl transfer between aminoacyladenosine and a second amino acid. He also demonstrated how the RNP enzyme telomerase, responsible for synthesizing the ends of chromosomes in eukaryotes, is attracting much attention because of its roles in cellular immortality and in cancer. Prof. Cech's work combines genetic and biochemical approaches to improve our understanding of RNP enzymes.

Prof. Dr. Thomas R. Cech

Prof. Dr. Stephen J. Lippard of the Department of Chemistry, Massachusetts Institute of Technology, Cambridge, MA, USA, spoke on "The Chemistry of Selective Hydrocarbon Oxidation in Bacteria". He described how methanotrophic bacteria use a soluble methane monooxygenase (sMMO) system of proteins to convert methane selectively to methanol in the first chemical step required for carbon assimilation and energy via the reaction $CH_4 + O_2 + NADH + H^+ \rightarrow CH_3OH + H_2O + NAD^+$. His laboratory is engaged in an extensive program to understand all aspects of this reaction through

Prof. Dr. Stephen J. Lipppard

studies of sMMO from *Methylococcus capsulatus* (Bath) as well as through the synthesis and characterization of synthetic model compounds. Prof. Lippard's work has employed X-ray crystallography and high resolution NMR spectroscopy to elucidate the structures of the enzymes and proteins involved. Depending on the relative concentrations of the regulatory protein, reductase, and hydrocarbon substrate, the sMMO system can function alternatively as an oxidase or hydroxylase. From analysis of steady state kinetic and isothermal titration calorimetry data, Prof. Lippard has proposed a model in which the reductase and coupling protein bind noncompetitively at distinct interacting sites on the hydroxylase during catalysis.

Prof. Dr. Roald Hoffman (1981 Nobel Prize winner) of the Department of Chemistry, Cornell University, Ithaca, NY, USA, after being made an Honorary Member of the GDCh, delivered a disarmingly delightful lecture entitled "Chemistry in Culture, Culture in Chemistry". In a five-minute introduction presented entirely in German, he declaimed quite movingly that despite having lost three grandparents and his father to the Holocaust by the time he arrived in the United States at the age of eleven, he bears no animosity about the past. This artist, poet, author, and—above all—superb exponent of applied, theoretical, organic, inorganic, and solid state chemistry then spoke in a most accessible manner of the need for chemists to build bridges to the general public. It is so important, he said, for chemists to teach as widely as possible—and not just in schools—because chemical research is fundamentally about change, and people are at best ambivalent about change and at worst afraid of it. He amplified his point with many fascinating historical examples, most notably the platinum catalyst lamp, designed by Johann Wolfgang Döbereiner (1780–1849), which provided a significant amount of indoor lighting for central Europe during the second quarter of the 19th century. Prof. Hoffmann pointed out that papers about the chemistry of the Döbereiner lamp are still being published today. He also spoke of author–philosopher–poet Johann Wolfgang von Goethe's fascination with chemistry, a topic discussed in more detail in an evening Congress lecture by Prof. Dr. Georg Schwedt, who has written a book on the subject. Prof. Hoffman reminded us that the cultural dimension of chemistry is just as important as the science, and that both must be communicated effectively to the public if chemistry is to prosper.

Prof. Dr. Roald Hoffman (left) receives an Honorary Membership from Prof. Dr. Erhard Meyer-Galow, President of the German Chemical Society (Gesellschaft Deutscher Chemiker).

Prof. Dr. Heinz A. Staab

Prof. Dr. Heinz A. Staab of the Department of Organic Chemistry, Max-Planck-Institut, Heidelberg, Germany, a past president of the GDCh (1984–1985), also was made an Honorary Member before delivering his plenary lecture. He spoke in detail about "Quinone–Porphyrin Interactions". His presentation elucidated the photosynthetic reaction mechanisms of porphyrin donors and quinone acceptors, with many examples of structures and visible absorption spectra.

Prof. Dr. Sir John E. Walker (1997 Nobel Prize winner) spoke about "How ATP is Made" in the annual Federation of European Chemical Societies (FECS) lecture. His pioneering work on ATP (adenosine triphosphate) synthase, begun in the early 1980s with the aim of ascertaining its detailed chemical structure, has had a significant impact upon the chemical and biological sciences. With Paul Boyer and Jens Skou, he won the 1997 Nobel Prize for Chemistry for his "elucidation of the enzymatic mechanism underlying the synthesis of ATP". Prof. Walker graphically illustrated the importance of ATP synthesis by pointing out that we turn over approximately our entire body weight in ATP every 24 hours. The complexity of the effort in elucidating the structure of the enzyme is apparent from Prof.

Prof. Dr. Sir John E.Walker

Walker's demonstration that bovine F_1-ATPase consists of nine polypeptide chains with a total molecular weight of 371 765, with each of the substituent chains ranging in molecular weight from 5 652 to 55 264.

Prof. Dr. Martin Karplus of the Laboratoire de Chimie Biophysique, Université Louis Pasteur, Strasbourg, France (and Research Professor in the Department of Chemistry and Chemical Biology, Harvard University, Cambridge, MA, USA) gave a plenary lecture on "Protein Dynamics: From Femtoseconds to Milliseconds". He presented a brief overview of the use of simulations for studying protein dynamics and presented three examples that involved dynamic phenomena on time scales ranging from femtoseconds to milliseconds. Prof. Karplus described the behavior of the protein and the CO ligand after photodissociation of the myoglobin CO complex. He has investigated catalysis by the enzyme triosephosphate isomerase of the transformation of dihydroxyaldehyde phosphate to glyceraldehyde phosphate, and his work has shown how the enzyme reduces the activation barrier. Prof. Karplus compared the classical dynamics of the reaction in the enzyme with the results expected from transition state theory. His laboratory has employed simulations to determine some general principles of protein folding.

Prof. Dr. Martin Karplus

Prof. Dr. Chi-Huey Wong

Prof. Dr. Chi-Huey Wong of the Department of Chemistry and the Skaggs Institute for Chemical Biology, The Scripps Research Institute, La Jolla, CA, USA spoke on "Chemical–Enzymatic Synthesis and Glycobiology". He pointed out that of the three major classes of biomolecules—proteins, nucleic acids, and carbohydrates—it is carbohydrates that are the least exploited. Despite the important roles that saccharides play in numerous biological recognition events (e.g., bacterial and viral infection, cancer metastasis, and inflammatory reactions), the pace of development of carbohydrate-based therapeutics has been relatively slow. Prof. Wong suggested that this slow pace is further hindered by the lack of practical synthetic and analytical methods available for carbohydrate research and by the problems associated with undesirable properties of carbohydrates as drug candidates. He showed how recent advances in the field, however, have demonstrated that many of these problems can be circumvented with the use of chemo-enzymatic synthetic methods and carbohydrate mimetics, i.e., small molecules that contain the essential functional groups (often with additional hydrophobic or charged groups) to resemble the active conformation of the parent structure.

Prof. Dr. Robert Huber

Prof. Dr. Robert Huber (1988 Nobel Prize winner) of the Max-Planck-Institut für Biochemie, Martinsried, Germany delivered the final plenary lecture at the closing session of the Congress. His topic was "Biomolecular Cages for Protein Folding and for Protein Degradation". He demonstrated how recent crystal structural studies of the Thermosome, an archaeal homolog of the eukaryotic chaperonin CCT, of the yeast 20S proteasome, and of the *E. coli* HsIV protein, provide detailed views of the subunit structures and arrangements of these large homo- or hetero-oligomeric complexes. All three complexes observed are closed in their respective crystal forms, and the cavities are quite inaccessible from the outside such that substantial rearrangement of segments, domains, or subunits is required for macromolecular substrate entry and binding. Prof. Huber showed that binding of ATP and its analogs induces small local changes and large domain rotations in the thermosome, possibly representing intermediates between closed and open forms in the catalytic cycle, but leaves the overall conformation closed in all crystal forms studies. He pointed out how very detailed structural information is available for proteolysis by the proteasome through small substrate binding studies and mutagenesis experiments that explain the specificity, processivity, and preferred length distribution of its peptide products.

Chemistry in Today's Brazil

Professor Carlos A. L. Filgueiras (Departamento de Química Inorganica, Instituto de Química, Universidade Federal do Rio de Janeiro, C.P. 68563, 21945-970 Rio de Janeiro, RJ, Brazil; E-mail: calf@iq.ufrj.br), a National Representative for IUPAC's Commission on Nomenclature of Inorganic Chemistry (II.2), prepared this article. It is an English translation, edited slightly for a non-Brazilian audience, of a Portuguese version that appeared in the January/February issue of *Química Nova*. We thank Professor Carol H. Collins (Instituto de Química, Universidade Estadual de Campinas, C.P. 6154, 13803-970 Campinas, SP, Brazil), Executive Secretary of the Brazilian Chemistry Committee (BCC), which represents Brazil in IUPAC, for helping to facilitate publication of this contribution.

Summary

This article surveys the birth and development of the chemical community in Brazil over the last 50 years. Chemistry in Brazil has had its ups and downs over the years. The institutionalization of chemistry took considerable time and still is irregular, depending in part upon the whims of the government at any given time. Starting from humble beginnings, a vigorous chemistry community developed and rapidly expanded the scope of its activities across the country. Many problems remain unsolved, however, and to these have now been added dismal government policies that threaten to negate many of the accomplishments achieved thus far. Brazilian chemistry is at the threshold of a new age that will differ greatly from the previous half-century.

Chemistry in Colonial Brazil

Teaching of chemistry on a regular basis, as well as some rudimentary research, began in the first years of the 19th century, under the auspices of the Portuguese King John VI, who lived in Rio de Janeiro from 1808 to 1821. These activities were, however, very limited in scope. The situation did not change appreciably during the remainder of the 19th century, with chemistry regarded solely as an ancillary discipline in the study of other specialties, such as engineering, medicine, or pharmacy.

Beginnings of Modern Chemistry in Brazil

Curricula granting university degrees in chemistry were created only during the first decades of the 20th century. Their aim was to teach the state of the art, in order to prepare professionals capable of supervising important analytical or synthetic processes, transformations, and control operations in the country's nascent industry. Original contributions to the chemical sciences, experimental or theoretical, were almost nonexistent. An important exception was the systematic research undertaken at the University of São Paulo (USP) in the 1930s, led by chemists who had emigrated from Germany. Nevertheless, this situation was unique; despite the pioneering work led by those initial USP researchers and their first Brazilian collaborators, the country as a whole remained impervious to the idea of scientific research as a means to promote progress. There was hardly any awareness of this need, because of the scientific ignorance of the population, especially the elite.

Discontinuity in policies, programs, institutions, and scientific activities was another important factor that slowed the development of modern science in Brazil. The following pattern recurred often: from time to time, a brilliant scientist or a group of scientists excelled in some important work, gathering a following of disciples and often founding an institution or school of thought. Their achievements were recognized, sometimes widely, but after a certain time, support for their work decreased and could even be discontinued. It was as if Brazilian society liked the ephemeral glitter of scientific achievement and considered it as some sort of cake frosting or a social ornament, not something *essential* to the life and the progress of that same society.

Postwar Development of Chemistry in Brazil

It was necessary to wait until the awareness of the need to develop science grew stronger before concrete actions could be undertaken. The period immediately after World War II witnessed this ripening process, as a result of the evidence, shown in the military field, of what science and technology can achieve. The enormity of the gap between Brazil and many other allies in the war was shocking to many. The lack of any national program or agency dealing with scientific development pointed to an inexorable economic, social, and intellectual regression if nothing were done. Thus, in 1951 the agencies of the National Research Council, now the National Council for Scientific and Technological Development (CNPq), and the Coordination for Training of University Professors (CAPES) were created, to fund and direct research, establish graduate programs at the universities, and devise national policies of scientific and educational development.

Several important research centers were also created in that period, such as the Brazilian Center for Physical Research (CBPF) and the National Nuclear

Energy Commission (CNEN), which were crucial, in their early history, in discovering and nurturing new scientific talents. Beside these institutions, various nongovernmental organizations made their appearance, of which the most important at the time was the Brazilian Society for the Advancement of Science (SBPC), founded in 1948. Together, all those new organizations began to work to change the country's scientific panorama. Progress was slow at first; the goal was very ambitious and included creation of a body of scientists; establishment of active research institutions; introduction of continuing scientific research programs at universities; training of high-level scientists in the widest possible number of specialties; and, above all, the beginning of a change in a stubborn, nonscientific national mentality that was centuries old.

In spite of all the obstacles, advancement was considerable and, after two decades, at the beginning of the 1970s, there was clear evidence of progress. Several graduate-level programs were functioning regularly, and the universities, which had undergone thorough restructuring in the late 1960s, proclaimed the need to pursue original research as well as teaching. The university community already took for granted that the creation of new knowledge was one of the pillars upon which the institution must be founded; the transmission of knowledge alone, however important, no longer sufficed.

Growth of Research and Graduate Programs

Research and graduate programs grew at an extraordinary pace in the 1970s and 1980s. There was ample political and financial support for this development, which translated into remarkable quantitative and qualitative growth of science in Brazil, in particular of chemistry.

Among the reasons for the success enjoyed by CNPq, particularly as conductor of the national science and technology policies of the 1970s and 1980s, were strong financial backing and introduction of the peer review system and scientific advisory committees, both drawn from the scientific community. The scientific advisory committee system, started in 1976, had enormous importance in decisions concerning recommendations and resource allocations based on merit, rather than on political influence.

One of the indications of the political importance given to scientific progress was the publication, in 1974, of a Basic Plan for Scientific and Technological Development (PBDCT) as a government priority. This kind of planning was considered to be so crucial that, in 1976, a second plan succeeded the first. Also in 1974, both CNPq and another agency, the Fund for Financing Studies and Research (FINEP), were reformulated, enabling them to function for many years as effective agents to promote the goals of PBDCT and other programs that followed it.

A diagnosis for all scientific areas at the time was made and published in 1974. The situation was a far cry from what exists today, even taking into account any inaccuracies present in that document. In December 1973, there were only 144 holders of doctorates in chemistry, as well as 118 students pursuing doctorates in chemistry. To give an idea of how things have changed, in 1997, Brazilian universities awarded 200 doctorates in chemistry, up from 170 in 1996 and 153 in 1995. Currently, 25 university programs grant doctorates in chemistry.

In 1996, there were 80 000 chemistry professionals, of whom 50 000 were technicians and 30 000 were university-trained in chemistry or chemical engineering. Of the university-educated professionals, more than 1 600 had a doctorate and, of these, 90% were employed at universities.

Chemical Industry in Today's Brazil

Today Brazil is ranked among the top ten countries in the world, with respect to the size of its chemical industry; this industry is of paramount importance in creating jobs, internal wealth, and profits from exports. This condition would not have occurred without the large increase in chemical education and training programs at all levels, as well as augmentation of related areas, such as metallurgy or mining, in which chemistry plays a major role. In this manner, teaching institutions responded to the challenges posed to them. However, most of the Brazilian chemical industry is concerned mainly with producing relatively less elaborate goods, such as petrochemicals, monomers, polymers, etc., in large quantities. The specialty chemicals industry, which makes lesser amounts of value-added products, is still quite modest. Development of specialty chemicals will require, in addition to capital and political will, a large number of high-level scientists in order to succeed.

Educational and Research Assessments

CAPES and CNPq launched monitoring and assessment programs in the 1970s to gauge how the activities under their responsibility were faring, with the objective to assess and correct, where necessary, the educational and funding policies.

CAPES, which is the agency in charge of graduate programs in the Education Ministry, was the more successful of the two. Its assessment of graduate education was based from the start on the principle of peer review, i.e., visits by committees of specialists and analysis of all aspects concerning graduate studies, including physical facilities, libraries, equipment and supplies, qualifications and performance of teaching

staffs and students, etc. This system is still in use and enjoys great credibility in the academic community.

Similar assessments of research projects by CNPq were not as successful, even though they were based on the same peer review principle used by CAPES. The quality, appropriateness, and impact of research efforts are particularly difficult to assess. Perhaps more important, there was a relative unwillingness to formulate and demand clear research guidelines on the part of university departments and research institutes. Research assessment remains an important, albeit difficult, problem that will soon have to be solved adequately, in view of the mounting complexities of funding and carrying out research nowadays.

Role of Brazilian Scientific Societies

It is important to note the extraordinary role played by the scientific societies. The Brazilian Chemical Society (SBQ), founded in 1977, has become the country's largest scientific organization, with some 4 000 paying members and a very strong presence in Brazil. SBQ's most important activities are the several regular conferences it organizes and its four publications. Conferences held by SBQ include the large annual meeting, held during the last week of May, with an average attendance of 2 000 people from the whole country and several foreign countries; thematic conferences (inorganic chemistry, organic syntheses, NMR, electrochemistry, etc.); and regional meetings, held in distinct places throughout the country. SBQ publications include the *Journal of the Brazilian Chemical Society* (in English), *Química Nova* (in Portuguese and English), *Química Nova na Escola* (in Portuguese), and the *Boletim da SBQ* (in Portuguese). The *Journal of the Brazilian Chemical Society* (*JBCS*) is a research-only journal; *Química Nova* (*QN*) publishes research together with technical notes, chemical education material, history of chemistry, etc; *Química Nova na Escola* (*QN na Escola*) is a journal for high school teachers of chemistry; finally, the *Boletim*, which appears electronically, conveys information about the Society, the chemical profession, political and social implications of science, etc. *JBCS* and *QN* are indexed in *Chemical Abstracts*. *QN* and the *Boletim* are sent to all members of the society, whereas the other two publications are sold by subscription.

Logo of the Brazilian Chemistry Society (SBQ)

Other scientific societies that deal with chemistry and related topics include the Brazilian Association for Chemistry (ABQ), the Brazilian Association for Chemical Engineering (ABEQ), the Brazilian Association for Polymer Science (ABPol), and the Brazilian Association for the Chemical Industry (ABQuim). Each of these associations has an annual meeting and publishes either a bulletin or a journal, or both, in Portuguese. Together with the SBQ, these associations make up the Brazilian Chemistry Committee (BCC), which represents Brazil in IUPAC.

Chemistry in Brazil's Latin American Neighbors

Another way to look at what has happened in Brazil in these recent decades is to compare how science was introduced and developed in Brazil's Latin American neighbors. Brazil entered the 19th century in a state of absolute inferiority. Several countries on the continent possessed venerable and distinguished universities, some dating from the first century of Spanish colonization. Mexico, for instance, pursued chemistry vigorously in the 18th century, and the Mexican discovery of vanadium is an important contribution of that early period. Brazil, on the contrary, had scant scientific tradition and, during the colonial period, was never allowed by Portugal to have either universities or printing presses. This situation only began to improve after 1808, with the arrival of the Portuguese court in Rio de Janeiro. Although several schools of higher education in medicine, law, and engineering were founded and prospered during the 19th century, they did not begin to merge into true universities until 1920. This historical perspective helps one to appreciate the immense obstacles that had to be overcome to catalyze the process that began after 1945.

Overcoming Obstacles to Chemistry in Today's Brazil

Of course, several problems persisted and, in recent times, many others have surfaced. There are currently no bold directives or plans for continuing the developments of the previous decades. Past plans had merits as well as flaws, and were liable to criticism; however, these plans were backed by a national will to pursue science and technology and to further the well being of the nation. Many concrete actions were put into practice and led to significant growth, both on a quantitative and on a qualitative basis. Today what is needed is to go further, with the necessary corrections demanded by new times and situations. However, there is an almost total vacuum of firm policies or actions regarding the support of science. CNPq no longer functions as a leader of national science policy.

The lack of continuing and steady support has been almost constant in the present decade, particularly in the last few years. The traditional federal funding sources for science have shrunk, and the resources available to researchers are not sufficient enough to maintain current projects, let alone to provide for the growing demand from new researchers. Project evaluation by the agencies tends more and more to become a game of musical chairs, with a minute number of seats and a large standing crowd. The shrinking of the federal funding agencies took place without their replacement by any other funding scheme of similar magnitude. Several of the Brazilian states have their own agencies for funding research, but with the exception of the Foundation for Research Support of the State of São Paulo (Fapesp), they do not have the resources to cope with the demand in their respective states. If the present situation persists much longer, science establishments may become obsolete throughout Brazil, except in São Paulo. This setback would increase the asymmetry already present in the country to the point of being extremely harmful to the very nature of the federation of Brazilian states. The constant chorus of scientists, educators, scientific societies, universities, and research institutes denouncing the present state of things and urging change has only met with deaf ears within the present national and state government administrations. The danger inherent in this asymmetry might affect the state of São Paulo, which will be under intense pressure from at least part of the science community in the rest of the country, leading to an uneasy situation.

The catchword to justify the present state of things is "market". It seems that nothing can be done in the country if it is not geared to the immediate needs of the market. In the educational and scientific fields, this shortsightedness can lead to an irreparable disaster. For example, universities are institutions that must be at the forefront of society; in addition to performing services strictly tuned to the market, such as the education of future professionals, they must also perform a number of other functions. Good universities must go beyond their time or contingencies; not only must they transmit knowledge in an efficient manner and prepare professionals of the highest quality, but they must create new knowledge by means of original research. If universities do not maintain their leadership in society, they will become moribund. It would not have been possible for educational institutions in Brazil to produce the enormous specialized labor force at work today in the chemical industry without the extraordinary support given to science activities in the past.

From the point of view of professional education alone, the alliance between teaching and research is meaningful. Without ongoing research activities, both teachers and students will lack the exposure to the critical decision-making process that one faces so often during the course of any research project, depending on what happens in the laboratory. Performing only previously tested experiments, for example, introduces a sense of certainty—almost of dogma—into the subject, which completely reverses the nature of science. It is the research component that sets the correct path, showing how treacherous experimental work can be and how alert and resourceful the experimentalist must be in order to interpret what is taking place. Exposure to this decision-making process is invaluable to any future professional, regardless of what field he or she will be engaged in.

If the universities were limited to satisfying market needs only, many other important human activities would also disappear from their concern. Culture in general, and the humanities and arts in particular, would suffer most. Is this really the kind of university we want? Might this not reduce us to a brutish and greedy tribe, intent only on making money for its own sake?

Until a few years ago, Brazil enjoyed a very enviable situation by offering scholarships over a wide spectrum, from undergraduate research to postdoctoral fellowships. Of course, this scholarship support was essential to achieve the results outlined above. The number of scholarships has shrunk considerably, and there is widespread concern that it will shrink even more. This contraction of support has significantly affected all graduate programs as well as the "scientific initiation" programs for undergraduates. Salaries in scientific establishments are no longer as attractive as in the past, and it is feared that all these changes will have an adverse effect on the number of students willing to pursue scientific careers. As a consequence, the scientific edifice carefully put together over the last decades runs the risk of crumbling. This edifice should be a source of national pride. Those who do not see it this way, and who pretend to be up-to-date, ignore the fact that in the modern world the most precious good is knowledge. The destruction, or even worse, the demoralization of the science and technology system is relatively easy to bring about, if the present tendencies are not reversed. Much more difficult will be the restoration of the building, if this course of action persists for much longer.

Future of Chemistry in Brazil

As scientists and academicians, we are at a crossroads of enormous complexity. Gone is the age of innocence, of certainties, or of transparent policies. Instead, we are faced with multiple challenges. What can be done? To start with, we must acknowledge the multiple nature of problems and agree that solutions can and must be pursued. Secondly, solutions will be laborious and costly, and can only be achieved through great effort, unity, and tenacity from the scientific community. We

need a confident, unified approach toward a common goal, political in nature, in order to reverse, even if only gradually, the present government policies that are choking Brazilian science. If these policies are not changed, they will lead the country dangerously backwards.

Unity of purpose is also essential at all levels of chemistry teaching, as well as within the industrial sector and in any activity linked directly or indirectly with chemistry. This unanimity must be understood as no mere political strategy but as a true ideology in action, expressing the belief I think all chemists share, that the cultivation and advancement of chemistry are essential for the progress and well being of the country. This undertaking is indeed difficult in the present climate, in which the nation's ruling circles tend to consider advanced quality education and scientific research as luxuries that can be postponed. The preference now is to import everything, rather than to encourage domestic development. We thus face an inversion in the direction of history, by which the nation might be led to a situation reminiscent of that which prevailed before the last half-century.

In addition to immense academic and political effort, there is more to be done. We need to encourage, as individuals and institutions, together with the scientific societies, the popularization of science and the education of the lay population. Without widespread public backing, this inversion process might take much longer. We would do well to remember that, until a few decades ago, awareness that cultivation of science is a necessity was far from unanimous, even in university circles. Moreover, to bring science to the public in general is a relevant task that we cannot shun, as members of a minority who had access to science education at all levels. The goal of this effort is not to find future scientists, but rather to disseminate science among common citizens and to make them scientifically literate. The discovery of scientific talents will be a possible consequence of this action, not its motivation. Insofar as chemistry is the central science, chemists are also at the center of this responsibility. If we criticize those who deny us support for our research, we cannot be omissive in this regard.

Reaching out to the general public, if well conducted, can result in great benefit for the scientific community, too. If we can persuade the general population to accept the idea that science is not only good but indispensable, that it is a manifestation of national pride to have a great number of scientists and institutions doing research, the social status of our activity, as well as our own status, will tend to rise, and we will have more influence on political decisions. In sum, the change in mentality that took place in the universities 30 years ago must now be extended to the rest of the nation.

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News from IUPAC

Biodegradation of Chemical Warfare Agents

This article by Dr. Walter Mulbry (wmulbry@asrr.arsusda.gov), a microbiologist at the Soil Microbial Systems Laboratory, USDA/ARS, Beltsville, MD, USA, and Evgenia Rainina, a microbiologist at the Department of Biochemistry and Biophysics, Texas A&M University, College Station, TX, USA, constitutes the report of a Working Party of the IUPAC Ad Hoc Committee on Chemical Weapons Destruction Technologies (chaired by Professor Joseph F. Bunnett, bunnett@chemistry.ucsc.edu). It was originally published in *ASM News*, Vol. 64, No. 6, 1998, pp. 325–331, and it is reprinted here with the kind permission of the American Society for Microbiology. We thank the authors and Patrick Lacey (patlacey@asmusa.org), Production Editor at *ASM News*, for making it possible for us to publish this report.

The Chemical Weapons Convention (CWC), which the U.S. government ratified in 1997, sets an explicit timetable for signatory countries to destroy their chemical weapon stockpiles and related facilities. Although destroying such agents and remediating contaminated sites by conventional means promise to be enormously costly processes, recent research indicates that some of these compounds can be biologically degraded, suggesting an environmentally and economically feasible alternative strategy for addressing these challenges.

The magnitude of the U.S. chemical weapon (CW) stockpile—over 30 000 tons of various blister and nerve agents—presents a formidable challenge to those charged with disposing of it. About 60% of the agents are stored in steel 1-ton bulk containers; the remaining 40% are loaded in several million explosively configured rockets, land mines, mortars, bombs, artillery projectiles, and spray tanks (Figure 1). The "youngest" CW munitions and storage tanks are 30 years old, and the oldest are 53. In addition, U.S. Army officials have identified 215 sites in 33 states that are likely to contain

Figure 1. Artillery shells containing the nerve gas sarin (GB) inside a storage bunker at the Umatilla Chemical Depot in Oregon. (Photo courtesy of Donna Fuzi, Department of the Army)

buried chemical weapons or to be contaminated with chemical agents.

The financial resources needed for these tasks are equally formidable. Since 1985, the U.S. Army has spent USD 3.2 billion on its programs for destroying the U.S. CW stockpile and on planning for the treatment of material at nonstockpile sites (about 4% of these funds were used for research and development). The current cost estimate for the stockpile disposal program, USD 12.4 billion, has increased sevenfold since 1985 and is likely to increase further. In addition, U.S. Army officials estimate that at least another USD 16.6 billion will be needed over the next 40 years to treat buried material at nonstockpile sites.

Although few of the other CWC signatory nations have major CW stockpiles to deal with, several of the independent republics of the former Soviet Union, whose financial resources are already strapped, face cleanup tasks comparable to that of the United States. Other known CW concentrations include Japanese CW munitions abandoned in China in 1945 and an estimated 100 000 tons of German CW munitions that were dumped into the Baltic Sea at the end of World War II.

Newer CW Biodegradation Research Efforts Show Progress

For more than 50 years, the U.S. military and its counterparts in other countries have disposed of obsolete and surplus chemical weapons by a variety of means that are no longer acceptable. For instance, prior to 1969, the U.S. Army disposed of chemical weapons by open-pit burning, evaporative "atmospheric dilution," burial, and placement of munitions in concrete coffins for ocean dumping. In the 1970s, the U.S. Army began using alkaline hydrolysis to deactivate mustard agents known as H and HD (Figure 2).

Because of problems with GB alkaline hydrolysis, U.S. Army officials in 1982 adopted incineration for destroying all classes of chemical weapons. Subsequently, a full-scale CW incinerator facility was built in the Marshall Islands on Johnson Atoll and, more recently, a similar incinerator was built and brought into operation in Utah. Strong and effective opposition to incineration has, however, stalled U.S. Army plans to operate incinerators at seven other U.S. CW stockpiles. Similarly, strong opposition has stalled CW incineration projects in the independent republics of the former Soviet Union.

Historically, chemists and engineers who were involved in developing CW agents also were the specialists who studied how to dispose of these agents. However, in the late 1980s, the U.S. Army began a small intramural program on biodegradation at their Edgewood Research, Development and Engineering Center (ERDEC) in Aberdeen, MD. From 1991–1996, this program was broadened to support extramural research at several universities, including Texas A&M University, Rutgers University, and the University of Washington. In Russia, civilian research groups at Moscow State University, the Pushchino Biological Research Center, and several other government institutes have also been working on disposal strategies for agents in their stockpile.

These biodegradative research efforts are showing progress, particularly with efforts to dispose safely of both nerve and blister agents. Indeed, faced with strong political pressure to avoid incinerating such agents, U.S. Army officials recently changed CW destruction plans at one stockpile site, formally assigning biodegradation a role in treating HD stored in bulk containers.

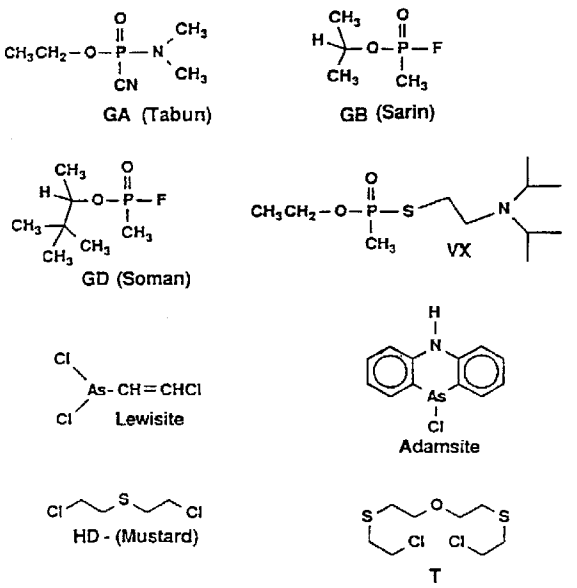

Figure 2. Chemical structures of the primary chemical warfare agents present in the U.S. and Russian stockpiles.

Table 1. Bacterial strains with hydrolytic activities against CW nerve agents

		Hydrolytic activity [kcat (sec^{-1})] against:				
Source Organism	**Enzyme**	**GA**	**GB**	**GD**	**DFP[a]**	**VX**
Pseudomonas diminuta	OPH	ND[b]	56	5	465	0.3
Alteromonas sp. JD6.5	OPAA-2	94	611	3 145	1 650	0
Alteromonas haloplanktis	ND[b]	111	257	1 389	575	0
Alteromonas undina	ND[c]	300	376	2 496	1 239	0

[a] DFP, diisopropyl fluorophosphate. A less toxic analog of the organophosphonate agents.
[b] ND, not determined.
[c] The responsible hydrolytic enzyme in this strain has not been purified.

Several Approaches to Biodegrading Nerve Agents

The organophosphorus (OP) "nerve gases" include VX, GA (tabun), GB (sarin), and GD (soman), all of which are liquid with varied volatility at room temperature (Figure 2). The blistering agents are oily liquids at room temperature and include the "mustard" agents H, HD (agent H that has been purified by distillation), and HT (a 60/40 mixture of HD and agent T), as well as the organo-arsenical agent lewisite (L). Adamsite (DA), a second organo-arsenical agent, is a severe respiratory irritant. Mixtures of the mustard and arsenical agents were also produced, such as agent MLM (mustard–lewisite mixture, a 37/63 mixture of agents HD and L).

In the 1980s, investigators began to search for microorganisms that could metabolize CW agents or structurally related compounds. In the search for microorganisms to act on nerve agents, researchers focused on microbial isolates capable of hydrolyzing OP insecticides. Among a range of microbially derived OP insecticide hydrolyzing enzymes, only the enzyme OPH from *Pseudomonas diminuta* is at all active in degrading nerve agents (Table 1).

Recently, James Wild and his colleagues at Texas A&M University modified the cloned gene for OPH, changing the enzyme's catalytic specificity and increasing its ability to degrade two organophosphonate nerve agents. Thus, following site-directed mutagenesis, cells displayed a 4-fold increase in activity against VX and a 40-fold increase in activity against soman.

Collaborating researchers in other laboratories at Texas A&M University, the U.S. Army ERDEC, the University of Wisconsin, and the University of Pittsburgh are helping to define the catalytic and structural capabilities of the native and modified forms of OPH. For example, in 1994, Hazel Holden and her colleagues at the University of Wisconsin determined a crystal structure for this protein, which can be downloaded from the Brookhaven Protein Data Base on the World Wide Web at http://pdb.pdb.bnl.gov/ (PDB code 1PTA).

Other Microorganisms with CW Hydrolytic Enzymes Identified

In 1989, reasoning that microbial enzymes used in decontamination may need to be resistant to high salt concentrations, Joe DeFrank at the U.S. Army's ERDEC screened isolates from a hypersaline spring in Utah for CW agent hydrolytic activities. Among those isolates, he and his colleagues found several related *Alteromonas* isolates that efficiently hydrolyze nerve agents such as GB, GD, and GF (Table 1).

Subsequently, DeFrank and his colleagues Steve Harvey and Tu-chen Cheng at ERDEC characterized two related enzymes from these *Alteromonas* strains and isolated the gene (*opaA*) that encodes one of these enzymes (termed OPAA-2). The DNA sequence of *opaA* shares a 28% amino acid homology to *Escherichia coli* aminopeptidase P and human prolidase. Moreover, OPAA-2 is highly active in hydrolyzing two dipeptide substrates of prolidase, namely Leu-Pro and Ala-Pro, but is not active against tripeptide substrates of aminopeptidase P or the dipeptides Pro-Leu or Pro-Gly. Such evidence suggests that OPAA-2 is a prolidase having a role in peptide metabolism.

Although no further screening efforts have been undertaken, a more comprehensive screening of microbial dipeptidase activities from different sources may yield entirely new enzymes with higher activities or activities toward other nerve agents such as GA and VX.

Strategies for Degrading Bulk Agents

The Chemical Weapons Convention specifies not only that CW agents be destroyed irreversibly but also that particular by-products be destroyed to ensure that they cannot be reused for military purposes. The by-products also need to be rendered safe for discharge into open environments. Hence, the members of several research groups are studying whether biodegradation will serve to destroy the by-products remaining following either chemical or enzymatic hydrolysis of CW agents. This research has yielded promising results for treating both nerve and mustard agents.

For example, Robin Autenrieth and her collaborators from Texas A&M University and the U.S. Army's ERDEC are studying the steps required to generate an environmentally acceptable waste stream following hydrolysis of sarin. She proposes hydrolyzing sarin with an excess of sodium hydroxide, a process that yields a solution containing sodium isopropyl methylphosphonate

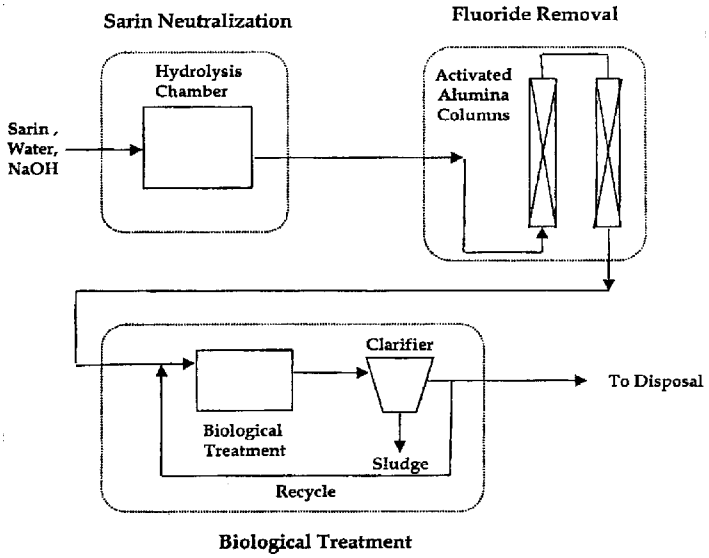

Figure 3. Schematic of a proposed strategy for the treatment of sarin from bulk containers. In this process, sarin is chemically hydrolyzed using excess sodium hydroxide, fluoride is removed by absorption to alumina columns, and the resulting effluent is treated in bioreactors. (Figure courtesy of Robin Autenrieth, Texas A&M University)

(IMPA) and sodium fluoride, both of which must be processed before discharge (Figure 3).

Although attempts to use IMPA as a carbon source to support microbial growth were not successful, IMPA is metabolized as a sole source of phosphorus in bioreactors. In batch experiments where sarin hydrolysate is supplied to microorganisms growing in bioreactors, IMPA levels decrease from 85 mg/liter to their detection limit of 1 mg/liter within 60–75 hours, depending on the microbial consortia in use. However, the consortia require a six-week acclimation period, are inhibited by high levels of the sarin hydrolysate or other sources of phosphate, and require significant amounts of carbon and nitrogen to achieve the required C:N:P ratio of 100:12:1.

The structurally similar nerve agent soman can be treated by comparable hydrolytic and biodegradation steps. However, to reduce the acclimation periods and to raise growth rates when suspended cultures are supplied with soman hydrolysate, Evgenia Rainina at Texas A&M University tested whether immobilized microbial cells metabolize propylmethylphosphonic acid (PMPA) (the primary product of soman hydrolysis) as a sole phosphorus source.

For such experiments, a PMPA-degrading strain from the ERDEC collection is first grown to a high density in rich medium, immobilized within a poly(vinyl) alcohol cryogel, and incubated in phosphate-limited media for 24 hours to reduce endogenous phosphorus pools. In successive batch experiments using immobilized cells, PMPA levels decrease from 164 mg/liter to the detection limit of 1 mg/liter within 60 hours. These results demonstrate the potential utility of the cell immobilization technique for maintaining high enzymatic activities.

Applied separately, water or hydrogen peroxide can effectively hydrolyze another organophosphonate agent, VX, providing a promising first step along the path to degrading this compound. Whether water or hydrogen peroxide is used, ethylmethylphosphonic acid (EMPA) is a by-product that needs to be further degraded. It, too, can serve as a sole phosphorus source for natural microbial consortia in bioreactors.

However, the use of VX, soman, or sarin hydrolysates as phosphorus sources requires the addition of excess nitrogen and carbon, and is rate-limiting. Introducing cells containing constitutive C-P lyase activities into these consortia might accelerate the overall degradative process and thereby reduce the need for adding large amounts of nitrogen and carbon.

Biodegrading the Blistering Agents HD and HT

The poorly soluble blistering agent HD reacts with microbial proteins and is therefore highly toxic to microbial cells, making it a poor candidate for direct biodegradation. Alkaline hydrolysis of HD yields significant amounts of polymerized by-products that also are difficult to biodegrade, according to Yu-Chu Yang and colleagues at the U.S. Army's ERDEC. However, Steve Harvey and his colleagues at ERDEC recently determined that water at 90 °C effectively hydrolyzes HD, yielding 90–95% thiodiglycol (TDG), which is nontoxic and miscible in water.

Because the CWC mandates destruction of TDG, Harvey has been testing an aerobic sequencing batch reactor for its ability to biodegrade hydrolyzed HD products. Using activated municipal sludge as an inoculum and HD hydrolysate as a sole carbon source, this batch process yields a nontoxic effluent. Meanwhile, a cryoimmobilized culture of *Alcaligenes xylosoxidans* from ERDEC metabolizes 150 mM TDG within 24 hours and retains 100% of its initial activity after 4 months of continuous use, according to Evgenia Rainina.

Although the two-step strategy of hydrolysis followed by biodegradation readily applies to bulk containers of HD (purified mustard) and HT, its applicability to stockpiled U.S. munitions containing HD or agent H (unpurified mustard) is less certain. The stockpiles of other nations include the less expensive agent H rather than agent HD. Depending on how those materials were manufactured, agent H typically contains

about 30% impurities and may also contain an array of thickeners and other additives. In many cases, during the decades of storage these materials have reacted with one another and with metal casing materials, forming solid or semisolid polymers that are recalcitrant to degradation.

Strategies for Degrading Organo-arsenical Blistering Agents

Although substantial progress has been made toward biodegrading other CW agents, treating the arsenic-containing agents such as adamsite, lewisite, and mustard–lewisite mixtures is problematic because arsenic is toxic. To overcome this problem, Alexander Boronin and his colleagues at the Institute of Biochemistry and Physiology of Microorganisms in Pushchino, Russia developed a three-stage, laboratory-scale process for destroying arsenic-containing CW agents.

For example, their process for treating lewisite entails initial hydrolysis to form 2-chlorovinyl arsine oxide (CAO). Because the remaining high arsenic inhibits further biodegradation, they treat the mixture by electrolysis and electrocoagulation (EC), yielding formate, acetate, and arsenous and arsenic acids; subsequently, during the EC step, arsenic precipitates from solution, reducing its concentration by four orders of magnitude. The remaining organic acids are mineralized in a fluidized bed reactor using a natural consortium of microorganisms immobilized on activated carbon. A similar approach is also effective in destroying mustard–lewisite mixture (MLM) and adamsite, according to Boronin.

Destroying the arsenic-containing CW agents in the Russian stockpile will generate thousands of tons of arsenic. Although this material might prove useful in the microelectronics, optics, and solar power industries, safe storage facilities are needed. Victor Petrov and coworkers at the Russian Institute of Applied Mechanics suggest that converting free arsenic into arsenic sulfide provides a means for safely storing this bulk material.

Unanswered CW Degradation Questions Require Further Research

Despite the progress in developing procedures for destroying CW agents, significant gaps in our knowledge of these compounds limit development of alternative technologies and slow progress on destroying them, according to Joseph Bunnett, an organic chemist at the University of California at Santa Cruz, who has served on a variety of international scientific panels examining CW agent destruction. For example, in 1982, officials in the U.S. Army identified incineration as the best technology to use for this purpose, he points out. Yet, 16 years later, complete reliance on this incineration-based "chemical demilitarization" program has resulted in little destruction of agents and remains stymied because of strong political opposition to incineration.

Citizen opposition to incineration stems in part from a widely held belief that small amounts of intact chemical warfare (CW) agents will be released to accumulate as a "toxic load" in the environment. However, although traces of CW agents released into the atmosphere are likely to be rapidly destroyed by photolysis, hydrolysis, and oxidation, little if any research has been done to document the atmospheric half-lives of most CW agents, according to Bunnett.

Several major CW munitions stockpiles need to be destroyed: the Russian stockpile, most of the U.S. stockpile, the Japanese CW munitions abandoned in China in 1945, and the German munitions that were dumped into the Baltic Sea. Although biodegradation could play a role in destroying these chemical agents, both fundamental and practical questions need to be addressed before even successful laboratory-scale degradative processes can be taken into field-scale use. Yet, unless the pace of research accelerates to meet the deadlines specified by the Chemical Weapons Convention, current gaps in knowledge will sharply limit any use of this promising technology.

Two critical questions need to be addressed soon. One is how well laboratory-scale procedures will perform under field conditions, particularly in settings where partly degraded materials contain a mix of chemical contaminants, as well as an ill-defined range of indigenous microorganisms. Researchers, who typically have tested their processes only on highly purified starting materials, will need access to CW agents from munition stockpiles to see if biodegradative processes will work on complex mixtures.

A second, more fundamental question to address is whether new microbial consortia can be selected or developed that are better suited for carrying out biodegradation of CW agents. One research approach will be to conduct a comprehensive screening of organisms from anaerobic sites or from highly acidic, hypersaline, or metal-contaminated aerobic environments.

In conducting this research, it is crucial that international collaborative efforts be continued and expanded. Although individual nations naturally have a domestic focus when deciding on national research priorities, chemical weapons are an international legacy, and their inappropriate disposal by any nation may have long-lasting consequences. By sharing ideas and resources, the international community stands the best chance of developing and implementing appropriate technology worldwide to prevent further contamination by these dangerous compounds.

Acknowledgments

The IUPAC Ad Hoc Committee on Chemical Weapons Destruction Technologies sponsored this review. We

gratefully acknowledge NATO for funding Russian-–American linkage grants and for funding the Advanced Research Workshop on Chemical and Biological Technologies for the Detection, Destruction, and Decontamination of Chemical Warfare Agents (12–15 May 1996, Russia). We thank Dr. Steve Harvey for his careful reading of the manuscript and Dr. Joe DeFrank for his suggestions and for calculating the values shown in Table 1.

Suggested Reading

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News and Notices from Other Societies and Unions

AOAC International Hires New Executive Director

AOAC's Board of Directors has selected E. James Bradford as AOAC International's new Executive Director. He assumed his responsibilities on 6 July 1999.

Dr. Bradford brings to AOAC International a combination of association management, academic, and chemistry experience. Dr. Bradford is former Director of Science, Mathematics, and Technology Education Programs at the American Association for the Advancement of Science (AAAS) in Washington, DC, USA. Prior to that, he was employed for nearly 15 years at the American Chemical Society (ACS) in Washington, DC, USA.

At AAAS, Dr. Bradford directed six science, mathematics, and technology education programs; an NSF-sponsored core competencies project; science books and films; and senior scientists and engineers.

At the ACS, he served as the administrator for Grants and Awards of the Membership Division in 1998 and as assistant director of the Membership Division from 1995 to 1997. Over the years, he was also the ACS special assistant to the executive director, program manager of National Chemistry Week, and manager of the Office of College Chemistry. He established National Chemistry Week as an annual event involving more than 1 000 volunteers reaching out to the public, and he has even appeared on Nickelodeon with Linda Ellerbee in an antismoking program for kids.

As the ACS administrator for Grants and Awards of the Membership Division, he directed a staff of 20 and a budget of USD 20 million to administer 62 national awards in the chemical sciences and a USD 16.3 mil-

lion grants program. He also served as staff liaison for the Board Committee on Grants and Awards, and for the Joint Board-Council Committee on Science.

Before his ACS experience, Dr. Bradford was a member of the adjunct chemistry faculty at Northern Virginia Community College, a lecturer in engineering chemistry and organic chemistry at the University of Missouri, and division chair and chemistry teacher at Lincoln Trail College in Robinson, Illinois, USA.

A 1975 graduate of Wichita State University, Wichita, Kansas, USA, Dr. Bradford also holds an M.S. degree in environmental chemistry from Western Illinois University, USA, and a Ph.D. degree from the University of Missouri-Columbia, USA, in higher and adult chemistry education with concentration in the support areas of descriptive inorganic chemistry, research design statistics, administration, and educational psychology. His professional affiliations include the American Chemical Society, the Greater Washington Society of Association Executives, the American Association for the Advancement of Science, the Nature Conservancy, the International Congress of Distinguished Awards (for which he recently served on the Board of Directors), and the Council of Engineering and Scientific Society Executives.

AOAC International is a professional scientific association whose primary purpose is to promote chemical and biological analytical methods validation and quality measurements in the analytical sciences. In addition to its method validation programs, AOAC International produces a variety of publications; conducts meetings, workshops, training courses, and topical conferences; and offers technical divisions, local sections, and membership.

New Books and Publications

New Book from IUPAC

***Chemistry for the Energy Future.* Chemistry for the 21st Century Monograph. Edited by V. N. Parmon, H. Tributsch, A. V. Bridgwater, and D. O. Hall. Blackwell Science (1999), pp. xi + 1–236. ISBN 0-632-05269-4, USD 75.**

Contents

Introduction and Statement of the Problem; Strategies for Sustainable Energy Production: Chemist's Approaches; Role of Chemistry in Improving Traditional Energetics via New Combustion Technologies and Chemical Heat Recuperation Techniques; Role of Chemistry in Improving Environmental Safety and Pollution Control of Traditional Energetics; Challenge of Hydrogen as an Energy Carrier of the Future; Integrating Chemical Energy Carriers (other than Hydrogen) for the Future; Production of Traditional Carbon-Containing Energy Carriers from Alternative Nonrenewable Raw Materials (other than Oil, Natural Gas, or Coal); Electrical Energy Carriers, Chemical Technologies, and Electricity; A Future Renewable Carbon Feedstock for Energy; Biological Conversion of Biomass to High Quality Chemical Carriers; Thermal Biomass Conversion Technologies for Energy Carriers Production; Thermochemical Energy Conversion; Quantum Chemical Processes for the Conversion of Energy; General Conclusions

IUPAC conceived the Chemistry for the 21st Century series to bring to the attention of a wide audience the role that chemistry will play in the future development of society and the preservation of our environment. This imaginative series has therefore set out to produce volumes that contain essays on topics within chemistry written by experts, with the nonexpert but interested individual as the largest readership. The interested individuals may comprise those who wish to study chemistry, make use of it, or enter into research on the subject.

The writing of this book was initiated by Professor Kirill Zamaraev, the President of IUPAC from 1993 to 1995. The main idea of this project was to demonstrate to the community of chemists how important chemical science will be in solving one of the most important problems of society, which is to provide inexhaustible and sustainable sources of energy. The book has been written by an international team comprising Professors V. N. Parmon (Russia), H. Tributsch (Germany), A. V. Bridgwater (UK), and D. O. Hall (UK), who represent different fields of chemistry and chemical technologies.

The book is not exhaustive and does not hope to encompass or discuss every possible contribution of chemistry and chemical technology to the energy problems of the future. However, the authors hope that the book is able to cover the most important directions of these contributions and that it will be of interest not only for chemists, but also for a wider spectrum of society who are concerned about the future of civilization.

The book was written as part of an IUPAC-sponsored pool project entitled, "Alternative scenarios for energy production in the future", and the authors express their cordial thanks to those in IUPAC for their continuous support, especially to the former Executive

Secretary of IUPAC, Dr. M. Williams, who retired in 1997.

V. N. Parmon, Boreskov Institute of Catalysis, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

H. Tributsch, Freie Universitat Berlin and Hahn-Meitner Institut, Dept. Solare Energetik, Berlin, Germany

A. V. Bridgwater, Bio-Energy Research Group, Chemical Engineering, Aston University, Birmingham, England, UK

D. O. Hall, Life Sciences Division, King's College, London, England, UK

New Publications from the World Health Organization

Methyl tertiary-*Butyl Ether*, Environmental Health Criteria No. 206

1998, xix + 199 pages (English with summaries in French and Spanish), ISBN 92 4 157206 X, CHF 42.-/ USD 37.80; In developing countries: CHF 29.40, Order no. 1160206. WHO Distribution and Sales, CH-1211 Geneva 27, Switzerland; E-mail: Publications@who.ch; Tel.: +41 22 791 24 76; Fax: +41 22 791 48 57.

This book evaluates the risks to human health and the environment posed by exposure to methyl *tertiary*-butyl ether (MTBE). Used almost exclusively as a fuel additive, MTBE is blended with gasoline to provide both octane enhancement and an increase in oxygen content. MTBE currently numbers among the 50 chemicals produced in the highest volume worldwide. Production and use are expected to increase, particularly in countries where oxygenated or reformulated gasoline is required in national programs aimed at reducing ambient air levels of carbon monoxide and ozone or benzene and other volatile hydrocarbons.

A summary of sources of human and environmental exposure is followed by an assessment of what is known about the chemical's environmental behavior and fate. Studies demonstrate that, after discharge into air, MTBE largely remains in the air, with smaller amounts entering soil and water. Although atmospheric MTBE can partition into rain, data indicate that atmospheric formation by hydroxyl radicals is a more important pathway of removal.

Concerning environmental levels and human exposure, evaporative emissions from oxygenated gasoline are identified as the main source of exposure for the general population. Widespread exposure via inhalation is noted to occur during time spent at service stations, while driving cars, in public parking garages, and in homes with attached garages. The report also cites data on exposure levels obtained in numerous studies of urban air, in facilities where MTBE is manufactured or blended, and in such occupational settings as service stations, garages, and the transportation of neat MTBE and fuel mixtures through pipelines, barges, railroad cars, and trucks.

A review of the kinetics and metabolism of MTBE draws on toxicokinetic data derived from controlled studies in healthy adult volunteers and in occupationally exposed workers. Data indicate that MTBE is rapidly absorbed into the circulation following inhalation. In rodents, the compound is likewise rapidly absorbed and distributed following exposure by both inhalation and oral routes.

From studies in laboratory animals, the report identifies the principal signs of intoxication as depression of the central nervous system, ataxia, and labored respiration. Most effects on the central nervous system are transient. From the few studies available, the report concludes that MTBE is moderately irritating to the skin and eyes and induces slight to severe respiratory irritation. Repeated exposure results primarily in increases in organ weights and histopathological effects in the kidneys of rats and the liver of mice. The report found no evidence of adverse effects on reproduction, genotoxicity, or mutagenicity. Although limited carcinogenicity studies showed significant increases in tumor incidence, the report judged these findings inconclusive and thus inadequate to support an assessment of carcinogenic risk in humans.

An evaluation of health effects in humans gives major attention to several recent "outbreaks" of health complaints in the United States that occurred shortly after the introduction of MTBE-blended gasoline. Symptoms most widely reported by consumers include headache, eye and nose irritation, cough, nausea, dizziness, and disorientation. The report also draws on findings from epidemiological studies of occupationally exposed workers and from experimental studies of volunteers exposed in inhalation chambers. Based on this evaluation, the report concludes that MTBE alone, under common conditions of inhalation exposure, is not likely to induce acute adverse health effects in the general population. In making this conclusion, the report also notes that the potential effects of mixtures of gasoline and MTBE, as well as the manner in which most people are exposed to MTBE via oxygenated fuels, have not been examined experimentally or in prospective epidemiological studies.

Acetone, Environmental Health Criteria No. 207

1998, xviii + 159 pages (English with summaries in French and Spanish), ISBN 92 4 157207 8, CHF 36.-/USD 32.40; In developing countries: CHF 25.20, Order no. 1160207.

This book evaluates the risks to human health and the environment posed by exposure to acetone. Acetone is widely used as an intermediate in chemical production and as a solvent for resins, paints, inks, varnishes and lacquers, and in adhesives, thinners, and cleanup products. Pharmaceutical applications include use as an intermediate and solvent for drugs, vitamins, and cosmetics. Acetone is also used in food processing as an extraction solvent for oils and fats and as a precipitation agent in the purification of starches and sugars.

A discussion of sources of human and environmental exposure covers both natural and anthropogenic sources. In the mammalian body, studies show that acetone is formed endogenously from fatty acid oxidation, is found as a natural metabolic component in blood, urine, and human breath, and is exhaled. Acetone has been detected in a variety of plants and foods and is emitted, in vapor form, from several tree species. Acetone also occurs naturally as a biodegradation product of sewage, solid wastes, and alcohols, and as an oxidation product of humic substances. Concerning man-made sources of emissions, the report identifies the most important sources in wastewater discharges from many industries, leaching from industrial and municipal landfills, and evaporation of acetone solvent from coating products such as paints, cleaners, varnishes, and inks. Acetone may also be emitted from the combustion of wood and in exhaust from automobile, diesel, and turbine engines.

A review of data on environmental behavior and fate cites evidence from several studies of acetone levels detected in air, water, soil, and biological analyses. Studies indicate that atmospheric acetone is degraded by a combination of photolyis and reaction with hydroxyl radicals. Acetone is readily biodegradable in soil and water. A discussion of kinetics and metabolism draws on extensive data from absorption and tissue distribution studies, radiolabeled metabolic and kinetic studies, and studies of elimination and excretion. Abundant evidence shows that acetone is rapidly absorbed via the respiratory and gastrointestinal tracts and mainly distributed to non-adipose tissues. Under normal circumstances, metabolism is the predominant route of elimination. Studies in humans confirm the importance of such variables as diet, exercise, and alcohol consumption as factors affecting kinetics.

A review of toxicity studies in laboratory mammals and *in vitro* test systems concludes that acetone is only mildly toxic to the liver, unless physiological processes are compromised, as in diabetes mellitus. Some adverse effects on development and reproductive function have been reported. One of the major adverse effects identified is acetone's ability to potentiate the toxicity of other chemicals. Extensive studies on the mechanisms of toxic action help elucidate the possible mechanisms by which acetone enhances the neurotoxicity of ethanol.

A section on health effects in humans evaluates findings from numerous case reports of accidental or intentional poisoning, studies conducted in healthy volunteers, and studies of occupationally exposed workers. The most commonly reported effects include irritation to the nose, eyes, throat, and trachea. Studies also show that acetone can produce neurobehavioral and other changes, including headache, dizziness, confusion and, at high vapor concentrations, central nervous system depression and narcosis. The report found no evidence that acetone is either a skin or a respiratory tract sensitizer. Human studies confirm the ability of acetone to potentiate, and in some instances antagonize, the toxic effects of other chemicals. Those at greatest risk include diabetics, alcoholics, and those undergoing prolonged fasting. The report found no evidence that acetone is genotoxic or carcinogenic.

Concerning effects on the environment, the report concludes that acetone, even in the case of accidental spills, is unlikely to have a major or lasting adverse effect on the ecosystem.

WHO Monographs on Selected Medicinal Plants, Volume 1

1999, v + 289 pages (available in English; French in preparation), ISBN 92 4 154517 8, CHF 92.-/USD 82.80; In developing countries: CHF 64.40, Order no. 1150460.

This book provides a collection of 28 monographs covering the quality control and traditional and clinical uses of selected medicinal plants. Plants were selected for inclusion on the basis of their widespread use, particularly in countries that rely heavily on medicinal plants to meet primary health care needs. Monographs are provided for a number of medicines traditionally used to treat such common complaints as diarrhea, constipation, headache, appetite loss, sleep disorders, fatigue, and mild respiratory, gastrointestinal, and skin disorders. Additional medical applications assessed range from the lipid-lowering potential of garlic powder preparations, through the possible antiplasmodial activity of Fructus Bruceae, to the role of curcumin in promoting peptic ulcer healing and reducing the associated abdominal pain.

In preparing and publishing these monographs, WHO aims to encourage standardized scientific approaches to ensuring the safety, quality, and efficacy of medicinal plants and their products. The monographs are also intended to promote international harmoniza-

tion in the quality control and use of herbal medicines and to serve as models for the development of national formularies. Draft monographs were finalized following review by over 100 experts in 40 countries. Some 1 400 references to the literature are included.

Each monograph follows a standard format, with information presented in two parts. The first gives pharmacopoeial summaries for quality assurance, botanical features, distribution, identity tests, purity requirements, chemical assays, and active or major chemical constituents. A section on definition provides the Latin binomial pharmacopoeial name, the most important criterion in quality assurance. Latin pharmacopoeial synonyms and vernacular names, listed in the section on synonyms and selected vernacular names, are those names used in commerce or by local consumers.

The second part of each monograph begins with a list of dosage forms and of medicinal uses categorized as uses supported by clinical data, uses described in pharmacopoeias and in traditional systems of medicine, and uses described in folk medicine, but not yet supported by experimental or clinical data. Each monograph also includes an extensive review of available data on experimental and clinical pharmacology, followed by information on contraindications, such as sensitivity or allergy, warnings or precautions (particularly in such special groups as pregnant and breast-feeding women), adverse reactions, and dosage. A list of references concludes the monograph.

Additional medicinal plants will be covered in a second volume, which is currently undergoing review.

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 center to request a copy of the full report. Copies are not available from the IUPAC Secretariat. The most recent list of national/regional centers appeared in Chemistry International 1997, 17, 141. This information is also available on the IUPAC web site: http://www.iupac.org/.

Analytical Chemistry Division. Commission on Analytical Nomenclature—Nomenclature for X-Ray Emission Spectrochemical Analysis

This draft document contains the nomenclature and practices of X-ray spectrochemical analysis, which is practically carried out by X-ray emission spectroscopy (XES), especially by the X-ray fluorescence method. Quantitative analysis by XES has excellent repeatability. Reproducibility and accuracy of XES, however, depend strongly on specimen preparation and data analysis. Some 60 terms together with definitions are contained herein. These terms are followed by condensed descriptions of the conditions that should be observed in order to realize feasible analytical performance.

General comments refer to similarity and difference of terms used in X-ray analysis and in other optical methods. Terms related to material examined describe specimen preparation-related matters. Terms related to X-ray generation deal with the mechanism of X-ray generation and X-ray sources. These also refer to X-ray attenuation, which is important in quantitative analysis. Terms related to X-ray measurement cover spectrometer and detector systems. Terms related to X-ray data interpretation concern statistical description of X-ray intensity measurement and various quantification methods. The analytical function method and the fundamental parameter method, both widely used, are described in a concise manner referring to an ASTM standard. This document is a revision of a part of spectrochemical analysis in the Orange Book (*Nomenclature System for X-Ray Spectroscopy*, IUPAC Recommendations 1991).

Comments by 30 April 2000 to Prof. Yohichi Gohshi, Deputy Director General, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba 305-0053, Japan. Tel.: +81-298-50-2301; Fax: +81-298-51-2854; E-mail: gohshi@nies.go.jp.

Macromolecular Division. Commission on Macromolecular Nomenclature—Nomenclature of Regular Single-Strand Organic Macromolecules

A structure-based nomenclature for regular single-strand organic polymers is described. In concept, a generic name for the polymer $(ABC)_n$ is poly(ABC), in which (ABC) is a constitutional repeating unit (CRU) representing the chemical structure of the polymer chain, and A, B, and C are the subunits that comprise

the CRU. To provide a unique and unambiguous name, rules are given to identify the preferred CRU and to name it using the names of A, B, and C based on current organic nomenclature. Provisions are made for naming end groups of the polymers and the polymer substituents. In addition, the document contains a glossary of concepts and definitions, a list of common subunit names, and a variety of examples of structure-based polymer names. The document is a revision of the 1975 Rules.

Comments by 30 April 2000 to Dr. Jaroslav Kahovec, Ústav makromolekulární chemie, Akademie ved Ceské republiky, Heyrovského námestí 2, CZ-162 06 Praha 6, Czech Republic. Tel.: +420-2-360-341; Fax: +420-2-367-981; E-mail: kah@imc.cas.cz.

Awards and Prizes

IUPAC Prize for Young Chemists

The IUPAC Prize for Young Chemists has been established to encourage outstanding young research scientists at the beginning of their careers. The prize will be given for the most outstanding Ph.D. thesis in the general area of the chemical sciences, as described in a 1 000-word essay.

IUPAC will award up to four prizes annually. Each prize will consist of USD 1 000 cash and travel expenses to the next IUPAC Congress. In keeping with IUPAC's status as a global organization, efforts will be made to assure fair geographic distribution of prizes.

Prizes will be presented biennially at the IUPAC Congress (next Congress: 1–6 July 2001, Brisbane, Australia). Each awardee will be invited to present a talk on his/her research and to participate in a plenary award session.

Applications must be submitted, as described below, to the IUPAC Secretariat. In addition, some IUPAC National Adhering Organizations are soliciting applications in their own countries, frequently in conjunction with a national award. In such cases, applications may be submitted to the NAO or to the Secretariat (not both). A list of participating countries is given on the IUPAC web site**,** www.iupac.org/news/prize.html.

Applications will be judged by a committee of eminent scientists appointed by the President of IUPAC.

Procedures for the 2000 Prize

a. Entrants must have received their Ph.D. (or equivalent) degree, or completed all Ph.D. requirements including successful defense of the doctoral thesis, during calendar 1999 in any of the 60 countries that are Members or Associate Members of IUPAC. Entrants need not be citizens or residents of one of these countries at the time the application is submitted.

b. The research described in the entrant's thesis must be in the field of the chemical sciences, defined as "chemistry and those disciplines and technologies that make significant use of chemistry."

c. The IUPAC Prize recognizes only work that was performed while the entrant was a graduate student.

d. Application requires submission of a completed entry form (available on the IUPAC web site at http://www.iupac.org/news/prize.html*)*, together with the material listed in items *e* and *f*. The entry form and supporting material should be submitted by e-mail whenever feasible. Additional material may be sent as needed by fax or mail.

e. An essay must be submitted by the entrant that describes his or her thesis work and places it in perspective relative to current research in the chemical sciences. The essay must be written in English by the entrant and may not exceed 1 000 words. (For applications submitted through NAOs, a national language may be permissible, and the NAO will assist in translation to English. The announcement by the appropriate NAO should be consulted.)

f. Two supporting letters (sent by e-mail if feasible) are required from the thesis adviser and/or chairman of the thesis committee and one additional faculty member. These letters should comment on the qualifications and accomplishments of the applicant and the significance of the thesis work.

g. Complete applications must be received at the IUPAC Secretariat by 1 April 2000. If submitted through an IUPAC National Adhering Organization or Associate NAO, the deadline established by the NAO must be met. Early submission is strongly encouraged so that any questions may be resolved before the deadline date.

Visit the IUPAC web site at http://www.iupac.org/news/prize.html for complete information and an application form.

IUPAC Secretariat Addresses:

E-mail: secretariat@iupac.org
Fax: 1 919 485 8706
Mail: P.O. Box 13757
Research Triangle Park, NC 27709-3757 USA

Deliveries: Building 19
104 T. W. Alexander Drive
Research Triangle Park, NC 27709 USA

Conference Announcements

'99 International Symposium and Exhibition on Cereals and Their Food Processing Technology and Equipment, 23–26 November 1999, Beijing, China

This meeting is being organized by the Chinese Cereals and Oils Association (CCOA), International Association for Cereal Science and Technology (ICC), Sino-Japanese Food Marketing Development Committee (SJFMDC), and Chinese Academy of Agricultural Sciences (CAAS). The symposium will focus on the latest developments in the application of special cereal foods, steamed and boiled food technology, and their processing machinery. Colleagues from all ICC Member Countries are invited to take part in this meeting.

For more information, contact Dr. H. Glattes, ICC Secretary General/CEO, P.O. Box 77, Wiener Str. 22a, A-2320 Schwechat, Austria, E-mail: gen.sec@icc.or.at; Tel.: +43 1 707 72 02; Fax: +43 1 707 72 04; Web site: http://www.icc.or.at/icc/.

Sewage Treatment Strategies for Coastal Areas and Small Communities, 6–7 December 1999, Edinburgh, Scotland, UK

This meeting is being sponsored by Aqua Enviro Technology Transfer in conjunction with The Chartered Institution of Water and Environmental Management (CIWEM).

For additional information, contact Ms. Zena Hickinson, E-mail: z.hickinson@leeds.ac.uk; Tel.: +44 113 2332308; Fax: +44 113 2332243.

17th Process Development Symposium, 13–15 December 1999, Cambridge, England, UK

For further details, contact, D. A. Jackson, Fine Chemicals Group, Society of Chemical Industry (SCI), Tel.: +44 1484 433992; Fax: +44 1484 433227.

Natural Products as a Source of Crops Protection, 14–15 December 1999, London, England, UK

For some considerable time, natural products have been a source of new chemistry that can be used as products directly or as the basis of new synthesis programs from which new chemicals can be developed. This meeting addresses the successes of natural product research, including chemicals, living systems, and genes, and examines how developing technology can make new discovery more effective.

For further information, contact Dr. L. G. Copping, Crop Protection Group, Society of Chemical Industry (SCI), Belgrave Square, London, England, UK, Tel./Fax: +44 1799 521369 or SCI (Crop Protection Group), SCI Conference Secretariat, E-mail: conferences@chemind.demon.co.uk; Tel.: +44 171 235 3681; Fax: +44 171 235 7743.

AITA/ICC AISTEC International Conference on Training and Scientific Development for Cereal Industries: Programs of Schools, Institutes, and Universities in the World, 9 March 2000, Milan, Italy

This conference is being organized by the Associazione Italiana Technologia Alimentare (AITA); Associazione Italiana di Scienza e Tecnologia dei Cereali (AISTEC), the Italian member organization of the International Association for Cereal Science and Technology (ICC); and ICC.

For further information, contact, Prof. Dr. R. Cubadda, Distaam. Universitá del Molise, Via de Sanctis, I-86100 Campobasso, Italy, E-mail: cubadda@hpsrv.unimol.it; Tel.: +39 874 404 620; Fax: +39 874 404 652m or Dr. H. Glattes, ICC Secretary General/CEO, P.O. Box 77, Wiener Str. 22a, A-2320 Schwechat, Austria, E-mail: gen.sec@icc.or.at; Tel.: +43 1 707 72 02; Fax: +43 1 707 72 04; Web site: http://www.icc.or.at/icc/.

International Conference: Starch 2000, 27–29 March 2000, Cambridge, England, UK

This conference will be held at Churchill College in Cambridge, England, UK.

For further information, contact, Mrs. M. A. Staff, Cavendish Laboratory, Royal Society of Chemistry, Food Chemistry Group, E-mail: mas32@phy.cam.ac.uk; Tel.: +44 1223 337007; Fax: +44 1223 337000.

3rd European Congress on Food Freezing: Quality, Nutrition, and Safety, 30–31 March 2000, Montpellier, France

This meeting will address the state of the art in technological and scientific developments in frozen foods as well as environmental, consumer, and market concerns.

For further information, contact IFAB Communications, Department of Biology, University of York, P.O. Box 373, York YO10 5YW, England, UK, E-mail: biocomms@york.ac.uk; Tel.: +44 1904 432940; Fax: +44 1904 433029.

CIWEM and Aqua Enviro Technology Transfer—Joint Millennium Conference: Wastewater Treatment—Standards and Technologies to Meet the Challenges of the 21st Century, 4–7 April 2000, Leeds, England, UK

This conference will be held in the Queens Hotel in Leeds, England, UK.

For more information, contact Ms.Zena Hickinson, E-mail: z.hickinson@leeds.ac.uk; Tel.: +44 113 2332308; Fax: +44 113 2332243.

Joint ICC/AOAC International Conference on Dietary Fiber–2000: Processing, Milling, and Nutritional Effects, 14–17 May 2000, Dublin, Ireland

This joint ICC/AOAC International Conference will convene for the first time in Ireland and will be organized by Mrs. A. Kennedy, ICC National Delegate of Ireland, in cooperation with the ICC Secretariat General in Vienna, together with the cochairmen, Dr. L. Prosky (AOAC International) and Dr. B. V. McCleary (Megazyme International Ireland Ltd.).

The main aim of this conference will be to update the knowledge on definition, milling, processing, nutritional, and regulatory aspects of dietary fiber. Attendees will be invited to discuss state-of-the-art developments in these areas. There will be symposium talks with invited speakers and a poster session to cover broader aspects of subjects, as well as displays and demonstrations of the latest laboratory equipment.

For additional information, contact Conference Secretariat c/o A. Kennedy, Megazyme International (Ireland) Limited, Bray Business Park, Bray, Co. Wicklow, Ireland, Fax: +353 1 286 1264; Web site: http://www.megazyme.com or Dr. H. Glattes, ICC Secretary General/CEO, P.O. Box 77, Wiener Str. 22a, A-2320 Schwechat, Austria, E-mail: gen.sec@icc.or.at; Tel.: +43 1 707 72 02; Fax: +43 1 707 72 04; Web site: http://www.icc.or.at/icc/.

Meteorology at the Millennium, 10–14 July 2000, Cambridge, England, UK

This major international conference will be held at St. John's College, Cambridge University to celebrate both the new century and the 150th birthday of the Royal Meteorological Society. A particular aim will be to involve the new generation of younger scientists in the program.

Meteorology is now at the forefront of science. It has provided the stimulus for new developments in several areas. For example, the study of chaotic systems began with the problems of weather prediction. At the same time, advancing knowledge in other sciences has led to new and exciting changes in the atmospheric sciences. One example is the newly appreciated two-way interaction between living things and their environment, including climate.

No less important has been the advance of technology, which has given new tools and methods of analysis to the atmospheric sciences, and opened up new questions for scientific study. Developments in computing, space technology and radar have all played central roles in developing, and have themselves been advanced by, the modern science of meteorology. Included in the program will be invited talks on atmospheric chemistry, biogeochemical linkages between atmosphere and ocean, and modeling biological interactions.

The conference will explore these interactions, reflecting on the way in which modern meteorology is contributing to developments in other sciences and on the way in which atmospheric scientists are learning from their colleagues in other disciplines. Presentations will also reflect on the wider implications of these advances for society.

For additional information, contact The Executive Secretary, Royal Meteorological Society, 104 Oxford Road, Reading RG1 7LL, England, UK, E-mail: execsec@royal-met-soc.org.uk; Tel.: +44 118 956 8500; Fax: +44 118 956 8571.

11th International Cereal and Bread Congress, 8–15 September 2000, Surfers Paradise, Gold Coast, Queensland, Australia

The theme for this congress is "Cereal Health and Life—Technology for the New Millennium".

For more information, contact The Secretariat, 11th Cereal and Bread Congress, C/-AWB, P.O. Box 4562, Melbourne, Victoria 3001, Australia, E-mail: bracknell@awb.com.au, or visit the ICC home page at http://www.icc.or.at/icc/.

Conference Calendar

Visit http://www.iupac.org for complete information and further links.
NEW *designates a new conference since the last issue.*

1999

Toxicology

6–10 November 1999
4th Congress of Toxicology in Developing Countries, Antalya, Turkey.
Prof. Semra Sardas, Gazi University, Faculty of Pharmacy Toxicology Department, 06330, Hipodrom, Ankara, Turkey.
Tel.: +90 312 212 30 09
Fax: +90 312 222 23 26
E-mail: ek03-k@tr-net.net.tr

2000

Bio-Organic Chemistry

30 January–4 February 2000
5th IUPAC Symposium on Bio-Organic Chemistry (ISBOC-V), Pune, India.
Prof. S. Ranganathan, Discovery Laboratory, Indian Institute of Chemical Technology, Hyderabad 500 007, India.
Fax: +91 4 717 3757
E-mail: ranganathan@iict.ap.nic.in

High-Temperature Materials Chemistry

10–14 April 2000
10th International Conference on High-Temperature Materials Chemistry, Aachen, Germany.
Prof. Klaus Hilpert, Forschungszentrum Julich GmbH, Institut fur Werkstoffe der Energietechnik (IWE 1), 52425 Jülich, Germany.
Tel.: +49 2461 61 3280
Fax: +49 2461 61 3699
E-mail: k.hilpert@fz-juelich.de

Mycotoxins and Phycotoxins

21–25 May 2000
10th International IUPAC Symposium on Mycotoxins and Phycotoxins, Sao Paulo, Brazil.
Dr. Myrna Sabino, Instituto Adolfa Lutz, AV Dr. Arnaldo 355, Sao Paulo, Brazil, 01246-902.
Fax: +455 (11) 853 3505
E-mail: Myrna@Sti.COM.BR

Polymer-Based Technology

21–26 May 2000
9th International Conference on Polymer-Based Technology (POC'2000), Tianjin, China.
Prof. Zhang Zhengpu
Institute of Polymer Chemistry
Nankai University
94 Weijin Road
Tianjin 300071, China
Tel.: +86 22 2350 1386
Fax: +86 22 2350 4853
E-mail: zhangzp@sun.nankai.edu.cn

Flow Analysis

25–29 June 2000
8th International Conference on Flow Analysis, Warsaw, Poland.
Prof. Marek Trojanowicz, Department of Chemistry, University of Warsaw, Pasteura 1, 02-093 Warsaw, Poland.
Tel/Fax: +48 22 822 35 32
E-mail: trojan@chem.uw.edu.pl

Chemical Sensors

25–29 June 2000
EUROSENSORS XIV & International Meeting on Chemical Sensors VIII (ES-IMCS' 2000), St. Petersburg, Russia.
Prof. Yuri Vlasov, Chairman
Dr. Andrey Legin, Secretary
St. Petersburg University, Universitetskaya nab. 7/9, St. Petersburg, 199034, Russia.
Tel./Fax: +7 812 328 28 35
E-mail: andrew@sensor.chem.lgu.spb.su

Organic Synthesis

1–5 July 2000
13th International Conference on Organic Synthesis (ICOS-13), Warsaw, Poland.
Prof. M. Makosza, Institute of Organic Chemistry, Kasprzaka 44, 01-224 Warsaw 42, PO Box 58, Poland.
Tel.: +48 22 631 8788
Fax: +48 22 632 6681
E-mail: icho-s@ichf.edu.pl

Physical Organic Chemistry

8–13 July 2000 NEW
15th International Conference on Physical Organic Chemistry (ICPOC 15), Göteborg, Sweden.
Prof. P. Ahlberg, Organic Chemistry, Department of Chemistry, Göteborg University, SE-412 96, Göteborg, Sweden.
Tel.: +46 31 7722900
Fax: + 46 31 7723843
E-mail: Per.Ahlberg@oc.chalmers.se

Macromolecules

9–14 July 2000
38th International Symposium on Macromolecules (MACRO 2000), Warsaw/Lodz, Poland.
Prof. Stanislaw Penczek, Polish Academy of Sciences, ul. Sienkiewicza 112, 90363 Lodz, Poland.
Tel.: +48 42 81 9815
Fax: +48 42 684 7126
E-mail: spenczek@bilbo.cbmm.lodz.pl

Coordination Chemistry

9–14 July 2000
34th International Conference on Coordination Chemistry (34-ICCC), Edinburgh, Scotland.
Prof. P. Tasker, Chairman
Dr. John F. Gibson, Secretary
The Royal Society of Chemistry, Burlington House, London W1V OBN, UK.
Tel.: +44 171 440 3321
Fax: +44 171 734 1227
E-mail: gibsonj@rsc.org

Polymers in Medicine

17–20 July 2000
40th Microsymposium Polymers in Medicine, Prague, Czech Republic.
Dr. Jaromir Lukas, Institute of Macromolecular Chemistry, Academy of Science of the Czech Republic, Heyrovskeho nam. 2, 162 06 Praha 6, Czech Republic.
Tel.: +420 2360341
Fax: +420 2367981
E-mail: sympo@imc.cas.cz

Photochemistry

22–27 July 2000
18th IUPAC Symposium on Photochemistry, "Photochemistry into the New Century", Dresden, Germany.
Prof. Dr. Silvia E. Braslavsky, Max-Planck Institut fuer Strahlenchemie, Postfach 101365, D-45413 Muelheim an der Ruhr, Germany.
Tel: +49 (208) 306 3681
Fax: +49 (208) 306 3951
E-mail: braslavskys@mpi-muelheim.mpg.de

Organometallic Chemistry

23–28 July 2000 **NEW**
19th International Conference on Organometallic Chemistry (XIX ICOMC), Shangai, China.
Profs. Li Xin Dai and Chang Tao Qian, Chairmen, Prof. Xue Long Hou, Secretary, Shanghai Institute of Organic Chemistry, Chinese Academy of Sciences, 354 Fenglin Road, Shanghai 200032, PR, China,
Tel.: +86 21 641 63300
Fax: +86 21 641 66128
E-mail: xlhou@pub.sioc.ac.cn

Solubility Phenomena

25–28 July 2000
9th International Symposium on Solubility Phenomena (9th ISSP), Hammamet, Tunisia.
Prof. Najia Kbir-Ariguib, National Institute for Scientific and Technical Research, P.O. Box 95, Hammam-Lif, 2050 Tunisia.
Tel: +216 1 430 215
Fax: +216 1 430 934
E-mail: ariguib@planet.tn

Chemical Education

6–11 August 2000 **NEW**
16th International Conference on Chemical Education: Chemistry for a Healthier Planet (16 ICCE), Budapest, Hungary.
Prof. Alajos Kalman, Chairman, Prof. Gabor Naray-Szabo, Department of Theoretical Chemistry, Lorand Eotvos University, Pazmany Peter st. 1b, H-1117 Budapest, Hungary.
Tel.: +36 1 209 0555, ext. 16-30
Fax: +36 1 209 0602
E-mail: mail2.mke@mtesz.hu

Chemical Thermodynamics

6–11 August 2000
16th IUPAC Conference on Chemical Thermodynamics, Halifax, Nova Scotia, Canada.
Prof. M. A. White, Department of Chemistry, Dalhousie University, Halifax, Nova Scotia B3H 4J3, Canada.
Tel.: +1 902 494 3894
Fax: +1 902 494 1310
E-mail: Mary.Anne.White@DAL.CA

Thermal Analysis and Calorimetry

14–18 August 2000
12th International Congress on Thermal Analysis and Calorimetry, Copenhagen, Denmark.
Dr. O. Toft Sorensen, Materials Research Department, Riso National Laboratory DK-4000, Roskilde, Denmark.
Tel: +45 4677 5800
Fax: +45 4677 5758
E-mail: o.toft.sorensen@risoe.dk

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To apply for IUPAC sponsorship, conference organizers should complete an Advance Information Questionnaire (AIQ). The AIQ form is available at http://www.iupac.org or by request at the IUPAC Secretariat, and should be returned between 2 years and 12 months before the conference. Further information on granting sponsorship is included in the AIQ and available online.

Biotechnology

3–8 September 2000
11th International Biotechnology Symposium, Berlin, Germany.
Prof. G. Kreysa, DECHEMA e.V.— c/o 11th IBS, Theodor-Heuss-Allee 25, 60486 Frankfurt/Main, Germany.
Tel.: +49 69 7564 235 / -249
Fax: +49 69 7564 176 / -304
E-mail: biotechnology2000@dechema.de

Nuclear and Radiochemistry

3–8 September 2000 **NEW**
5th International Conference on Nuclear and Radiochemistry (NRC5), Pontresina, Switzerland.
Prof. H. W. Gäggeler, Chairman, Mrs. R. Lorenzen, Secretary, Paul Scherrer Institut, CH-5232 Villigen-Ost, Switzerland.
Tel.: +41 56 310 2401
Fax: +41 56 310 4435
E-mail: ruth.lorenzen@psi.ch

Analytical Chemistry

3–9 September 2000 **NEW**
EUROANALYSIS XI, Lisboa, Portugal.
Prof. Maria Filomena Camões, Chair, Dr. Cristina Oliveira, Secretary, Departamento de Química e Bioquímica, Faculdade

de Ciências, Universidade de Lisboa, Edifício C1-5º Piso, P-1700 Lisboa, Portugal.
Tel.: +351 1 3906138
Fax: +351 1 3909352; 7500088
E-mail: euroanalysisxi@fc.ul.pt

Natural Products

4–8 September 2000
22nd International Symposium on the Chemistry of Natural Products, Sao Paulo, Brazil.
Dr. M. Fátima das G.F. da Silva, Universidade Federal de Sao Carlos, Depto. de Quimica, Via Washington Luiz, km 235, CP676, Sao Carlos, Sao Paulo, Brazil.
Tel.: +55 16 274 8208
Fax: +55 16 274 8350
E-mail: dmfs@power.ufscar.br

Medicinal Chemistry NEW

18–22 September 2000
XVI International Symposium on Medicinal Chemistry, Bologna, Italy.
Prof. C. Melchiorre, Universitá di Bologna, Dipartimento di Scienze Farmaceutiche, Via Belmeloro 6, I-40126 Bologna, Italy.
Tel.: +39 051 259 706
Fax: +39 051 259 734
E-mail: camelch@alma.inbo.it

Trace Elements in Food

9–11 October 2000
Warsaw, Poland.
Prof. B. Szteke, Chairman, Dr. R. Jedrzejczak, Secretary, Institute of Agricultural and Food Biotechnology
ul. Rakowiecka 36
02-532 Warsaw, Poland.
Tel.: +48 22 606 3876
Fax: +48 22 4904 28
E-mail: jedrzejczak@ibprs.waw.pl

Food Packaging

8–10 November 2000
2nd International Symposium on Food Packaging—Ensuring the Safety and Quality Food, Vienna, Austria.
Dr. L. Contor, ILSI Europe, 83, Avenue E. Mounier, Box 6, B-1200, Brussels, Belgium.
Tel.: +32 (2) 771 0014
Fax: +32 (2) 762 0044
E-mail: laura@ilsieurope.be

Polymers NEW

20–24 November 2000
7th Latin-American Symposium on Polymers (SLAP'2000) and 5th Ibero American Congress on Polymers, Havana, Cuba.
Dr. Ricardo Martínez, Dr. Waldo Argüelles-Monal, IMRE, Universidad de La Habana La Habana 10400, Cuba.
Fax: +53 7 33 42 47
E-mail: slap@imre.oc.uh.cu

2001

Chemistry and Chemical Engineering NEW

16–20 April 2001
IV International Congress on Chemistry and XIII Caribbean Conference on Chemistry and Chemical Engineering, Havana, Cuba.
Prof. Alberto J. Nunez Selles, Sociedad Cubana de Química, Ave 21&200, Atabey, Apdo. 16042, CP 11600, Havana, Cuba.
Tel.: +537 218 178
Fax: +537 336 471
E-mail: cqf@infomed.sld.cu

CHEMRAWN XIV

9–13 June 2001
Chemrawn Conference—Toward Environmentally Benign Processes and Products, Boulder, Colorado, USA.
Dr. Dennis L. Hjeresen, Environmental Management Program, Los Alamos National Laboratory - Mail Stop J591, Los Alamos, NM 87545.
Tel.: +1 505 665 7251
Fax: + 1 505 665 8118
E-mail: dennish@lanl.gov

IUPAC 41st General Assembly

29 June–8 July 2001
Brisbane, Australia.
IUPAC Secretariat.
Tel.: +1 919 485 8700
Fax: +1 919 485 8706
E-mail: secretariat@iupac.org

IUPAC 38th Congress / World Chemistry Congress 2001

1–5 July 2001
Brisbane, Australia.
Congress Secretariat, P.O. Box 177, Red Hill Q 4054, Australia.
Tel.: + 61 7 3368 2644
Fax: + 61 7 3369 3731
E-mail: wcc2001@ccm.com.au

Phosphorus Chemistry

29 July–3 August 2001
15th International Conference on Phosphorus Chemistry, Sendai, Japan.
Prof. Masaaki Yoshifuji, Department of Chemistry, Graduate School of Science,Tohoku University, Aoba, Sendai 980-8578, Japan.
Tel.: +81 22 217 6558
Fax: +81 22 217 6562
E-mail: yoshifj@mail.cc.tohoku.ac.jp

Analytical Sciences

6–10 August 2001
International Congress on Analytical Sciences 2001 (ICAS2001), Tokyo, Japan.
Prof. Tsuguo Sawada, Chairman, Department of Applied Chemistry, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Toyko 113-8656, Japan.
Tel.: +81 3 5841 7236 (or 7237)
Fax: +81 3 5841 6037
E-mail: icas2001@laser.t.u-tokyo.ac.jp

Biodiversity

3–8 November 2001
3rd IUPAC International Conference on Biodiversity (ICOB-3), Antalya, Turkey.
Prof. B. Sener, Department of Phamocognosy, Faculty of

Pharmacy, Gazi University, P.O. Box 143 06572, Maltepe-Ankara, Turkey.
Tel.: +90 312 212 2267
Fax: +90 312 213 3921
E-mail: blgsener@tr-net.net.tr

Sweeteners NEW

13–17 November 2001
2nd International Symposium on Sweeteners, Hiroshima-Shi, Japan.
Prof. Kasuo Yamasaki, Institute of Pharmaceutical Sciences, Faculty of Medicine, Hiroshima University Kasumi, Minami-ku, Hiroshima 734-8551, Japan.
Tel.: +81 82 257 5285
Fax: +81 82 257 5289
E-mail: yamasaki@pharm.hiroshima-u.ac.jp

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IUPAC

announces the 2000

IUPAC Prize for Young Chemists

The IUPAC Prize for Young Chemists has been established to encourage outstanding **young research scientists** at the beginning of their careers. The prize will be given for the **most outstanding Ph.D. thesis** in the general area of the **chemical sciences**, as described in a 1000-word essay.

Prize USD 1 000 and travel
to the IUPAC Congress in Brisbane, Australia, July 2001
Each awardee will be invited to present a talk on his/her research and to participate in a plenary award session.

Call for Nominations
(deadline April 1, 2000)

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or contact the IUPAC Secretariat
by e-mail at <secretariat@iupac.org> or by fax: +1 919 485 8706.