for the FECS the *Guide to European Chemical Museums and Exhibitions* (3rd edition in 1998) and in addition has authored other books on the history of chemistry. His earlier international medals and awards include the Gillis Prize of the Royal Flemish Academy, Dexter Award of the American Chemical Society, and, more recently, the Liebig-Wohler Friendship Prize.

New Officers of the Kuwait Chemical Society

At the Kuwait Chemical Society General Assembly held on 7 October 1998, the following office-bearers were elected:

President: Dr. Abdulaziz Alnajjar
Vice President: Mr. Adnan Alshalfan
Secretary General: Mr. Marzooq Al-Shemmari
Treasurer: Mr. Mohammed Alqallaf
Executive Committee: Mrs. Samirah Al-Houli, Dr. Ahmed Karimi, Ms. Khalidah Aldalama, Dr. Ali Saleh Al-Omair, and Mr. Majed Al-Asfoor

New Officers of the Bangladesh Chemical Society

The 21st Annual Conference of the Bangladesh Chemical Society was held 22–24 October 1998 at Bangladesh Chemical Industries Corporation, BCCI Auditorium, Dhaka. Sheikh Hasina, the Honorable Prime Minister, Government of the People's Republic of Bangladesh, was present as the Chief Guest in the inaugural session. The theme for the symposium of this conference was "The Impact of Free Market Economy on the Industrialization of Bangladesh." More than 500 chemists from different universities, industries, research organizations, and educational institutions attended the conference.

Researchers from different organizations presented their papers in six technical sessions, all of which were well attended.

An Executive Committee consisting of 22 members was elected for two-year terms, which assumed office from 2 November 1998.

Executive Committee of the Bangladesh Chemical Society

President: Professor S. Z. Haider
Vice-President: Mr. A. S. Salah Uddin Ahmed and Mr. Md. Shafiqur Rahman
Treasurer: Dr. Akhtar Uddin Ahmed
General Secretary: Professor Jasim Uddin Ahmad
Joint Secretary: Dr. Tofail Ahmad Chowdhury & Mr. Md. Shafiqul Islam
Publicity Secretary: Mr. Md. Masuder Rahman
Organizing Secretary: Mr. Md. Sanowar Hossain Mondal
Social Welfare Secretary: Capt. (Retd.) A. B. M. Nowsher Alam

Members: Mr. Abu Hayder Ahmed Naser, Dr. Mobarak Ali Akand, D.. M. Ali Hossain, D.. Md. Mominul Huque, Mr. Kazi Saidul Haque, Mr. Md. Abdul Aziz Mollah, Mr. Md. Abdus Samad, Mr. Md. Ashraf Hossain, Mr. Md. Nurul Islam, Prof. A.. M. Shafiqul Alam, Prof. Mesbahuddin Ahmad, Prof. (Mrs.) Tajmeri S. A. Islam.

Reports from IUPAC-Sponsored Symposia

The OECD Workshop on Sustainable Chemistry

Introduction

The Workshop on Sustainable Chemistry (hosted by the Interuniversity Consortium *Chemistry for the Environment*) was held at Fondazione Cini (Venice, Italy) from 15–17 October 1998. This international event was co-sponsored by the governments of Germany, Italy, Japan, and the United States in cooperation with the International Union of Pure and Applied Chemistry (IUPAC) and the Business and Industry Advisory Committee to the OECD (BIAC). Also participating in the organization of the workshop were the OECD (Organisation for Economic Cooperation and Development) and the Interuniversity Consortium *Chemistry for the Environment.*

Joe Carra (U.S. Environmental Protection Agency) and Pietro Tundo (Interuniversity Consortium *Chemistry for the Environment*) co-chaired the workshop. Seventy-five experts attended, representing 16 member countries, the European Commission, industry, and nongovernmental organizations.

Within the broad framework of sustainable development, we should strive to maximize resource efficiency through activities such as energy and nonrenewable resource conservation, risk minimization, pollution prevention, minimization of waste at all stages of a product's life cycle, and the development of products that are durable and can be reused and recycled. Sustainable chemistry strives to accomplish these ends through the design, manufacture, and use of efficient and effective, more environmentally benign chemical products and processes.

Prior to the workshop a survey was conducted to collect basic information on sustainable chemistry activities recently completed or ongoing in member countries. This information included activities initiated by governments, academia, and industry, and which are managed solely by one of these parties or in a collaborative fashion (e.g., government/industry partnership). The results of this survey were discussed at the workshop.

The workshop focused on the policy/programmatic aspects of sustainable chemistry initiatives, as compared to the technical aspects of any particular approach, with a mandate to

1. identify the types of sustainable chemistry activities underway;
2. identify effective techniques and approaches in the field of sustainable chemistry (including educational approaches), highlighting problems encountered and considering solutions; and
3. identify activities that can further the development and use of sustainable chemistry programs.

Breakout Sessions

Five breakout sessions were held in parallel, at which the topics listed above were discussed. The results from these discussions were reported in the plenary session. The plenary session then developed a consolidated paper summarising the discussions and recommending further work.

Breakout Session 1

Object: Recognize sustainable chemistry accomplishments by the chemical industry and scientists in universities and research institutions

Co-chairs: Paul Anastas (U.S. Environment Protection Agency) and Ferruccio Trifirò (University of Bologna, Italy)

Goal: Provide effective awards and recognition for the purpose of promoting sustainable chemistry

Breakout Session 2

Object: Dissemination of technical information and event information related to sustainable chemistry

Co-chairs: Joe Breen (U.S. Green Chemistry Institute) and Alvise Perosa (Ca' Foscari University of Venice, Italy); rapporteur: Dennis Hjeresen (Los Alamos National Laboratory)

Goals: Promote the development and functioning of an international sustainable chemistry community

Breakout Session 3

Object: Support and promote the research, discovery, and development of innovative sustainable chemistry technologies

Co-chairs: Masao Kitajima (Japan Chemical Innovation Institute) and Junshi Miyamoto (IUPAC); rapporteur: Uwe Wolcke (Bundesanstalt für Arbeitschutz und Arbeitsmedizin)

Goals: Stimulation of interest in assessments, industry, academia, and the public in sustainable chemistry as a basis for national and international research programs; identification of mechanisms to support/promote research; description of ways to implement research programs

Breakout Session 4

Object: Develop guidance on how to implement sustainable chemistry programs for use by OECD member countries and others

Co-chairs: Peter Hinchcliffe (UK Department of Environment, Transport, and Regions) and Herwig Hulpke (BAYER - AG); rapporteur: John Keating (Canada Natural Resources)

Goal: Individuate the mechanisms to develop guidance on how to implement sustainable chemistry programs for use by OECD member countries and others

Breakout Session 5

Object: Promote incorporation of sustainable chemistry principles into the various levels of chemical education

Co-chairs: Tracy Williamson (U.S. Environmental Protection Agency) and Giuseppe Blasco (Interuniversity Consortium Chemistry for the Environment, Italy); rapporteur: John Warner (University of Massachusetts).

Goals: Educate all people involved in products and processes on sustainable chemistry; includes those who currently are involved as well as those who will be involved in the future; includes educators.

It was evident from the workshop that there is considerable interest and enthusiasm within academia, industry, government, and NGOs for both the basic concepts and practical developments in the field of sustainable chemistry. Italy, Japan, Germany, the United States, and Austria presented considerable information on developments in sustainable chemistry.

Workshop Outcomes

I. Conclusions/Workshop Statement

Workshop participants agreed that sustainable chemistry provides a cost-effective means of

- reducing chemical threats to health and the environment;
- accelerating the pace of chemical innovation; and thereby
- contributing to economic competitiveness and sustainable development.

Workshop participants also agreed that efforts

should be made to promote the establishment of such programs by governments, industry, and academia.

II. Recommendations

In order to achieve this aim, the workshop made a number of recommendations either of a general nature that apply to all aspects of sustainable chemistry, or of a more specific nature that apply to one of the objectives listed above. The recommendations follow.

General Recommendations

The following two overarching recommendations would facilitate the promotion of sustainable chemistry in general and also the implementation of the more specific workshop recommendations.

Recommendation 1: The existing OECD Steering Group that was formed to organize the workshop should remain intact and take on the new responsibility of overseeing the implementation of these recommendations. As part of these duties, the Steering Group will form work groups or study groups as necessary.

Recommendation 2: OECD should publish the proceedings for this workshop (including the results from the OECD-wide survey), provided funds are available.

Specific Recommendations

The following recommendations are organized according to the themes that were the focus of the five breakout sessions.

1. Awards and recognition for work on sustainable chemistry.
2. Exchange of technical information related to sustainable chemistry
3. Research and development
4. Guidance on activities and tools to support sustainable chemistry programs
5. Sustainable chemistry education

Awards and Recognition for Work on Sustainable Chemistry

Recommendation 3: OECD should begin an activity which (1) establishes an *international* program for rewarding and recognising work in the area of sustainable chemistry; and (2) provides guidance to countries interested in establishing *national* programs. This activity will promote the incorporation of sustainable chemistry concepts into all aspects of chemistry and environmental sciences and the industrial sectors they affect by recognizing the value of this approach with respect to environmental and economic sustainability.

a) OECD should assist in the establishment and implementation of an annual *international* awards program to recognize excellence in the area of sustainable chemistry. The following elements would be important to the successful implementation of this awards program
   - the OECD Steering Group should create a work group to manage this program that would include representatives from international and regional professional societies, relevant intergovernmental organizations, nongovernmental organizations (NGOs), and industrial trade associations;
   - the official presenter of the awards should be a multinational governmental body;
   - the exact nature of the nonmonetary award should be defined and established; and
   - eligible recipients of the awards can include representatives from academia, industry, government, and nongovernmental organizations.

b) OECD should develop guidance on methods to design *national* awards and recognition programs in the area of sustainable chemistry. The workshop recognized that the essential elements of an effective international or national awards and recognition program would require
   - the award or recognition be given by a group which is highly respected by the public;
   - the award be highly visible both to the scientific and industrial communities as well as the general public; and
   - the information collected during the award nomination process (including, for example, information on the economic and environmental benefits of a particular innovative technology that incorporates the principles of sustainable chemistry), should be made available to the relevant community.

Exchange of Technical Information Related to Sustainable Chemistry

Recommendation 4: OECD should establish an information exchange activity on sustainable chemistry. To do so, OECD should

a) identify existing communication channels;
b) coordinate among these channels within OECD countries; and
c) encourage development of new communication channels deemed necessary.

The purpose of this activity is to help promote the development and functioning of an international sustainable chemistry community by

- facilitating the exchange of information through established programs;
- providing enabling information to developing programs; and
- communicating program opportunities and re-

sults to both technical and nontechnical audiences.

Research and Development

Recommendation 5: While it is recognized that OECD cannot fund or carryout actual research, OECD should (1) encourage member countries to undertake sustainable chemistry research and (2) facilitate the development of effective research activities in institutions and other organizations.

a) OECD should encourage governments to initiate research programs. The approach and specific rationale for doing so can be developed by the Steering Group or other experts as it sees fit.
b) OECD should organize member country expert meetings to identify basic (i.e. precompetitive) research agendas to facilitate the exchange of information and experiences and to foster cooperation.
c) OECD should monitor the implementation of and results from research programs for the purpose of improving the effectiveness of future programs.
d) OECD should encourage national and multinational research funding organizations to increase research funding for sustainable chemistry and foster international collaborations for short- and long-term research.

Guidance on Activities and Tools to Support Sustainable Chemistry Programs

Recommendation 6: OECD should assist in the development of guidance on sustainable chemistry activities and tools to improve awareness and support of sustainable chemistry activities in member and nonmember countries.

a) To improve awareness and adoption of sustainable chemistry, the following actions are recommended:
    - Stakeholders in sustainable chemistry should be identified and informed about the initiative. OECD should facilitate contact with international organisations, national governments, industry and trade associations, labour and trade unions, environmental and other NGO's, academia and other relevant parties.
    - SME activities in sustainable chemistry should be stimulated by engaging innovative companies, trade associations, governments, and professional associations through mentoring, education, and training of SMEs.
    - Academia, industry, governments, and other institutions should develop opportunities that support greater cooperation between the various fields of chemistry and other related disciplines (e.g., analytical chemistry, physical chemistry, engineers) on the design and implementation of sustainable chemistry projects.
b) Tools should be developed to support national sustainable chemistry programs. These tools could include the following:
    - developing new (or adapting existing) mechanisms for monitoring progress, exchanging information, and benchmarking; and
    - exploring, through existing OECD programs, economic incentives, including the internalization of environmental costs.
c) National governments or others should, as appropriate, establish qualitative or quantitative targets with realistic time scales.

Sustainable Chemistry Education

Recommendation 7: OECD should promote the incorporation of sustainable chemistry concepts into chemical education (within and outside of academia) and provide support material to do so.

a) It is recommended that approaches and material be developed that can describe and promote the benefits of sustainable chemistry education programs to:
    - the business community, through publications in relevant press, provision of material to relevant conferences/meetings, and by targeting existing programs (such as *Responsible Care*), etc.;
    - the scientific community; and
    - the public.
b) It is recommended that OECD develop guidance on how to implement sustainable chemistry education programs based on materials from existing programs and new materials developed to meet unique needs. This guidance could involve:
    - surveying existing sustainable chemistry education programs (including experiences on what worked and what did not work);
    - identifying educational needs, including identifying barriers and drivers to meeting those needs (i.e., identify gaps);
    - developing materials to meet unique educational needs that cannot be met by existing programs (i.e., fill gaps);
    - compiling materials from existing sustainable education programs and newly developed materials, and developing guidance on how to use these materials;
    - convening educators at a workshop to more thoroughly assess the situation; and
    - disseminating the package of guidance/material (e.g., using the Internet, conferences/

meetings, continuing education programs, networks, professional societies, trade associations, media, etc.).

The IUPAC Working Party on Synthetic Pathways and Processes in Green Chemistry

At the end of the Workshop, Saturday afternoon 17th and Sunday 18th October, a meeting of the IUPAC Working Party of Commission III.2 was held. This was the second time the workgroup met from its constitution (Washington, 27 May 1998).

This Working Party was founded during the 13th IUPAC Conference on Physical Organic Chemistry (25–29 August 1996, Inchon, Korea) and formally approved by the General Assembly (Geneva, August 1997).

Workgroup Composition: P. Tundo, Chairman (Ca' Foscari University of Venice, Italy).

Members: Paul Anastas (U.S. Environment Protection Agency), Masakazu Anpo (Osaka Prefecture University, Japan), Terrance Collins (Carnegie Mellon University, USA), Werner Klein (IUCT, Germany), Tomasz Modro (University of Pretoria, South Africa), Martin Poliakoff (University of Nottingham, UK), William Tumas (Los Alamos National Laboratory, USA).

This group operates in collaboration with the IUPAC Division Chemistry and the Environment, represented by its President Prof. J. Miyamoto, and with the Committee for Chemistry and Industry (COCI), represented by Prof. G. Martens (SOLVAY s.a., Belgium).

The first aim of the meeting was to create a network of single IUPAC initiatives in the field of sustainable chemistry among the CHEMRAWN Committee and the Subcommittee on Synthesis of the Organic Division.

It was decided to propose to organize a joint meeting together at the General Assembly in Berlin (August 1999).

The Working Party agreed that they needed to help define the general concept of green-sustainable chemistry to ensure that leading scientists are attracted to the area.

The Working Party agrees upon the set of goals to be achieved as outlined in the following four points:

1. impact and awareness heightening of the chemical community
2. informational linkage of green chemistry initiatives and efforts
3. international political and funding impact
4. standardization and formalization of definitions and principles of Green Chemistry

While there is a high level of activity in the new field of green chemistry, a large portion of the chemistry community is still unfamiliar with the principles, methods, and definitions that are a fundamental part of this new area.

Throughout the world currently, there are government programs and policies in green chemistry being developed independently and in collaboration with the chemical industry and academia. The need for scientific input and a scientific framework in green chemistry by an international scientific body is necessary in order to inform the decisions of the policy makers and program directors.

The role of IUPAC as the scientific body for definition and standardisation will be particularly useful as OECD incorporates the work products of the green chemistry Working Party into the implementation phases of its sustainable chemistry initiative. Moreover, this interaction is an example of a particular benefit to IUPAC. A green chemistry focus will strengthen IUPAC because the potential of the field for beneficial social impacts provides a unifying force that positively couples the mission of IUPAC to other international bodies such as OECD.

The main purpose of the two-day meeting of the IUPAC Working Party, was to define the products of this group. A number of key issues were discussed and decisions were made on what the technical products will be.

The goal of these products was two-fold: 1) to communicate green or sustainable chemistry concepts more broadly to the chemical community (industry and academia) and 2) to enhance the image of chemistry to the broader community through a lay-type publication. The main motivation of these products arises from what needs to be done to promote green chemistry and how to show that it is a new worldwide approach distinct from other concepts for environmental protection. These products are apparently very important for advancing the global nature of this concept, given the important issues at the OECD workshop.

For its major product, the Working Party will attempt to prepare a cogent product (report or progress report) on green chemistry to be submitted by Commission III.2 during the Berlin General Assembly, with the following outline:

I The Concept of Design
II Sustainability and the Role of Chemistry (Energy and Materials)
III Evolution of Chemical Problems and Solutions.
IV Evolution of Risk Management (Processes as well as Products)
- Disposal
- Treatment
- Recycle and Reuse