International Union of Pure and Applied Chemistry

A member of the International Council of Scientific Unions

Division of Chemistry and the Environment (DCE - VI)

Report of Activities

September 2003 – September 2004

Kenneth D. Racke

1. HIGHLIGHTS

1.1 Terms of Reference

Through its internationally recognized membership and project teams, the Division of Chemistry and the Environment (DCE) will provide unbiased and timely authoritative reviews on the behavior of chemical compounds in food and the environment. The DCE will undertake both fundamental and applied evaluations that contribute to solving environmental problems and enhancing the quality of food on a global scale (revised May-2004).

1.2 Organization

The Division Committee is currently comprised of 10 TM's, 7 AM's, and 6 NR's. The 7th AM was a new position added during 2004 to accommodate a closer working relationship with IOCD. A new Division President assumed responsibilities during 2004. Several of the newly elected members for the 2004-2005 biennium are from outside the IUPAC family and have brought fresh perspectives. The work of the Division Committee is assisted by the efforts of several sub-committees, which help identify new priority project areas, stimulate proposals and recruit potential project leaders, and facilitate external communication encompassing the broad areas of environmental and food chemistry:

- Food Chemistry
- Biophysico-Chemical Processes in Environmental Systems
- Chemistry of Environmental Compartments
- Crop Protection Chemistry

1.3 Projects

Projects sponsored by the DCE generally fall into three broad categories. First, state-of-the-art **authoritative reviews** of a particular area of environmental chemistry are developed and published in book form. To this end, the Division has a long-standing working partnership with Wiley Press. Second, **technical evaluations** focus on critical assessment and development of specific recommendations for an area of environmental chemistry so as to assist and influence research and public policy. Primary areas of emphasis include definitions, methodologies, and regulations. Third, **outreach** activities help move IUPAC project outcomes outside the small circle of specialists

and into the broader scientific and regulatory arena, with a strong emphasis on technology transfer to developing countries. These outreach activities include both regional workshops and international congresses that maintain a high level of IUPAC involvement and serve to highlight ongoing and completed IUPAC projects.

During the period of this report the Division completed 8 projects and terminated 1 moribund project. From a total of 15 submitted project proposals, 10 new projects have been initiated since the Ottawa General Assembly. This brings the total number of active projects to 21 as of September 2004.

1.4 Collaboration

The Division has maintained historically strong collaboration with a number of external bodies including several Codex committees, FAO, International Standard Organization (ISO), Intergovernmental Forum on Chemical Safety (IFCS), and ICSU Scientific Committee on Problems of the Environment (SCOPE). The Division has recently moved to increase collaboration with the WHO International Program on Chemical Safety (IPCS), Association of Official Analytical Chemists International (AOAC), International Organization for Chemistry in Development (IOCD), and International Union of Soil Sciences (IUSS). Within IUPAC, DCE has recently cultivated increased collaboration with the Analytical Chemistry Division (V), and as a result two interdivisional projects have recently been initiated.

2. PROJECT ACTIVITIES

Examples of some of the project activities of DCE during the reporting period are provided below in relation to several of the long-range goals established by IUPAC. This is only a sampling, but should provide insight into the project areas of greatest involvement for the Division.

2.1 IUPAC will provide leadership as a worldwide scientific organization that objectively addresses global issues involving the chemical sciences.

- ***Environmental Implications of Endocrine Active Substances*** (2000-016-1-600). This joint IUPAC-SCOPE project was focused on a critical environmental contamination and health issue with global significance. Following a successful international symposium during 2002 in Japan, the authoritative views and recommendations of workgroups of leading experts were published during late 2003 in a monumental 2-volume issue of *Pure and Applied Chemistry* that has become a standard reference for scientists and policy-makers alike.
- ***Local and Regional Contributions to Air Pollution in Developing Countries*** (1999-030-1-600). Following a successful workshop held during 2001 in China, a summary report addressing critical aspects of air pollution chemistry in Chinese urban areas was recently published in *Pure and Applied Chemistry*. The report should provide a sound model for evaluation of critical air quality issues in some of the world's largest and fastest growing cities.
- ***XI International IUPAC Symposium on Mycotoxins and Phycotoxins.*** This symposium, held in Maryland, USA during May 2004, was only the latest in a long-standing series that has become the premiere forum for exchange of research results and methodologies related to these

important naturally occurring toxins. The traditional strength of IUPAC as related to the chemistry aspects of these biotoxins has been an important factor in the success of this series. The next symposium is now being planned for Istanbul, Turkey in 2007.

- ***Remediation Technologies for Removal of Arsenic from Water and Wastewater*** (2003-017-2-600). The impetus for this project is the already apparent toxicity of water supplies in several regions through natural arsenic contamination affecting the health of millions of residents. There is an urgent need to reduce arsenic levels in drinking water supplies and, in some areas, irrigation waters. Although several technologies have been proposed, there has not been sufficient in-depth evaluation especially for routine treatment of large volumes of water, and agreement on assessment criteria is also lacking. This project will address these important issues and collaborate with WHO and other IUPAC initiatives in this area.
- ***Impact of Transgenic Crops on the Use of Agrochemicals and the Environment*** (2001-24-2-600). This topic area is of the utmost interest with respect to current scientific, regulatory, political and public perception issues surrounding transgenic crops. This ongoing project will provide an opportunity for IUPAC to take an important leadership role in promoting the importance of sound scientific assessment around a highly charged contemporary issue.

2.2 IUPAC will facilitate the advancement of research in the chemical sciences through the tools that it provides for international standardization and scientific discussion.

- ***Physicochemical Kinetics and Transport at Chemical-Biological Interfaces*** (Project 610/42/97). This completed project resulted in publication of the 9th volume in the acclaimed Wiley book series on fundamental physico-chemical processes. Authoritative reviews by the task group provide a basis for understanding chemical flows between the living and inert components of the environment.
- ***Pesticide Residues in Food – Acute Dietary Exposure*** (1999-009-1-600). This completed project elaborated an internationally acceptable method of establishing safe limits for pesticide residues in food based on exposures during a single day or from a single meal. Acute exposures are a contentious issue for which only a few divergent national approaches currently exist, so the final report has been influential with both national regulatory authorities and international bodies such as the Codex Committee on Pesticide Residues.
- ***Regulatory Limits for Pesticide Residues in Water*** (1999-017-1-600). This recently completed project provided a critical evaluation of methodology for establishment of standards and drew attention to the varied nature of current practices, which range from very scientifically-based to politically-based. Practical recommendations were offered and particularly targeted at developing countries seeking to establish a way forward. It so happened that the final report was completed at just the moment this issue was reaching a critical boil in India, and the recommendations were prominently featured at a conference of government and private sector policy-makers held in that country to seek resolution.
- ***Glossary of Atmospheric Chemistry*** (2003-030-1-600) and ***Glossary of Pesticide Chemistry*** (2004-002-1-600). These two recently initiated projects will be providing authoritative updates of existing IUPAC recommended definitions. Both hard copy and internet-based electronic versions are envisioned. Collaboration with WHO-IPCS and OECD is being pursued to enable the broadest possible acceptance of the revised IUPAC recommendations.

2.3 IUPAC will foster communication among individual chemists and scientific organizations, with special emphasis on the needs of chemists in developing countries.

- ***Mycotoxin Methods for Developing Countries*** (1999-010-1-600). This recently completed project revolved around a collaborative study of a simplified but highly sensitive method of analysis for alflatoxin B1 in corn and peanuts. A total of 17 laboratories were involved, mostly in developing countries of South America, Asia, and North Africa. Important lessons were learned for conduct of such collaborative work, and it is hoped these will contribute to development of more effective surveillance programs for such naturally occurring toxins with both health and international trade implications.
- ***Development of Simplified Methods for Ecological Risk Assessment of Pesticides*** (2004-011-1-600). This recently initiated project will address a critical gap that now exists between the highly sophisticated and resource-intensive approaches to risk assessment practiced in some developed countries with the unreliable or non-scientific consideration of exposure and risk that plagues many developing countries. A project team consisting of leading government, industry, and academic modellers and risk assessment experts has been assembled to make rapid progress.
- ***Standardization of Analytical Approaches and Analytical Capacity-Building in Africa*** (2004-017-1-600). This new project is a cooperative effort with the Analytical Chemistry Division (V), the International Organization for Chemical Sciences in Development (IOCD), and the Association of Official Analytical Chemists International (AOAC). Uganda and Kenya are the initial focus, with Nigeria, South Africa, and Mozambique of future interest in conjunction with an ongoing World Bank project. The project aims to build regional analytical laboratory capabilities in relation to monitoring and enforcement of international trade standards.
- ***Regional Pesticide Chemistry Workshops.*** During the past 15 years DCE has sponsored a series of regional workshops focused on broadening the adoption of harmonized, international approaches to pesticide research and regulation in developing countries. The workshops create a forum where IUPAC project outcomes as well as recommendations from other international bodies can be discussed and applied within the context of local environmental problem areas. Following successful sessions in China, Thailand, Taiwan, and Brazil, the *IUPAC-Korean Society of Pesticide Science Workshop on Pesticides* (2001-046-1-600) was held in Seoul during October 2003, and attracted more than 300 scientists, government regulators, and industry leaders representing 28 countries from the Asia-Pacific region. The *IUPAC-University of Costa Rica Workshop on Crop Protection Chemistry in Latin America* (2003-013-1-600), being planned for San Jose during February 2005, is expected to have a similar impact on the Central American and Andean regions.
- ***Regional Workshop on Fats, Oils, Oilseeds Analysis and Production*** (2002-011-2-600). This workshop is the second in what hopefully will become a standing series, and is being planned for Tunis, Tunisia during December 2004. It is being organized by IUPAC and AOCS in cooperation with the Tunisian Office National de l'Huile (ONH), the American Soybean Association (ASA), and the Internatíonal Olive Oil Council (IOOC), and is targeted at the important oil-exporting region of North Africa. The first such IUPAC workshop on this topic occurred in Brazil during 2000 (1999-042-1-600).

3. FUTURE OPPORTUNITIES AND DIRECTION

To remain effective and maintain relevance, the Division will need to pay attention to both current strengths and weaknesses of the IUPAC approach, and seek a way forward that takes advantage of the opportunities while avoiding looming threats. The Division Committee recently took the first steps toward development of a long-range Division activities plan in alignment with the IUPAC long-range goals by completing a SWOT analysis of the DCE program:

- **Strengths** – Global audience; international viewpoint and approach rather than a national/regional one; good productivity; important issues for society; credibility; networks (individuals, institutions, cross discipline); flexibility for projects to garner external funding; breadth (scholarly, applied, workshops/symposia); subcommittees helping bring new issues, projects and people to IUPAC.

- **Weaknesses** – Token in-house funding; heavy reliance on enthusiasm and availability of volunteers; very high dependence on single individuals (i.e., project task group leader); lack of direct influence for project performance and completion; limited peer review process in place for final project reports (in absence of the Commissions); lack of recognition for individual efforts; low impact/visibility for PAC; lack of a long-range strategic direction for the Division.

- **Opportunities** – Increase credibility through more rigorous project review (planning, outputs); increase inputs from developing countries; more emphasis on food chemistry (functional foods); increase partnerships with other international organizations; seek more interdivisional projects; make better use of electronic media (web, email); attract funding from multiple sources to make viable projects.

- **Threats** – Loss of relevance; losing intellectual property to collaborating organizations; having Division direction driven by randomly submitted project proposals; having lead on key areas taken by other organizations; slowness in addressing key issues of interest and project areas; not reaching the intended audience; conflicts of interest in funding decisions; inability to define and measure success.

The Division Committee will be further wrestling with these topics at the Beijing General Assembly with the aim of developing a long-range Division activities plan. One particular area for which the Division is already taking action involves a move to reinvigorate the area of food chemistry. Through past mergers of Commissions with divergent interests (oils and fats standardized methods vs. food-borne mycotoxin chemistry) and subsequent disbandment of the hybridized Food Chemistry Commission, the current level of expertise for food chemistry available to IUPAC has been depleted and food chemistry-related project activities have been reduced. A new sub-committee has been appointed to organize a discussion forum in Beijing to reexamine the IUPAC approach to food chemistry and chart a new direction which brings to bear the traditional strengths of the Union with contemporary issues and problems related to food chemistry.

4. PUBLICATIONS (SEP-2003 TO SEP-2004)

Ambrus, A.; Hamilton, D.J.; Kuiper, H.A.; Racke, K.D. "Significance of Impurities in the Safety Evaluation of Crop Protection Products." *Pure Appl. Chem.* (**2003**) 75:937-973.

Anklam, E.; Stroka, J. "Collaborative Trial Tests for Method Validation: Lessons to be Learned." *Chem. Int.*, (**2004**) 26:7-9.

Egli, H.; Dassenakis, M.; Garelick, H.; Van Grieken, R.; Peijnenberg, W.J.G.M.; Klasinc, L.; Koerdel, W.; Priest, N.; Tavares, T. "Minimum Requirements for Reporting Analytical Data for Environmental Samples." *Pure Appl. Chem.* (**2003**) 75:1097-1106.

Hamilton, D. J.; Ambrus, A.; Dieterle, R.M.; Felsot, A.S.; Harris, C.; Holland, P.T.; Katayama, A.; Kurihara, N.; Linders, J. "Regulatory Limits for Pesticide Residues in Water." *Pure Appl. Chem.* (**2003**) 75:1123-1155.

Hamilton, D.J.; Ambrus, A.; Dieterle, R.; Felsot, A.; Harris, C.; Petersen, P.; Racke, K.; Wong, S., Gonzalez, R.; Tanaka, K. ; Earl, M.; Roberts, G.; Bhula, R. "Pesticide Residues in Food: Acute Dietary Exposure." *Pest Manag. Sci.* (**2004**), 60:311-339.

Koester, W.; Van Leeuwen, H. (eds.) *Physicochemical Kinetics and Transport at Chemical-Biological Membranes*, Series on Analytical and Physical Chemistry of Environmental Systems, Vol. 9, John Wiley & Sons, New York (**2004**) 576 pages

Miyamoto, J.; Burger, J. (eds.) *Implications of Endocrine Active Substances for Humans and Wildlife*, Special Topic Issue, *Pure Appl. Chem.* (**2003**) 75:1617-2615.

Oh, B.Y.; Racke, K.D. *Proceedings of the IUPAC-KSPS International Workshop on Pesticides 2003*. Korean Society of Pesticide Science, Suwon, (**2003**) 320 pages.

Racke, K.D. "Pesticide Science - Harmonization of Data Requirements and Evaluation." *Chem. Int*. (**2004**) 26:18-20.

Slanina, S.; Zhang, Y. "Aerosols: Connection between Regional Climate Change and Air Quality." *Pure Appl. Chem.* (**2004**) 76:1241-1253.

Zhang, Y.; Zhu, X.; Slanina, S.; Shao, M.; Zeng, L.; Hu, M.; Bergin, M.; Salmon, L. "Aerosol Pollution in Some Chinese Cities." *Pure Appl. Chem.* (**2004**) 76:1227-1239.

5. ACTIVE PROJECTS (AS OF SEP-2004)

630/24/95 - Solute movement in soils with potential rapid by-pass transport (report nearing publication)

1999-014-2-600 - Airborne and remote monitoring of water quality: evaluation of remote sensing techniques for water quality control in surface water bodies

1999-041-1-600 - Bioavailability of xenobiotics in the soil environment

2001-022-1-600 - Global availability of information on agrochemicals

2001-023-1-600 - Agrochemical spray drift: Assessment and mitigation

2001-024-2-600 - Impact of transgenic crops on the use of agrochemicals and the environment

2001-026-1-600 - Use of reference soils for testing fate and effects of chemicals

2001-039-1-600 - Pest management for small-area crops: a cooperative global approach

2002-011-2-600 - International Workshop on Fats, Oils and Oilseeds Analysis and Production

2002-013-2-600 - Determination of trace elements in oils and fats by inductively coupled plasma optical emission spectroscopy (ICP-OES) - evaluation of a method by collaborative study

*2003-011-3-600 - A critical compendium of pesticide physical chemistry data

2003-013-1-600 - Crop protection chemistry in Latin America: Harmonized approaches for environmental assessment and regulation

2003-014-2-600 - Bio-physical chemistry of fractal structures and processes in environmental systems

2003-017-2-600 - Remediation technologies for the removal of arsenic from water and wastewater

2003-030-1-600 - Glossary of atmospheric chemistry

2003-058-1-600 - Air pollution models in environmental management and assessment

2004-002-1-600 - Glossary of terms related to pesticides

2004-003-3-600 - Biophysico-chemical processes of heavy metals and metalloids in soil environments

2004-011-1-600 - Development of simplified methods and tools for ecological risk assessment of pesticides

2004-015-1-600 - Environmental colloids: behavior, structure and characterization

*2004-017-1-500 - Standardization of analytical approaches and analytical capacity-building in Africa

* Interdivisional project