

# AMERICAN CHEMICAL SOCIETY

## Division of Environmental Chemistry

### Preprints of Extended Abstracts

Presented at the

## 221st ACS National Meeting San Diego, CA

### April 1-5, 2001 Vol. 41 No.1

- General Papers
  - ▶ M.L. Trehy
- Field Analytical Chemistry: Techniques, Technologies, and Applications (Cosponsored with the Division of Analytical Chemistry)
  - ▶ E. Koglin, L.H. Keith, W.H. Batschelet and D. Crumbling
- Sustainable Chemistry in the New Millennium
  - ▶ M.L. Trehy
- Advances in Remediation of Heavy Metals in the Environment
  - ▶ M.L. Trehy and D.A. Atwood
- Biogeochemistry of Environmentally Important Elements
  - ▶ Y. Cai and O. Braids
- Elegant Analytical Chemistry Applied to Environmental Problems - A Practical Symposium
  - ▶ V. Turoski, S.D. Richardson and J. Plude
- Environmental Trends (Cosponsored with the ACS Committee on Environmental Improvement)
  - ▶ T.L. Wade
- ACS Award for Creative Advances in Environmental Science and Technology: Honoring Dr. Michael R. Hoffmann (Sponsored by Air Products and Chemicals, Inc.)
  - ▶ M.R. Hoffmann and R.A. Hathaway
- Innovative Strategies for the Remediation of Chlorinated Solvents and DNAPLs in the Subsurface
  - ▶ S.M. Henry and C.R. Bennett
- Tropospheric Chemistry
  - ▶ J.M. Andino



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Michael L. Trehy

Secretary:  
Larry LaFleur

# Preprints of Extended Abstracts

Presented  
at the  
221st ACS National Meeting

San Diego, CA  
April 1-5, 2001

Volume 41 No. 1

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Division of Environmental Chemistry, Inc.  
American Chemical Society

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**Division of Environmental Chemistry  
American Chemical Society**

The Division of Environmental Chemistry was established as a Division of the American Chemical Society in 1913, as the Division of Water, Sewage, and Sanitation Chemistry. (The name was changed in 1959). The objectives of the Division are to promote research, disseminate information and improve education and public awareness regarding the chemistry of the environment, in all of its aspects. In addition, the Division provides assistance to the American Chemical Society and its committees and divisions in matters regarding the environment.

In fulfillment of the above objectives, the Division sponsors symposia at the two annual meetings of the American Chemical Society. These symposia are organized by volunteers from the Division under the guidance of the program chair. For information on upcoming symposia at national meetings or to volunteer to organize a symposia, contact the **Program Chair**:

**Michael L. Trehly**  
Solutia Inc.  
P.O. Box 66760  
St. Louis, MO 61366-6760  
314-674-1515

Extended abstracts of papers presented in symposia sponsored by the Division of Environmental Chemistry are published twice each year by the Division. These extended abstracts generally are two to four pages in length and contain data, figures and references. The extended abstracts appear in "Preprints of Extended Abstracts...", which are sent to all members of the Division as part of their benefits of membership. Copies of this volume and previous volumes are available from the **Publication Manager**:

**Ruth A. Hathaway**  
1810 Georgia St.  
Cape Girardeau, MO 63701-3816  
573-334-3827

Membership in the Division of Environmental Chemistry is open to all members and National Affiliates of the American Chemical Society upon request to the Secretary of the Division and payment of dues. A person who is not a member or National Affiliate but wishes to participate in the activities of the Division may become a Division Affiliate provided that person is not a chemist or chemical engineer, resides in the United States, and pays all dues. For information regarding membership in the Division or the American Chemical Society, contact the **Business Office**:

**Ruth A. Hathaway**  
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## **EXECUTIVE COMMITTEE**

The Executive Committee is the governing body for the Division of Environmental Chemistry. The committee regularly addresses programming for future National meetings, membership dues and benefits, finances, and involvement of the Division in environmental activities of the American Chemical Society and related organizations. All members of the Division are encourage to participate in the governance of the Division.

**The Executive Committee meeting will begin at 7:00 PM on  
Sunday, April 1, 2001 in the Sante Fe Room at the Westin.  
All Division members are invited to attend.**

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**Division Web Site General**

<http://acs-envchem.duq.edu/>

**Division Web Site Program**

<http://gemini.tntech.edu/~mjw5030/acspage.html>

**Division of Environmental Chemistry  
Activities during the San Diego National Meeting**

**Technical Sessions:**

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<b>Symposia:</b>	<b>Sunday-Thursday,</b>
<b>Division Poster Session/Social Hour:</b>	<b>Wednesday</b> Evening, Westin, 5:00-7:00 p.m.
<b>ACS Sci-Mix</b>	<b>Monday</b> Evening, Sails Pavilion, 7:00-9:00 p.m.

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**Division Business:**

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<b>Long Range Planning Committee:</b> The future of the Division is discussed and planned. Issues dealing with membership, finances, and programs may be discussed. All members of the Division are welcome and encouraged to participate.	<b>Sunday</b> Afternoon, Envoy Room, Westgate 2:30-5:30 p.m.
<b>Program Planning Committee:</b> Future symposia topics are considered and discussed. All members interested in participating in the technical session planning for the Division are encouraged to attend this meeting.	<b>Sunday</b> Afternoon, Envoy Room, Westgate, 2:30-5:30 p.m.
<b>Executive Committee Meeting:</b> Financial and program issues are addressed and decided in this meeting. All members of the Division are encouraged to attend.	<b>Sunday</b> Evening, Santa Fe Room, Westin, 7:00-10:00 p.m.

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**Division Social Events:**

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<b>Social Hour and Dinner:</b> All members and their guests are invited. We select the restaurant for its quality and atmosphere. You will have the opportunity to meet with other Division members in a relaxing atmosphere.	<b>Tuesday</b> Evening, Top of the Market (above The Fish Market), 720 N. Harbor Dr.
<b>Tickets must be purchased by Monday, August 21.</b> Tickets can be purchased at the meeting registration area or at the Division Desk.	<b>Social Hour:</b> 6:30-7:30 p.m. (COD)  <b>Dinner:</b> 7:30 p.m. \$50 per person

**Division of Environmental Chemistry  
Activities during the San Diego National Meeting**

Event	Sun	Mon	Tues	Wed	Thurs
Long Range, Program Planning, and Executive Committee Meetings					
Division Social Hour and Dinner (Top of the Market)					
ACS Sci-Mix					
<b>Division Symposia</b>					
Division Poster Session/Social Hour					
General Papers					
Field Analytical Chemistry: Techniques, Technologies, and Applications (cosponsored with Division of Analytical Chemistry)					
Sustainable Chemistry in the New Millennium					
Advances in Remediation of Heavy Metals in the Environment					
Biogeochemistry of Environmentally Important Elements					
Elegant Analytical Chemistry Applied to Environmental Problems — A Practical Symposium					
Environmental Trends (cosponsored with the ACS Committee on Environmental Improvement)					
ACS Award for Creative Advances in Environmental Science and Technology: Honoring Dr. Michael R. Hoffmann (Sponsored by Air Products and Chemicals, Inc.)					
Innovative Strategies for the Remediation of Chlorinated Solvents and DNAPLs in the Subsurface					
Tropospheric Chemistry					

**For changes in times or events, please stop at the Division Information Desk, which will be located in the Westin, near the Division's Symposia.**

## **DIVISION OF ENVIRONMENTAL CHEMISTRY**

Listed below are upcoming symposia scheduled for the Division of Environmental Chemistry at future National ACS meetings. If you are interested in presenting a paper at a symposium or assisting in symposia organization, please contact the appropriate symposium organizer listed below or the Program Chair: Michael L. Trehy, Solutia Inc., P.O. Box 66760, St. Louis, MO 61366-6760; Phone (314) 674-1515, Fax (314) 674-5640, [mltreh@solutia.com](mailto:mltreh@solutia.com). Papers should be sent to the Environmental Division Office: Ruth A. Hathaway, 1810 Georgia St., Cape Girardeau, MO 63701-3816; Phone (573) 334-3827, Fax (573) 334-2551, [scifair@semovm.semo.edu](mailto:scifair@semovm.semo.edu).

### **CHICAGO, IL, AUGUST 26-30, 2001**

The Online Abstract Submittal System (OASys) is now available for instant paper submissions at [www.acs.org/meetings](http://www.acs.org/meetings). If you do not have web access, please send one original hard copy abstract form to the individual listed. Original plus 2 copies of extended abstract should be sent to respective symposium organizers. Deadlines: Electronic submittals by April 11, 2001. Hard copy submittals must be received by March 28, 2001. All general papers will be presented in the Division's poster session. The Extended Abstract Instructions are available on the Web. Links to this and other important meeting information are also available on the ACS Environmental Division Program Page.

#### **General Papers.**

- M.L. Trehy (see above)

#### **Analysis of Environmental Phenomena at Molecular Scales.**

- B.E. Logan, Civil and Environmental Engineering, Pennsylvania State University, 212 Sackett, University Park, PA 16802; (814) 863-7908; [blogan@psu.edu](mailto:blogan@psu.edu).
- P. Hatcher, Department of Chemistry, Ohio State University, Newman and Wolfrom Lab, 100 West 18th Avenue, Columbus, OH 43210; (614) 688-8799; [hatcher.42@osu.edu](mailto:hatcher.42@osu.edu).
- K. Gray, Dept. of Civil Engineering, Northwestern University, 2145 Sheridan Road, Evanston, IL 60208-3109; (847) 467-4252; [k-gray@northwestern.edu](mailto:k-gray@northwestern.edu).

#### **Chemical Transformations of Mercury in Aquatic Systems.**

- P.L. Brezonik, Department of Civil Engineering, University of Minnesota, 500 Pillsbury Drive, Minneapolis, MN 55455.

**Elegant Analytical Chemistry Applied to Environmental Problems — A Practical Symposium.**

- V. Turoski, 345 East Wisconsin Ave., Neenah, WI 54956; (920) 729-9281, [vturoski@execpc.com](mailto:vturoski@execpc.com).
- J. Plude, Department of Environmental and Analytical Chemistry, University of Wisconsin - Oshkosh Campus, 800 Algoma Blvd., Oshkosh, WI 54901; (414) 424-7098, Fax (414) 424-7317, [plude@uwosh.edu](mailto:plude@uwosh.edu).
- S.M. Richardson, US EPA, 60 College Station Rd., Athens, GA 30613; (706) 355-8304; Fax (706) 355-8302; [richardson.susan@epa.gov](mailto:richardson.susan@epa.gov).

**Emerging Issues in the Great Lakes.**

- D.L. Swackhamer, Mayo Mail Code 807, 420 Delaware St. SE, Environmental & Occupational Health, University of Minnesota, Minneapolis, MN 55455; (612) 626-0435; Fax (706) 626-0650; [dswack@mail.eoh.umn.edu](mailto:dswack@mail.eoh.umn.edu).
- K.C. Hornbuckle, Dept. Civil and Environmental Engineering, 4016 SC, University of Iowa, Iowa City, IA 52242; (319) 335-3337; Fax (319) 384-0789; [keri-hornbuckle@uiowa.edu](mailto:keri-hornbuckle@uiowa.edu).

**Environmental Chemistry Awards Symposium.**

- T. Anderson, The Institute of Environmental and Human Health, Texas Tech University, P.O. Box 41163, Lubbock, TX 79409-1163, (806) 885-4549 ext. 231, Fax (806) 885-4577, [tanderson@ttu.edu](mailto:tanderson@ttu.edu)

**Remediation of Water and Soil Contaminated with Gasoline Oxygenates: In situ and ex situ Treatment Technologies.**

- D.D. Dionysiou, Civil and Environmental Engineering, University of Cincinnati, 741 Baldwin Hall, Cincinnati, OH 45221-0071; (513) 556-0724; Fax (513) 556-2599; [dionysios.d.dionysiou@uc.edu](mailto:dionysios.d.dionysiou@uc.edu).
- M.T. Suidan, Dept. Of Civil and Environmental Engineering, 701 Engineering Research Center, University of Cincinnati, Cincinnati, OH 45221-0071; (513) 556-3695, Fax (513) 556-2599, [makram.suidan@uc.edu](mailto:makram.suidan@uc.edu).

**Themes in Potable Water Chemistry.**

- E.T. Urbansky, U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Water Supply and Water Resources Division, 26 West Martin Luther King Drive, MS-681, Cincinnati, OH 45268; (513) 569-7655, Fax (513) 569-7658, [urbansky.edward@epa.gov](mailto:urbansky.edward@epa.gov).

**ORLANDO, FL, APRIL 7-11, 2002**

The Online Abstract Submittal System (OASys) is now available for instant paper submissions at [www.acs.org/meetings](http://www.acs.org/meetings). If you do not have web access, please send one original hard copy abstract form to the individual listed. Original plus 2 copies of extended abstract should be sent to respective symposium organizers. Deadlines: Electronic submittals by November 20, 2001. Hard copy submittals must be received by November 15, 2001. All general papers will be presented in the Division's poster session. The Extended Abstract Instructions are available on the Web. Links to this and other important meeting information are also available on the ACS Environmental Division Program Page.

**General Papers.**

- M.L. Trehy (see above)

**Biodegradation of Organics and Chemical Indicators.**

- E.M. Thurman, U.S. Geological Survey, Water Resources Division, 4821 Quail Crest Place, Lawrence, KS 66049; (785) 832-3559; [ethurman@usgs.gov](mailto:ethurman@usgs.gov).

**Mercury in the Environment: Assessing and Managing the Multimedia Risks.**

- W.G. Stelz, USEPA/ORD/NCER, 1200 Penn Ave. 8722R, Washington, DC 20460; [stelz.william@epa.gov](mailto:stelz.william@epa.gov).
- Thomas Atkeson, Florida DEP, 2600 Blair Stone Road, MS 6540, Tallahassee, FL 32399; [Thomas.Atkeson@DEP.STATE.FL.US](mailto:Thomas.Atkeson@DEP.STATE.FL.US).
- A.M. Ford, 1050 Edgewater Lane, Gulf Breeze, FL 32561; [fordam@ispchannel.com](mailto:fordam@ispchannel.com).

**The Science and Polity of Topical Antimicrobial Agents.**

- E.T. Urbansky, U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Water Supply and Water Resources Division, 26 West Martin Luther King Drive, MS-681, Cincinnati, OH 45268; (513) 569-7655, Fax (513) 569-7658, [urbansky.edward@epa.gov](mailto:urbansky.edward@epa.gov).

**The Environmental Chemistry Division  
of the  
American Chemical Society**

**Presents the Following Awards in Recognition of Excellence  
in the Environmental Sciences:**

- | **Distinguished Service Award** (sustained and distinguished contributions to the field of environmental chemistry and to the Division)
- | **Certificate of Merit** (first notable presentation)
- | **Kenneth G. Hancock Memorial Scholarship in Green Chemistry** (contribution in green chemistry)
- | **Graduate Student Award** (excellence in graduate studies)
- | **Graduate Student Research Paper Award** (excellence in research and presentation)

**Distinguished Service Award**

Members of the Division who demonstrate continued and active participation in the Division and in environmental chemistry will be considered for this award. The nominee must have been a member of the Division for at least ten years and active through presentations at and organization of symposia, effective work on Division committees, regular attendance and participation at National meetings, holding office in the Division and a general attitude and willingness to help in the Divisional work. The award is presented annually at the Fall ACS meeting.

**Certificate of Merit Award**

A certificate of merit award is given for a notable first appearance before the Environmental Division. If you are planning to make your first presentation at a National American Chemical Society meeting, please notify the Program Chair at the same time you submit your ACS abstract forms and Extended Abstract.

**For further information regarding the Distinguished Service Award or the Certificate of Merit, contact: Glenn C. Miller, Dept. of Environmental & Resource Sciences, MS 199, University of Nevada-Reno, Reno, NV 89557, (775)784-4108.**

### **Kenneth G. Hancock Memorial Scholarship in Green Chemistry**

To honor his contributions in the field of Green Chemistry, Dr. Hancock's colleagues from academia, government, and industry established the Kenneth G. Hancock Memorial Scholarship in Green Chemistry, offered under the auspices of the American Chemical Society's (ACS's) Division of Environmental Chemistry. The Kenneth G. Hancock Memorial Scholarship is awarded annually in conjunction with the Presidential Green Chemistry Challenge Awards Ceremony, administered by the U.S. Environmental Protection Agency (EPA) at the annual Green Chemistry and Engineering Conference sponsored by EPA, ACS, and other chemical organizations associated with industry, government, and academia. The scholarship provides national recognition for outstanding student contributions to furthering the goals of Green Chemistry (i.e., the research, development, and implementation of fundamental and innovative chemical technologies that incorporate the principles of Green Chemistry into chemical design, manufacture, and use, and that have the potential to be utilized in achieving national pollution prevention goals). The Kenneth G. Hancock Memorial Scholarship is open to all undergraduate and graduate students.

**For further information regarding the Kenneth G. Hancock Memorial Scholarship in Green Chemistry, contact: Tracy Williamson, Office of Pollution Prevention and Toxics (Mail Code 7406), U.S. Environmental Protection Agency, 401 M Street, SW, Washington DC 20460, (202)260-2659.**

### **Graduate Student Award in Environmental Chemistry**

The Division of Environmental Chemistry sponsors up to 25 annual awards to full-time graduate students currently enrolled in a United States educational institution in chemistry, environmental engineering or other programs emphasizing environmental chemistry. These students must have completed one full year of graduate study at their current institution by the date of announcement of the awards (January or February).

The award is based upon students' records in course work, evidence of research productivity, and on statements from graduate faculty advisors. Primary emphasis will be given to the students' potential for future contributions as professionals in environmental chemistry. The application for the award is submitted by the graduate students' faculty advisors.

Graduate students who receive the award will receive a one year membership in the Division of Environmental Chemistry (which includes the Preprints of Extended Abstracts for the two National meetings and the Division newsletter, EnvirofACS) and a one year subscription to Environmental Science & Technology. Awardees will be publicized in the Preprints, ES&T and EnvirofACS.

### **Graduate Student Research Paper Award**

The Division of Environmental Chemistry also sponsors the Graduate Student Research Paper Award, the highest honor granted by the Division for students. Up to five awards are presented annually. All graduate students enrolled full-time in chemistry, environmental engineering or other programs emphasizing environmental chemistry are eligible.

The research paper must be relevant to environmental chemistry, the student must be the first and major author, and the work must have been done while attending the student's current institution. The paper may have been submitted to a journal at the time of submission, but it should not have already been published or presented at another meeting.

Graduate students who receive this award will present their papers at the American Chemical Society National meeting in the Fall. Each awardee will also receive a \$500 cash award at the Environmental Division Dinner at the national meeting, a one year membership in the Environmental Division, and recognition in EnvirofACS, the newsletter of the Division and in ES&T.

Application materials and announcements regarding the Graduate Student Award in Environmental Chemistry and the Graduate Student Research Paper Award are distributed in the Fall of each year. If you do not receive the announcement or have **further questions regarding eligibility or application requirements, contact: Todd A. Anderson, The Institute of Environmental and Human Health, Texas Tech University, P.O. Box 41163, Lubbock, TX 79409-1163, (806)885-4549 ext 231, Fax (806)885-4577, [tanderson@ttu.edu](mailto:tanderson@ttu.edu).**

**Distinguished Service Award Winners**

1957	W.D. Collins A.N. Buswell Edward Bartow A.S. Behrman R.C. Bardwell	1973	James P. Lodge, Jr. S. Charles Caruso
1958	F.W. Mohlman W.D. Hatfield	1974	Henry C. Bramer Benjamin F. Willey Louis F. Wirth, Jr.
1959	J.R. Baylis D.K. French	1975	Francis L. Estes
1960	C.S. Howard O.M. Smith	1977	Alvin P. Black John J. Dwyer J. Carrell Morris
1961	William Steriker Fred Lindsey	1978	Robert A. Baker Aaron A. Rosen
1962	Hovhanness Heukelekian L.D. Betz	1979	Frank M. Middleton C. Ellen Gonter
1963	William Allan Moore William L. Lamar	1984	Nina I. McClelland Donald F. Adams John I. Tealsey
1965	Louis F. Warrick Clair S. Boruff	1985	Lawrence H. Keith Leslie B. Laird Roger A. Minear
1967	S. Ken Love Richard D. Hoak	1986	Robert L. Jolley
1968	John J. Maguire H. Gladys Swope	1987	Herbert E. Allen
1969	Hilding B. Gustafson Henry C. Marks	1988	J. Donald Johnson
1970	George Hatch A.A. Berk	1989	Gordon E. Bellen
1971	J. Fred Wilkes T.E. Larson	1990	Irwin H. (Mel) Suffet V. Dean Adams
1972	Robert Ingols Calvin Calmon	1992	Richard G. Zepp
		1998	Alan W. Elzerman
		1999	Jurgen Exner

**Edward Bartow Award**

1952	H. C. Marks
1953	F. J. Ludzack
1954	E. B. Tooper
1955	Frank M. Middleton
1956	John J. Maguire
1957	W. Allen Moore
1959	Aaron A. Rosen
1963	Robert S. Ingols
1964	Walter Chamot
1966	L.C. Terriere
1967	Henry G. Schwartz, Jr.
1969	Harry P. Kramer

**Fraser Johnstone Award**

1966	Andrew E. O'Keeffe
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**ACS Award for Creative Advances in Environmental Science and Technology**  
(Sponsored by Air Products and Chemicals, Inc.)

1980	James J. Morgan	1992	Glen E. Gordon
1981	Philip W. West	1993	John H. Seinfeld
1982	Jack G. Calvert	1994	Steven J. Eisenreich
1983	F. Sherwood Rowland	1995	Donna L. Bedard
1984	Julian Hecklen	1996	Donald H. Stedman
1985	Arthur Fontijn	1997	Charles E. Kolb
1986	Eugene E. Kenaga	1998	Mario J. Molina
1987	Joseph C. Arcos	1999	Terry F. Bidleman
1988	A. Welford Castleman, Jr.		James F. Pankow
1989	James G. Anderson	2000	Michael R. Hoffmann
1990	David M. Golden		
1991	Ronald A. Hites		

**ACS Award for Pollution Control**  
(Sponsored by Monsanto Company)

1973	A.J. Haagen-Smit
1974	H.S. Johnston
1975	Aubrey P. Altshuller
1976	Thurston E. Larson
1977	Werner Stumm

**Certificate of Merit**

1952	A. W. Busch Lillian A. Russell E. W. Mood R. C Kroner	1962	James J. Morgan Roger N. Saragent Otie J. Sproul
1953	W. N. Hearon A. Eugene Bowers L. J. Schmauch Frank E. Clark	1963	Max Blumer Ronald S. Joyce Irwin A. Rabin Murrell L. Salytsky Joseph Shapiro Ronald M. Siverstein Walter J. Weber, Jr.
1954	R. E. Anderson Earl Robert Gerhard Willard F. Libby	1964	Hugh Eisenhauer George P. Fitzgerald R.B. Grieves Louis Hemphill L.L. Wikstrom
1955	H. A. Barker Raymond A. Kolbeson Orville Wyss		
1956	Clayton F. Callis	1965	Solloff E. Bishop Glenn E. Johnson Don C. Lindsten Samuel H. Sharman Robert G. Spicher
1957	R. H. Burttschell Emillio Savinelli A. Lovis Medin J. Kenneth Brown		
1962	Richard L. Davie Thomas F. Demmitt Norman Michael	1966	Harvey W. Boyle Roy V. Comeaux Robert A. Erb John W. Hamaker

**Certificate of Merit (continued)**

	James J. Hickey	1987	Patrick H. Davies
	Ulo Kligemagt		Gary A. Epling
	Gordon C. Ortman		Jennifer Field
	Peter H. Westigard		William Fish
	R.W. Zwich		T. Mark Florence
			James Graineger
1967	F.J. Pocock		Steven B. Hawthorne
			Geneva M. Omann
1968	Mark J. Tenney		Ralph J. Portier
			Angel L. Rivera
1971	L.L.C. Sorensen		John E. Rogers
	P.L. Levins		Thomas H. Row
1973	Barbara J. Slatt	1988	W.H. Benson
			P.H. Davies
1975	Linda A. Deans		G.A. Epling
			W. Fish
1977	Rose Ann Cochran		T.M. Florence
	David M. Haile		J. Grainger
	Robert W. Looyenga		S.B. Hawthorne
			R.J. Portier
1980	Stuart W. Krasner		J.E. Rogers
1981	Purnendu K. Dasgupta	1989	Colleen Tashiro
	Jeral L. Schnoor		
		1990	Gerald T. Coyle
1986	Marcia F. Collins		Sayed Z. El-Sayed
	Douglas Craft		David J. Miller
	Werner R. Haag		Robert F. Mouradian
	Robert J. Kieber		T.R. Schwartz
	Joseph J. Pignatello		Helena Solo
	Richard J. Pruell		
	Jennifer E. Stern	1991	Wayne F. Chan
	James E. Woodrow		Dennis L. Corwin
			Werner R. Haag
1987	William H. Benson		Patricia Snyder

**Certificate of Merit (continued)**

1992	Deborah J. Fox Margaret S. Mills Lee J. Yoo	1996	Allen W. Apblett John C. Bart Kathleen E. Brummel Amy E. Childress Seungkwan Hong Tiehong Huang Jeanne A. Itak Kimberly L. Jones Herman O. Krabbenhoft Amy E. Witter
1993	Jeff Collett, Jr. Kent W. Schmidt Staci Lynn Simonich Rengao Song Paul Westerhoff		
1994	Thomas P. Franz Richard W. Gullick William P. Hamilton Ewa Lipczynska-Kochany Gary M. Litton Jimena P. Lopez Janice D. Makos Anuradha Ramaswami Thomas M. Young	1997	William A. Arnold Sandip Chattopadhyay Jennifer F. Clark Manvendra K. Dubey David A. Jeffrey Perry L. McCarty
1995	Lisa Axe Damia Barcelo Susan E. Burns Suresh Chandran Yolanda Fintschenko Robert N. Lerch Waihung Lo Thomas F. Perrone Joan D. Sulzberg Jennifer Wilkie	1998	Edward Heyse Eugene J. LeBoeuf Richard J. Murphy Lisa L. Phegley Tammy P. Taylor Jon Michael Williams

**Graduate Student Award Winners for 2001**  
Sponsored by the Division of Environmental Chemistry

<b>Name</b>	<b>Advisor</b>	<b>Graduate Program</b>
Dionysios Dionysiou	Makram Suidan	University of Cincinnati
Ed Scollon	George Cobb	Texas Tech University
Anne-Marie Compton	Richard Foust	University of Northern Arizona
Mike McCormick	Peter Adriaens	University of Michigan
Derek Peak	Donald Sparks	University of Delaware
Alexandra Stenson	William Cooper	Florida State University
Mazyar Zeinali	Alba Torrents	University of Maryland
Jim Chen	Menachem Elimelech	Yale University
Amy Dahl	Jean-Francois Gaillard	Northwestern University
Ryan James	Ron Hites	Indiana University
Ted Kuplinski	Yu-Ping Chin	Ohio State University
Jill Kostel	Kimberly Gray	Northwestern University
T. Michael Keinath	Walter Weber	University of Michigan
James Nurmi	Paul Tratnyek	Oregon Graduate Institute
Jason Lynch	Joseph Delfino	University of Florida
Kim Hageman	Jennifer Field	Oregon State University
Aaron Peck	Keri Hornbuckle	University of Iowa
Thomas Jabusch	Deborah Swackhamer	University of Minnesota
James Morris	Paul Davidovits	Boston College
Karlin Danielsen	Kim Hayes	University of Michigan
Juel Gibbons	Joel Burken	University of Missouri-Rolla

**Graduate Student Award Winners**

1986	Marijan Ahel Joseph T. Angley Stephen E. Cabaniss Patricia V. Cline Allen P. Davis Richard T. DeCesar Frank M. Dunnivant Thomas D. Gauthier Kimberly A. Gray Stephen R. Harper George D. Harris Hans Jannasch James N. Jensen Deborah J. McKechnie James R. Mihelcic Daniel L. Norwood Mary E. Pitts Chittaranjan Ray Charles V. Shorten Thomas J. Simpkin James E. Szecsody Mark A. Tumeo	1987	Mark Milke J. William Munger Meredith Newman Stephen G. Pedersen Mukund Ramamurthi Ann E. Sheffield Susan Stripp Paul G. Tratnyek Wanjia Zhang
		1988	Tekeshi Arakai Joel Eric Baker Gaboury Benoit Greg Butters Yu-Ping Chin Gary P. Curis Edward Franzblau Kenneth Michael Hart Diane M. Hermann Joon-Wun Kang Anil Kumar Brent L. Lewis Winston T. Luke Tom McDonald Terese M. Olson Debra R. Reinhart James R. Rhea Kevin G. Robinson Lucinda B. Sonnenberg John Storey Peter D. Tsakanikas
1987	Morton A. Barlaz Barbara A. Bates John Borrazzo Andrea M. Dietrich Talbert N. Eisenberg Julia E. Fulghum Nancy J. Hayden George B. Jarvis Judy S. LaKind Cheryl Matthias Janet A. Mayernik John F. McCarthy Lyn M. McIlroy		
		1989	Lisa M. Alvarez Todd A. Anderson Debra A. Backhus Kathy Boswell

**Graduate Student Award Winners (continued)**

1989	Suda Bunduwongse Menachem Elimelech Mohamad R. Farvardin Gary M. Hutter Seungdo Kim Leslie S. Laudon Caroline B. Purdy Janice P. Stowell Christine L. Tiller	1991	Hak Sung Lee George Murgel Mark A. Nanny Brian E. Rood John Sagebiel Mark Schlaufman David L. Sedlak Melinda A. Trizinsky
1990	William M. Davis Keith E. Dennett Matthew B. Gerhardt Kathryn Hunchak-Kariouk Joe Jersak James Jersey Man-Chi Lo Steve Machemar Karal Mesuere Sandra K. Miles A. Lynn Roberts Joseph G. Schnable Youshang Zang Yuewei Zhu	1992	Amy Lunn Bryce Susan E. Burns Margaret C. Carter Barbara R. Coughlin Shinoka Fujita Keri C. Hornbuckle Sally Jo Palmer Susan E. Powers Schawn Shottler Chichwen Shao Rengao Song Richard Sutton Anthony J. Tesoriero Kathryn K. Levenberg Ticho Dharanija Vasudevan Qingxi Wang Charles Shiu Wong Yuping Xu
1991	Diane Achman David A. Edwards Thomas P. Franz, Jr. Kevin H. Gardner Yuyang Gong Anne M. Hoylman Mark Jacobs Ramesh Lyer Lynn E. Katz	1993	Barbara Anderson Nada Assaf-Anid Joseph Chung Mamadou S. Diallo Anne Falke Lai Gui

**Graduate Student Award Winners (continued)**

1993	Corey Knoop Ellen Louise Kruger Suen-Zone (Jack) Lee Leah J. Matheson Angus E. McGrath Kurtis G. Paterson B. Douglas Reeves Carolyn J. Sampson Sukalyan Sengupta Jiamin Wan Jeyong Yoon	1995	Lisa M. Borbridge Amy Childress Britt E. Erickson Seungkwan Hong Michael J. Howdeshall Suilou Huang Margaret Hunter Emmanuel Iyiegbuniwe Timothy L. Johnson Kimberly L. Jones Franz-Günter Kari Alok Kumar Jian Li Wentai Luo Edward O'Loughlin Christopher M. Reddy Sujoy Roy Jennifer Sasaki Bo Shi Jean M. Smolen Maryann Suero Ying Xie
1994	Zafar Adeel Muhammad Ashraf Ali Cort Anastasio Lisa Axe Jon David Chorover Harry R. Beller Kirk E. Dean Baolin Deng Susan Grube Donaldson Jason Derek Geddes Gregory W. Harrington Edward Heyse John F. Kenneke Shi-Ping Lia Yarrow Nelson Roger Pearson Staci L. Simonich Bryan M. Smith Jeffrey C. Wallace Liza P. Wilson Jingfend Wu	1996	Brett Brunk Joel Burken Colin Chen Neal Durant Cynthia Evanko Alessandro Franchi Tohren Kibbey Daniel Schmelling Annette Trowbridge John J. Waypa Jennifer Wilkie

**Graduate Student Award Winners (continued)**

1996	Wells Wei-Shih Wu Yujun Yin Thomas Young Jianzhen Yu Dongye Zhao Huan Zhu	1998	Denise Taylor Lisa Ann Totten Timothy Tsukamoto Jianzhong Zheng Meifang Zhou
1997	Blakely Adair Barbara Bergen Sandip Chattopadhyay Yuan Chen Peter D'Adamo Jeff Darland Annette Dietz Susan Glassmeyer Weilin Huang Joon Min Matthew Morrison Michelle Scherer Brian Schroth Ning Sun Peter Vikesland Alex Yavich	1999	David Adamson William Arnold Hiroshi Awata William Bedsworth Robert Bruant Paul Brunciak Elizabeth Butler Martin Johnson Tarek Ladaa Brian Mader Heath Mash William Mills Tammy Taylor Eric Vrijenhoek
1998	W. Wayne Brubaker Rajat Ghosh Yann Le Gouellec Carolyn Krueger Eugene LeBoeuf Angela Lindner Brian Logue Huizhong Ma Penney Miller Annett Sullivan	2000	Joel Bandstra Rajat Chakraborti Jeffrey Chen Brian Desharnais Paul Hartmann Sarunya Hengpraprom Mehmet Kitis Jens-Uwe Kuhn Tie Li Katrice Lippa Shaun Mendonsa C. Andrew Ramsburg Alexa Rihana

**Graduate Student Award Winners (continued)**

2000      Darryl Roberts  
              Julia Rogers  
              Reggie Spaulding  
              Kavitha Subramaniam  
              Weihong Wang  
              Ted Wu  
              Haojiang Zhou  
              Julie Zimmerman

**Graduate Student Paper Award Winners for 2000**  
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“Abiotic Reduction of the Pesticides Oxamyl and Methomyl by Fe(II): Reaction Kinetics and Mechanism”

**Timothy J. Strathmann**, Alan T. Stone, Department of Geography and Environmental Engineering, The Johns Hopkins University

“Electrokinetic Water Splitting at Bipolar Interfaces of Ion Exchange Membranes and Soils”

**Brian Desharnais**, Barbara Lewis, Department of Civil Engineering, Northwestern University

“Intercalibration of LABS in Marine Sediment SRM1941A and Their Application as a Molecular Marker in Narragansett Bay Sediments”

**Paul Hartmann**, James Quinn, John King, S. Tsutsumi, Graduate School of Oceanography, University of Rhode Island

“Kinetic Distribution of Substrate Oxidation Potential as a Function of Geosorbent Characteristics: Implication of Contaminant Bioavailability and Kinetic Endpoints”

**Alexa N. Rihana**, Peter Adriaens, Department of Civil and Environmental Engineering, University of Michigan

“Vapor Pressures of Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs): Measurements and Evaluation of Estimation Techniques”

**Brian Mader**, James F. Pankow, Environmental Science and Engineering, Oregon Graduate Institute

Note: **Graduate student paper award winners are presented in bold**; faculty advisors are underlined.

**Graduate Student Paper Award Winners**

1987	Allen P. Davis Frank M. Dunnivant Wen H. Pan	1993	Grace M. Haggerty Wei Li Jiamin Wan
1988	G.C. Germann Janet G. Hering G.H. Peters C.V. Shorten C. Yurteri	1994	M.S. Diallo Jason Derek Geddes B.A. Homen S.T. Martin Staci L. Simonich
1989	Deb Backhus Larry B. Barber, II Meredith E. Newman Stuart A. Rounds	1995	Zafier Adeel Nicola J. Peill Dharni Vasudevan Jeffrey C. Wallace
1990	Bernadine A. Bonn Jennifer A. Field A.Lynn Roberts David L. Sedlak Guoshun Zhuang	1996	S. Colin Chen Cikui Liang David L. Lord Jean M. Smolen Nelson M. Yarrow
1991	Todd A. Anderson Sarah A. Green Murray Hackett Joseph N. Ryan John M.E. Storey	1997	Ching-Hua Huang Weilin Huang Tohren C.G. Kibbey Michelle M. Scherer Diane M. Wagrowski
1992	Diane R. Achman Keri C. Hornbuckle Laura L. McConnell Simo O. Pehkonen Charles S. Wong	1998	Barabara J. Bergen John M. Lendvay Huizhong Ma Mahaligam Ravichandran Lisa A. Totten William A. Arnold Chia-Chen Chen Martin D. Johnson
1993	Nada Assaf-Anid Huiling Ding		

**Graduate Student Paper Award Winners**

1999	Ping Li Peter Vikesland	2000	Brian Desharnais Paul Hartmann Brian Mader Alexa N. Rihana Timothy J. Strathmann
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**Based On Division of Environmental Chemistry Symposia**

**Books Available From: ACS Books/Oxford University Press**

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**Benign by Design: Alternative Synthetic Design for Pollution Prevention.** Paul T. Anastas and Carol A. Farris, Editors, Symposium Series 577, \$70

**Bioremediation Through Rhizosphere Technology.** Todd A. Anderson and Joel R. Coats, Editors, ACS Symposium Series 563, \$70

**Designing Safer Chemicals: Green Chemistry for Pollution Prevention.** Stephen C. DeVito and Roger L. Garrett, Editors, Symposium Series 640, \$95

**Electromagnetic Fields: Biological Interactions and Mechanisms.** Martin Blank, Editor, Advances in Chemistry Series 250, \$145

**Environmental Biomonitoring: Exposure Assessment and Specimen Banking.** K.S. Subramanian and G.V. Ivengar, Editors, Symposium Series 654, \$110

**Environmental Chemistry of Lakes and Reservoirs.** Lawrence A. Baker, Advances in Chemistry Series 237, \$165

**Environmental Epidemiology.** William M. Draper, Editor, Advances in Chemistry Series 241, \$90 (hardcover), \$60

**Environmental Immunochemical Methods: Perspectives and Applications.** Jeanette M. Van Emon, Clare L. Gerlach, and Jeffre C. Johnson, Editors, Symposium Series 646, \$115

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40(2)	220, Fall, 2000 Washington, D.C.	Sequestration of Organic Solutes in Natural Organic Matter and Mineral Aggregates; Electrochemical Methods for the Environmental Analysis of Trace Metal Biogeochemistry; Scientific Uncertainty and Risk Management; Membrane Separation Processes in Aquatic Systems; Chemical-Biological Interactions in Contaminant Fate; Chemical Speciation and Reactivity in Water Chemistry and Water Technology: A Symposium in Honor of James J. Morgan; Environmental Chemistry Awards Symposium; Environmental Chemistry: Emphasis on EPA and EPA Supported Research; General Papers	45.00 print 15.00 CD

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37(2)	214, Fall, 1997 Las Vegas	Isolation, Fractionation, Characterization, and Reactivity of Environmental Colloids; Soil Contaminant Remediation Issues; Mechanisms and Effects of Resistant Sorption Processes of Organic Compounds in Natural Particles; Student Awards Symposium; Environmental Programs in Nevada; General Papers	20.00
37(1)	213, Spring, 1997 San Francisco	Redox Reactions in Natural and Engineered Aqueous Systems; Global Climate Change: Uncertainties and Research Needs; Environmental Application of Biosensors; Green Chemistry/Environmentally Sustainable Manufacture as a Competitive Advantage; Field Testing of Innovative Subsurface Remediation Technologies; ACS Award for Creative Advances in Environmental Science and Technology in Honor of Charles E. Kolb: Atmospheric Chemistry as a Science and a Service (Sponsored by <i>Air Products and Chemicals, Inc.</i> ); Degradation of Chemicals with Significant Environmental Impact; Environmental Fate and Effects of Gasoline Oxygenates; General Papers	20.00
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32(2)	204, Fall, 1992 Washington, D.C.	Molecular Biological Tools in Environmental Chemistry, Biology and Engineering; Lead Poisoning in Children: Exposure, Abatement and Program Issues; Environmental Success in the Chemical Industry; Assessing the State of the Environment; Student Awards; Environmental Chemistry of Dyes; General Papers	10.00
32(1)	203, Spring, 1992 San Francisco	Environmental Aspects of Surface and Aquatic Photochemistry; Solid Phase Extraction in Environmental and Clinical Chemistry; Oxidation-Reduction Transformations of Inorganic and Organic Species in the Environment; Environmental Successes in the Chemical Industry; Receptor Models for Airborne Particles: In Honor of G.E. Gordon, Recipient of the 1992 ACS Award for Creative Advances in Environmental Chemistry; Aquatic Chemistry (Honoring W. Stumm); Environmental Epidemiology: Detecting and Quantifying Effects of Environmental Chemicals on Human Health; Environmental Chemistry of Sustainable Agriculture; Environmental Chemistry and Toxicity of Surfactants; General Papers	10.00
31(2)	202, Fall, 1991 New York	Chemistry and Microstructure of Solidified Waste Forms; Soil Gas Analysis-Environmental Containments; The Quantitative Ranking of Environmental Problems According to Risk-What Must We Yet Know to Accomplish This Task?; EPA's Hazard Ranking System and Decision Methodology-What is the Basis of EPA's Listing of Sites for Superfund?; Remedial Action Plan-Program for the Great Lakes; Special Topics and General Papers	10.00
31(1)	201, Spring, 1991 Atlanta	Acid Rain Mitigation-Liming Technologies and Environmental Considerations; Biotechnology for Wastewater Treatment; Environmental Chemistry of Lakes and Reservoirs; Organics in the Environment; Pollution Prevention and Process Analytical Chemistry; Shallow Aquifer Chemistry; Wetland Chemistry; Southern Oxidants Study; General Papers	10.00

## **SYMPOSIA, SPECIAL TOPICS AND ORGANIZERS**

### **GENERAL PAPERS**

**MICHAEL L. TREHY** is a senior research specialist at Solutia, Inc. He has been actively involved in environmental issues related to waste water, chlorination by-products in drinking water, methods development for analyzing for trace components in the environment and the fate of surfactants such as linear alkylbenzene sulfonate in the environment. He obtained his B.S. in Chemistry from Eckerd College, his M.S. in Chemistry from Florida Atlantic University and his Ph.D. in Chemistry at the University of Florida. Dr. Trehy is the program chair and an alternate councilor for the Division of Environmental Chemistry.

### **FIELD ANALYTICAL CHEMISTRY: TECHNIQUES, TECHNOLOGIES, AND APPLICATIONS (cosponsored with Division of Analytical Chemistry)**

There have been tremendous advances in field portable and transportable technologies that can generate real-time measurement data. Measurement of an ever-increasing number of organic and inorganic contaminants in complex matrices at ever-increasing levels of sensitivity requires the development and evaluation of innovative field analytical, sampling, and sample handling techniques. There is a need for rapid, low-cost field analytical methods to support hazardous waste and mixed-waste site monitoring and characterization activities, drug interdiction, occupational safety, explosives detection, food safety, and emergency management, among others.

The objective of this Symposium is to bring together scientists, engineers, and practitioners to discuss progress in the development and application of field analytical chemistry and to share experiences in applying these techniques to real-world problems. The presentations will address a myriad of topics including real-world applications and a few will discuss innovative chemical analytical techniques that are being developed for deployment in the field.

**ERIC KOGLIN** is the Manager of the Site Characterization and Monitoring Technologies Center of the U.S. Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) Program. He works in Las Vegas, Nevada in the Environmental Sciences Division of the National Exposure Research Laboratory. As the Center Manager he is responsible for implementing the demonstration, verification, and information diffusion activities that focus on site characterization and monitoring technologies. Eric graduated with a B.S. in Geology from Indiana State University in 1979, and a M.S. in Hydrology from the University of Arizona in 1984. He started his career with EPA in 1984, initially as a Superfund

Remedial Project Manager with Region 9 in San Francisco, California. In 1985 he accepted a position as a staff hydrologist with the National Exposure Research Laboratory's Environmental Sciences Division in Las Vegas, Nevada (formerly known as the Environmental Monitoring Systems Laboratory) and is presently a senior scientist on the staff. Among his many past duties at the Laboratory, he has managed the monitoring and measurement technologies demonstration portion of the Superfund Innovative Technology Evaluation (SITE) Program, he has served as the Technical Chairman of the last five International Symposia on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, and is an Associate Editor of the John Wiley and Sons journal *Field Analytical Chemistry and Technology*.

**LAWRENCE H. KEITH** is a Vice President and Senior Corporate Fellow at WPI, a non-profit institute affiliated with Virginia Tech in Blacksburg, VA. He is author of 170 books and technical articles on toxic chemicals and environmental pollution. A Ph.D. chemist, he is past Chairman of the Division of Environmental Chemistry, current editor of the Division's newsletter, and also its Web Master. He has helped to organize three symposia on endocrine disrupting chemicals at national meetings and published a 1200 page book on properties of these chemicals with John Wiley Publishers. He began his career at the U.S. EPA Research Laboratory in Athens, GA and also worked for 21 years at Radian International prior to joining WPI.

**WILLIAM H. BATSCHELET** is an Environmental Chemist in the Consultant Operations Division, Headquarters, Air Force Center for Environmental Excellence (AFCEE), located at Brooks AFB, San Antonio, Texas. As such, he serves as a chemical consultant on environmental issues, including providing technical expertise and chemical insight for restoration projects, reviewing technical reports and data packages to ensure that they meet quality standards, and reviewing contractor and laboratory operations to ensure that they provide quality services. He joined AFCEE in July 1999. Before serving in his present position, he was the Lead Environmental Chemist in the Chemical Science Section at Kelly AFB, Texas. Dr. Batschelet received his B.A. degree in Chemistry from Grinnell College, his M.S. and Ph.D. degrees in Chemistry and Inorganic Chemistry, respectively, from the University of Washington, Seattle. He serves as a member on the ACS Committee on Environmental Improvement and on the ACS Committee on Technician Affairs.

**DIANE CRUMBLING** has worked in USEPA's Technology Innovation Office since 1997. She holds a B.S. in Biochemistry and an M.S. in Environmental Science, and has over 20 years of experience in biomedical, analytical, and environmental chemistry.

## SUSTAINABLE CHEMISTRY IN THE NEW MILLENIUM

This half-day symposia on sustainable chemistry will discuss new synthesis techniques, biofuels, biodegradation testing of plastics, impacts of crumb rubber recycle and new remediation techniques.

**MICHAEL L. TREHY** (see above)

### **ADVANCES IN REMEDIATION OF HEAVY METALS IN THE ENVIRONMENT**

This symposia focuses on new technology for stabilization and removal of mercury and other heavy metals in the environment and in waste streams.

**DAVID A. ATWOOD** received his B.S. the University of Alabama and his Ph.D. in Inorganic Chemistry in 1992 from the University of Texas, Austin. In 1993, he moved as an Assistant Professor to North Dakota State University as part of their new Center for Main Group Chemistry (of which he was co-director). In 1998, Dr. Atwood joined the chemistry department at the University of Kentucky faculty as an Associate Professor. At this point he had close to 100 publications and funding from several governmental agencies (ONR, NSF, PRF, DOE) and industrial sponsors (Praxair Surface Technologies, Union Carbide).

**MICHAEL L. TREHY** (see above)

### **BIOGEOCHEMISTRY OF ENVIRONMENTALLY IMPORTANT ELEMENTS**

Over the past decade there have been great advances in the understanding of the significance of trace elements in environmental and biological systems. The symposium will address the latest developments in the study of occurrence, transport, and transformation of trace elements in the environment and biological systems as well as recent advances in analytical chemistry applicable to the biogeochemical studies of trace elements. Since the toxicity and environmental behavior of trace elements are dependent on their physico-chemical forms, speciation information involved studies are especially emphasized in this symposium. The symposium will be divided into four sessions including three orals and one poster. Each session contains about eight presentations. The symposium offers a unique opportunity for the exchange of information and ideas among scientists who work in the biogeochemistry of trace elements.

**YONG CAI** is currently assistant professor in the Department of Chemistry and Southeast Environmental Research Center (SERC) at Florida International University. He received his B.S. degree in Chemistry at Ocean University of Qingdao and his M.S. and Ph.D. degrees in Environmental Chemistry at Nankai University in China. He worked as a post doctoral research fellow at the Max Planck Institute for Chemistry in Germany for three years and as a research scientist at the Centro de Investigación y Desarrollo (CSIC), Barcelona, Spain for two years. His research interests are in the field of environmental and bioanalytical chemistry of trace metals and organometallic compounds, which include the development of new analytical techniques for speciation

of metals and metalloids, and their fate and transport in the environmental and biological systems. His current research is focused on 1) the study of arsenic in soil-plant system, including the development of speciation techniques and the mechanisms of arsenic accumulation and detoxification in arsenic hyperaccumulating plants; and 2) the study of the fate and transport of trace metals and metalloids in the South Florida ecosystems, especially the biogeochemical cycling of mercury in the Everglades.

**OLIN C. BRAIDS** holds a B.A. degree in Chemistry (1960) and a M.S. degree (1963) in Soil Chemistry from the University of New Hampshire and a Ph.D. degree in Soil Chemistry (1966) from The Ohio State University. He was a post-doctoral fellow and Assistant Professor in the Agronomy Department at the University of Illinois, Urbana-Champaign. His research included metal and nutrient relationships with the agricultural utilization of wastewater biosolids and the fate and behavior of lead in the environment. He joined the U.S. Geological Survey, Water Resources Division on Long Island to study the effects of municipal landfill leachate on groundwater quality. He then joined Geraghty & Miller, Inc. to continue similar studies and became involved with investigations of industrial waste practices. It was during this time that organic chemical contamination of surface and groundwater became evident through development of analytical techniques that could measure it. Dr. Braids assisted the USEPA in developing groundwater-monitoring programs and sampling protocols for organic chemical contaminants. For the past several years, he has provided litigation support in matters of groundwater contamination, CERCLA cost recovery allocation, and compliance with the National Contingency Plan. He was an expert witness in the Anne Anderson *et al.* vs. W.R. Grace, Inc. *et al.* case that was the subject of the recent book and movie, "A Civil Action."

Dr. Braids has been a member of the American Chemical Society and the Division of Environmental Chemistry since 1963. He has been social chair for the Environmental Chemistry Division for the past four years.

### **ELEGANT ANALYTICAL CHEMISTRY APPLIED TO ENVIRONMENTAL PROBLEMS — A PRACTICAL SYMPOSIUM**

This symposium has been organized to provide a platform for the presentation and discussion of clever ways to overcome problems encountered when analyzing environmental samples. Participants will share practical solutions that could be immediately applied by the chemist at the bench. Topics relating to a wide variety of analytical techniques are represented. It is interesting to note that what is an extremely clever way to proceed in capillary electrophoresis may have very little interest to a mass spectroscopist — yet, there is a common thread throughout all of environmental analytical chemistry and the papers presented here will be of good general interest to all analytical and environmental chemists who pursue the quest for a cleaner environment.

**VICTOR TUROSKI** is a graduate of Wilkes University, Wilkes-Barre, Pennsylvania and has pursued a career in analytical chemistry at Carter Wallace, the American Can

Company, and Fort James. Vic is presently Analytical Manager Emeritus of the Corporate Analytical Research Laboratory at the Fort James Technical Center in Neenah, Wisconsin. He led a technically advanced analytical group whose role is to support corporate R&D, trouble shoot manufacturing problems, and provide toxicity and safety data to the Fort James Regulatory Affairs Department. Vic has published several articles in the field of environmental chemistry and is editor of two books based on major ACS symposia: Formaldehyde - Analytical Chemistry and Toxicology and Chlorine and Chlorine Compounds in the Paper Industry. Vic has been an active member of the Environmental Division for the past twelve years. He currently serves the ACS Division of Environmental Chemistry as Program Chairperson for Environmental Analytical Chemistry and from time to time performs article peer review for *Environmental Science and Technology*.

**SUSAN D. RICHARDSON** is a research chemist at the U.S. Environmental Protection Agency's National Exposure Research Laboratory in Athens, GA. She received her B.S. in Chemistry and Mathematics from Georgia College in 1984 and her Ph.D in Chemistry from Emory University (in Atlanta, GA) in 1989. At the U.S. EPA, she leads a team of chemists in developing and applying multispectral analysis techniques to environmental problems. Her recent research has focused on the identification and characterization of disinfection by-products (DBPs), with special emphasis on alternative disinfectants and polar by-products. She has authored more than 20 publications and book chapters in this area. She has entered into two collaborative efforts, which when combined with her identification research, will provide the basis for evaluating public health risks for DBPs. The first is an exhaustive survey of DBP occurrence in municipal water supplies to establish the extent and levels of public exposure. The second is a collaborative effort with scientists at the U.S. EPA's National Health and Environmental Effects Research Laboratory to determine human health effects for DBPs, singly and collectively.

**JOHN PLUDE** attended the University of Connecticut, Storrs, for undergraduate education and continued at the University of New Hampshire, where he received his degree in analytical chemistry. His thesis dealing with metal ion interactions with illite clay were the start of a lifelong interest in the interface of environmental and analytical chemistry. He taught at Bloomsburg University, PA and moved to the University of Wisconsin-Oshkosh where he now holds a professorship in chemistry and adjunct professor positions in biology/microbiology and medical technology. His interests have spanned endocrine system stimulation studies in alligators and turtles, metal ion affinities of naturally produced polysaccharides of cyanobacteria, and metal uptake and deposition in endangered sea turtle eggs in the Middle East (Oman). He has published several articles in these interdisciplinary areas, and has been a reviewer of a major text and was involved in the creation of the year 2001 Analytical Chemistry National Exam. He has been very active in the ACS as a councilor for the Northeast Wisconsin local section. He is very interested in student education and involvement in chemistry. As an ACS student affiliate advisor he has directed student efforts to win two national awards.

**ENVIRONMENTAL TRENDS**  
**(Cosponsored with the ACS Committee for Environmental Improvement)**

From the beginning of human habitation of the earth one reason nomadic tribes are believed to have moved was to escape the stench of the animal, vegetable and human wastes that they created. Humans have been advanced enough for the last 10,000 years to tamper with the earth's natural cycles. Over the last 175 years industrialization has greatly improved humans standard of living as well as accelerating human modification of our planet. Human activities continue to modify natural cycles. Research results over the last few decades have heighten our concerns about adverse effects of human activities. These concerns have resulted in regulations (e.g. Clean Water and Clean Air Acts) that are attempts to lessen adverse effects and to provide for sustainable development of the Earth. The purpose of this session is to provide a forum for the presentation of results that detail environmental trends. What were the conditions in the past? Are conditions getting better, remaining the same or getting worse? Are current conditions adequate to provide sustainable development and can regulation be relaxed or are more stringent regulations needed? With several decades of environmental data available we should be able to address environmental trends for plants, animals, soils, sediments, waters and the atmosphere. This session should help to demonstrate our state of knowledge regarding environmental trends of our Earth.

**TERRY L. WADE** Deputy Director of Environmental Sciences and Research Scientist, received his Ph.D in Chemical Oceanography from the University of Rhode Island in 1978. Dr. Wade has been active in the field of marine organic environmental chemistry for more than 30 years and is a respected international expert in environmental chemistry. He has developed and validated methods for analysis of trace organics in environmental samples including aliphatic hydrocarbons, aromatic hydrocarbons, biomarkers, chlorinated hydrocarbons, PCB, coprostanol, toxaphene, dioxins/furans and butyltins. He has applied these methods to research projects involving air, rain, fresh water, seawater, soils, sediments, plant tissues and animal tissues. Dr. Wade has more than 150 publications which deal with method development, intercalibration, and sources and fate of contaminants in the environment. He has had extensive field experience and has participated in nine oceanographic research cruises, as well as being a scientist on board the Navy NR-1 research submersible. In addition, he has been responsible for collection of air and precipitation samples for contaminant analyses. Dr. Wade has extensive experience in project development and management. He is currently Program Manager for the NOAA Status and Trends Program, and both USFWS Organic and Inorganic Contracts. He has been extensively involved in trace organic compound intercalibrations in association with these programs and has co-authored several intercalibration reports. As a member of UNESCO group of experts on Standards and Reference Materials (GESREM), Dr. Wade co-authored a workbook entitled "Use of Standards and Reference Materials in the Measurement of Chlorinated Hydrocarbon Residues". This workbook is intended to provide laboratories in underdeveloped nations clear examples of how to use reference materials as part of their laboratory quality management program. Dr. Wade also reviews several proposals and

journal articles every year. Dr. Wade has had a leading technical and management role in most of GERG's environmentally related projects. As Project Manager, Dr. Wade is responsible for scheduling and timely completion of sample preparation, analysis, data processing, and reporting for this project.

**ACS AWARD FOR CREATIVE ADVANCES  
IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY:  
HONORING DR. MICHAEL R. HOFFMANN  
(Sponsored by Air Products and Chemicals, Inc.)**

Hoffmann's detailed investigations of the kinetics and mechanism of the oxidation of dissolved sulfur dioxide in the form of bisulfite by hydrogen peroxide in acidic aqueous solution (Llofmann and Edwards, 1975; McArdle and Hoffmann, 1983) established the state-of-the-art for our understanding of important pathways for the oxidation of sulfur dioxide to sulfuric acid in the atmosphere. This fundamental reaction is now recognized as the single most important pathway for the conversion of sulfur dioxide to sulfuric acid on a global basis. As much as 80% of the total sulfur dioxide on a global basis is oxidized via the cloud-processing pathway originally proposed by Hoffmann and Edwards (1975). The reaction mechanism involves the nucleophilic addition of hydrogen peroxide to the bisulfite ion to form a peroxymonosulfite intermediate, which, in turn, undergoes a proton-catalyzed rearrangement to give bisulfate as the final product. This mechanism has been formally named the "Hoffmann and Edwards' Mechanism.

The next major advancement by Hoffmann and his group involved a detailed field-oriented study of the chemistry of clouds and fogs. The primary focus of these studies was to obtain solid field-based observations of dynamic chemical changes within liquid water droplets and to very predictions of chemical kinetic models (e.g., Jacob and Hoffmann, 1983) for cloudwater acidification. In this regard, Hoffmann and co-workers developed several patented (US Patent Numbers 4,697,462 and 4,732,037) devices for the automatic time-series collection of cloud and fog water from ground-based sampling stations. In 1982, they published a seminal paper (Waldman et al., 1982) in *Science* entitled "The Chemical Composition of Acid Fogs," in which they determined the detailed chemical composition of hyperacidic clouds and fogs. Hoffmann and his students measured pH values below 1.7 in coastal marine clouds and fogs. The occurrence of such highly acidic clouds and fogs was not predicted.

During the course of their field studies, Hoffmann and his students discovered that many cloud systems in near urban environments were enriched in dissolved sulfur dioxide (i.e., S(IV)) and aldehydes such as formaldehyde, methyl glyoxal, glyoxal, and hydroxyacetaldehyde. Based on their initial observations they (Boyce and Hoffmann, 1984; Munger et al., 1984; Munger et al., 1986; Olson and Hoffmann, 1989) proposed that bisulfite and the aldehydes react in situ within cloud droplets via a classical reaction to form reversibly aldehyde-bisulfite adducts or hydroxyalkylsulfonates as reservoir species for S(IV). A short time later, Hoffmann and his group a new analytical

methods that allowed for the direct chromatographic determination of the hydroxyalkyl-sulfonates in ambient samples. They reported their discovery of the actual occurrence and quantification of these compounds in *Science* (Munger et al., 1986).

In the field of pollution control chemistry, Hoffmann (1977) investigated the detailed kinetics and mechanism of the oxidation of hydrogen sulfide by hydrogen peroxide over a broad pH range and proposed that this reaction could be used to conveniently control  $2 S$  in water and wastewater systems. Today this simple chemical system is widely used to control the odor, corrosion, and toxicity problems posed by  $H_2S$  in engineered systems. In the next major advance, Hoffmann and his students (Hoffmann and Lim, 1979; Boyce et al., 1983; Hong and Hoffmann, 1987ab, Leung and Hoffmann, 1989ab) synthesized a series of metal phthalocyanine complexes that were highly effective homogeneous catalysts of the oxidation of hydrogen sulfide in water by molecular oxygen, which is a slow reaction in the absence of any catalytic influences.

Over the same period of time, Hoffmann and his students (Kormann et al, 1988; Bahne-mann, et al., 1987; Hong et al., 1987ab; Choi et al., 1994; Martin et al., 1994abc) carried out a detailed series of investigations in the photochemistry and photophysics of colloidal metal oxide semiconductor systems that could be used for the effective elimination of chemical contaminants from water or for the in situ production of hydrogen peroxide. Hoffmann and colleagues were the first to synthesize nano-sized colloidal ZnO in the quantum-size domain (i.e., the photochemical characteristic such as the band-gap energy increase with decreasing particle size) and show that as the particle sizes decrease toward 2 nm in diameter the quantum yield for the photoreduction of dioxygen to form hydrogen peroxide approaches unity (Hoffmann et al., 1994). This research also led to the development of hybrid photocatalytic systems involving the chemical coupling of Co(H)tetrasulfophthalocyanine catalysts to the surface of  $TiO_2$  to produce an unusually high reactivity photocatalyst (Hong et al., 1987ab). In the case of the photooxidation of  $\sim$  by oxygen, the measured quantum yield in the presence of the hybrid photocatalyst was greater than 1000, which indicated that the reaction proceeded via the photolytic induction of a free-radical chain reaction on the surface of the functionalized titanium dioxide (Hong et al., 1987b).

Research in the area of metal-doping of the quantum-size semiconductor photocatalysts led directly to the successful development of niobium (V)-doped  $TiO_2$ -coated titanium anodes for the direct electrochemical production of hydroxyl radical from the oxidation of hydroxide ion and water with current efficiencies approaching 98% (Kesselman et al., 1997; Weres and Hoffmann, U.S. Patents 5,364,508, 5,419,824; and 5,439,577).

Hoffmann and his group have applied several forms of electrohydraulic cavitation for the elimination of hazardous chemical compounds from water. They have advanced our understanding of the chemistry and physics of ultrasonic irradiation in water and advocated its application of the destructive elimination of chemical contaminants such as carbon tetrachloride, pentachlorophenol, TNT, parathion, triethanolamine, and

methyl tertiary-butyl ether from groundwater. Hoffmann and his students have demonstrated that electrohydraulic cavitation induced by ultrasonic irradiation over the frequency range of 16 to 1,100 kHz results in the complete oxidative and pyrolytic degradation of a wide range of organic and inorganic compounds in water (Kotronarou et al., 1991; Kotronarou and Hoffmann, 1992; Hua and Hoffmann, 1996; Hua and Hoffmann, 1997; Kang and Hoffmann, 1998).

**RUTH A. HATHAWAY** serves as the Business Office Manager for the Division of Environmental Chemistry of the American Chemical Society. Mrs. Hathaway is a consultant with Hathaway Consulting and a part time instructor in the Department of Chemistry at Southeast Missouri State University. Prior to her consulting work, she was the quality control/quality assurance director for an environmental lab and the laboratory director for a transformer manufacturer. She received her B.S. in Chemistry from Huntington College and did graduate work in Medicinal Chemistry at Purdue University. She is an active member of the Division of Environmental Chemistry. She serves on the ACS Divisional Activities Committee and the Board for the National Registry for Certified Chemists.

### **INNOVATIVE STRATEGIES FOR THE REMEDIATION OF CHLORINATED SOLVENTS AND DNAPLS IN THE SUBSURFACE**

Chlorinated solvent contamination resulting from the release of such chemicals as perchloroethylene (PCE), trichloroethylene (TCE), and carbon tetrachloride (CTET) represent a continuing challenge to soil and groundwater remediation. Sites contaminated with chlorinated solvents are particularly difficult to remediate when undissolved separate-phase solvents, commonly referred to as DNAPLs (dense non-aqueous phase liquids) are present in the subsurface. Recent technology developments resulting from innovations in the public, academic, and private sectors are providing new strategies for cleaning up chlorinated solvents in soil and groundwater. Many of these technologies are being pilot tested as part of field efforts supported by Federally-funded projects, regulatory work groups, and industry technology development forums; and several have been brought to market in full-scale systems. This two-day symposium provides a focused forum on some of the current technology developments in chlorinated solvent remediation. On Day 1 new innovations that will be presented include reactive emulsions, surfactant flushing, cosolvent flooding, oxidant flushing, advanced oxidation, steam injection, electrochemical remediation, and bioremediation. On Day 2, a morning and an afternoon session will focus on permeable reactive barriers (PRBs), with particular focus on zero-valent iron PRBs ("iron walls"). Topics will include reaction geochemistry, PRB longevity, rejuvenation of iron PRBs, construction methods and emplacement techniques, and other related topics. On the day following the PRB sessions, the PRB subcommittee of the Remediation Technology Development Forum will hold an open meeting for further discussion of PRBs.

Partially funding of this symposium by ACS Corporate Associates.

**SUSAN M. HENRY** works for URS Corporation in the Santa Ana, California office. She has over fifteen years of environmental engineering experience, with a focus on investigation and remediation of contaminated soil and groundwater. Dr. Henry manages projects for commercial and attorney clients, supervises staff, and provides firm-wide leadership on natural attenuation, bioremediation, and fate and transport evaluations. Her recent project experience includes project management of pilot studies for a large industrial facility with multiple chlorinated solvent DNAPL source locations and over 100 acres of dissolved-phase plume. This program included assessment of natural attenuation, iron permeable reactive barriers, *in situ* advanced oxidation, dual phase extraction, and soil vapor extraction as potential components of the site management strategy. Dr. Henry has provided litigation support as designated expert for cases involving petroleum hydrocarbon and chlorinated solvent affected sites, including a complex multi-party litigation in one of the Superfund operable units in Northern California. She has obtained case closure and no further action on three sites through successful negotiation with the Los Angeles RWQCB. Dr. Henry received a Ph.D. in Environmental Engineering from Stanford University, a M.S. in Environmental Science and Engineering from Virginia Tech, and a B.A. in Biology from Earlham College. Her doctoral research focused on aerobic biodegradation of TCE, and she has published extensively on bioremediation of chlorinated solvents.

**CHARLES R. BENNETT** died of a sudden heart attack at his home on November 12, 2000. Dr. Bennett had been an active member of the ACS Orange County Section, having held such positions as Chair-Elect, Chair, and Past-Chair, Councilor, OCS Representative on the Coordinating Committee of California ACS Sections, and a member of the ACS National Committee on Environmental Improvement. He was Chair of the OCS ACS Public Affairs Committee, the OCS Environmental Committee and he helped establish the Environmental and Industrial Technology (EIT) Committee as well as the Methyl *t*-Butyl Ether (MtBE) OCS ad hoc Committee. He was an active member on the Executive Committee of the Division of Environmental Chemistry. Chuck Bennett was a true environmental scientist and a valued mentor.

## TROPOSPHERIC CHEMISTRY

Understanding the chemistry of the troposphere is of fundamental importance to the prediction and subsequent control of air pollution in urban, regional, and global environments. Although the fates of anthropogenic and biogenic constituents of the troposphere are governed by complex chemical interactions, many advances have been made in our understanding of tropospheric chemistry. The Tropospheric Chemistry symposium will focus on studies of homogeneous gas-phase reactions, secondary aerosol formation, and heterogeneous/ multiphase reactions that are pertinent to the troposphere.

**JEAN M. ANDINO** is currently an Assistant Professor in the Department of

Environmental Engineering Sciences at the University of Florida. She received a Bachelor of Science degree in Engineering Sciences from Harvard University in 1988 and a Ph.D. in Chemical Engineering (under Dr. John Seinfeld) from the California Institute of Technology in 1996. Between undergraduate and graduate school she spent two years as a Research Scientist at Ford Motor Company (primarily in the Atmospheric Chemistry program).

Dr. Andino is a National Science Foundation CAREER awardee, and the co-author of numerous papers on chemical reactions pertinent to the troposphere. She is also an associate member of the ACS Joint Board-Council on Minority Affairs.

### **RTDF PERMEABLE REACTIVE BARRIERS**

The Remediation Technologies Development Forum (RTDF) Permeable Reactive Barriers (PRB) Action Team will be holding a special one-half day meeting in conjunction with the American Chemical Society (ACS) National Meeting in San Diego, California from April 1 through April 5, 2001. The RTDF meeting will be held the morning of Thursday, April 5, 2001, the day following a special ACS symposium: Innovative Strategies for the Remediation of Chlorinated Solvents and DNAPLs in the Subsurface. In addition to updating attendees on RTDF activities, the RTDF PRB Action Team meeting will provide a forum to discuss the key technical issues related to PRB development presented during the special ACS symposium. A specific series of presentations and panel discussions pertaining to PRB performance monitoring also will be held during the meeting. A summary report from the one-half day RTDF session will be prepared for attendees and possible future publication by ACS. Moderators of the meeting will include Tim Sivavic, Ph.D, Principal Research Scientist for the General Electric Company, Dr. Robert Puls, Branch Chief for the U.S. Environmental Protection Agency National Risk Management Laboratory in Ada, Oklahoma, Mr. John Vidumsky, Principal Engineer with the Du Pont Company, and Scott D. Warner, Senior Engineering Hydrogeologist with Geomatrix Consultants, Inc. Additional panelists will be named at a later date. The PRB Action Team was established in March 1995 as one of the seven Action Teams under the RTDF. The RTDF was created by the U.S. Environmental Protection Agency in 1992 to foster collaboration between public and private sectors in finding innovative solutions to mutual hazardous waste problems.

The PRB Action Team has met to discuss ongoing research, to identify development needs not currently being addressed, to identify and promote the funding of priority research needs to advance the acceptance of the technology, and to develop plans for collaborative field studies. The PRB Action Team also recently completed a two-year training course held in conjunction with the U.S. EPA and the Interstate Technology Regulatory Cooperation in 14 cities across the country.

Presented before the  
DIVISION OF ENVIRONMENTAL CHEMISTRY  
American Chemical Society  
221st National Meeting  
San Diego, CA

April 1-5, 2001

GENERAL PAPERS

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M.L. Trehy, Presiding

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M.L. Trehy, Presiding

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Honoring Dr. Michael R. Hoffmann  
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