

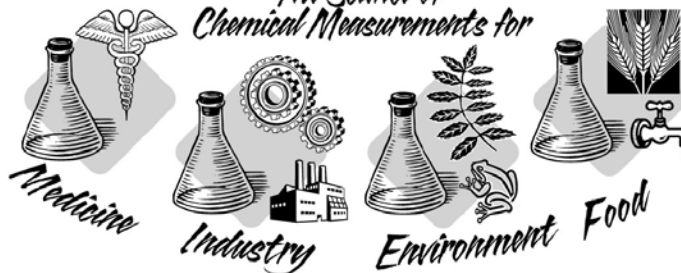


AMERICAN CHEMICAL SOCIETY  
DIVISION OF ANALYTICAL CHEMISTRY  
NEWSLETTER

Fall Meeting  
New York  
September, 7-11, 2003

## Analytical Chemistry Serves Humanity

The Science of  
Chemical Measurements for



# 3.8 Cents/Day, Homeland Security and Scientific Progress



By David Pinkston,  
DAC chair.

What might you buy with 3.8 cents per day? Not much, you reply. Well, how about 5 cents? Perhaps a piece of candy in a few stores or restaurants? What if I told you that you could improve the security of the Nation? How about furthering our understanding of global warming, improving the quality of life of thousands thanks to a new drug, or enhancing the education of future analytical scientists? Your membership in the ACS Division of Analytical Chemistry costs about 3.8 cents per day. Collectively, our dues allow our division to organize and sponsor symposia at National and Regional meetings that really do make a difference. Not only do these symposia educate and inform, but also they influence the direction of future research. For example, your division has sponsored a series of symposia on homeland security stretching over three National ACS meetings, culminating in 3 symposia scheduled for the fall meeting in New York City, which will conclude on the second anniversary of the September 11 attacks. These symposia will bring together leaders and scientists who will direct research and formulate policy on

national and global security measures in years to come.

In another area of critical importance to all of us, understanding the complex interrelationships within global environment systems depends critically on good analytical chemistry. I listened recently to a talk by Lonnie G. Thompson, the so-called "ice man" from The Ohio State University. While courage, perseverance, and many other disciplines contribute to the research he and his colleagues are conducting, it's clear that good analytical chemistry is the foundation for making the measurements that contribute to real understanding in this area. This understanding will influence public policy that will ultimately affect all of our lives. By supporting our discipline, you've had a hand in this policy.

Finally, over the past two decades, we've experienced a dramatic revolution in our understanding of biological systems, and in the way, for example, drug discovery and development are conducted. Advances in analytical chemistry are at the core of this revolution.

One core enabling analytical technology which has allowed this revolution is mass spectrometry. Koichi Tanaka, co-recipient of the 2002 Nobel Prize in Chemistry, recently said that the advance he literally stumbled upon "turned zero into one", but others (and he mentioned Professors Franz Hillenkamp and Michael Karas in particular) have "turned one into thousands", describing the proliferation of mass spectrometric methods for biological and synthetic macromolecules. Scientific symposia, such as the one your division will sponsor in New York City this September, entitled "Recent Advances in MALDI", have and will continue to play a role in this revolution.

So, a piece of candy, or scientific progress? I thank you for contributing both your time and your dues to your division. You have an open invitation to influence the direction your division takes, in its meeting programs, its educational endeavors, and its efforts to recognize outstanding students and scientists. Simply contact one of the Officers listed in this Newsletter. I promise you that your opinions will be heard.

## The Division of Analytical Chemistry



2001 Winner of the ACS Chemluminary Award for membership service

### The Division

1) Provides a forum for discussions of advances in Analytical Chemistry. 2) Increases awareness of the field on other scientists and the general public. 3) Encourages students to select Analytical Chemistry as their field of study. 4) Advises the ACS on matters related to Analytical Chemistry and 5) Offers analytical chemists opportunities for professional contacts.

### Mission of the DAC

The promotion of analytical chemistry in all of its aspects; the presentation of programs of papers on analytical chemistry and related fields at national meetings of the Society; cooperation with local sections and regional groups; the organization and sponsorship of symposia on topics of interest to analytical chemists; the development of activities which will promote the growth of analytical chemistry; and the establishment of means for increasing the professional status of and the contacts between analytical chemists.



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www.acs-analytical.duq.edu/  
analytical.html

# New York Meeting Program

By M. Bonner Denton  
DAC Chair Elect and Program Chair

With the New York ACS Meeting falling on the second anniversary of the great tragedy of September 2001, the Analytical Division has programmed an emphasis on the analytical chemistry of homeland security. Symposia ranging from analytical support to the first responders for detecting and identifying warfare agents, and advanced analytical techniques for homeland security, highlighted in sessions organized by John Carrico, Christopher Gresham, Phil Rodacy, and David Koppenaal, to the protection and remediation session organized by James Zeigler, will be presented.

A number of analytical chemistry's most outstanding researchers will be honored in award symposia organized by David Pinkston. Mark Meyerhoff will be honored for his outstanding contributions to the field of electrochemistry. Chris Enke will receive the J. Calvin Giddings Award for Excellence in Education for his many contributions to chemical

education. Norm Divichi will be honored for his outstanding contributions to spectrochemical analysis. Mike Ramsey will be recognized for his advances in chemical instrumentation. Fred Hawkrige will be honored for his distinguished service in the advancement of analytical chemistry, and Stephan Stranick will be awarded the ACS Division of Analytical Chemistry Arthur F. Findeis Award for Achievements by a Young Analytical Scientist. The awardees' and supporting speakers' lectures are sure to provide great insight into today's world of modern analytical chemistry.

The Subdivision of Chromatography and Separations Chemistry of the Analytical Division, in cooperation with the History of Chemistry Division, will present a full day symposium recognizing the 100th anniversary of chromatography, reviewing historical concepts up to the latest technology breakthroughs, organized by Dan Armstrong and Jeff Seeman.

Additionally, the Subdivision will sponsor timely sessions on supercritical fluid chromatography for high speed and high efficiency separations, organized by David Pinkston, and the use of modern separations science in the diagnostic assays for prion diseases, organized by Ira Krull and Richard Rubenstein.

Industrial-oriented sessions include a session on advances in the use of vibrational spectroscopy for process monitoring, organized by Bruce McIntosh; one on new assessment technologies in assuring pharmaceutical process and product quality, organized by Tom Layloff; and a session entitled "Six-Sigma in Industry: Problem Solving Methodologies for Success," organized by Al Ribes and Bruce Chase.

Sessions on the latest developments in scanning electrochemistry, organized by Christine Kranz and Wolfgang Schuhmann; chemometric analysis of complex NMR data, organized by Charles Eads; the advanced role of nanoparticles and nanostructures in analytical chemistry, organized by C. J. Zhong; new pharmaceutical applications of microfluidics, organized by Laurie Locascio; and recent advances in MALDI mass spectrometry, organized by Peter Williams, ensure a well-rounded program.

You are cordially invited to join your colleagues in the Division of Analytical Chemistry for the 226th National ACS Meeting in New York, New York, September 7-11, 2003.

## The Division Dinner at the New York Meeting

**China Grill**  
**60 W. 53rd St.**  
**New York, NY 10019**

**Monday, September 8, 2003.**  
**Social Hour/Cash Bar: 6:00 PM.**  
**Dinner: 7:00 PM.**

**Cost: \$65.00 per person.**

(Please order tickets when you pre-register)

China Grill is located in the lobby level of famed "Black Rock," the CBS headquarters building. The dramatic space compliments the food and will wow out-of-towners.

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for DAC wards.  
Contact  
Catherine Fenselau

## Division of Analytical Chemistry Awards Solicitation of Nominations for 2004

Deadline for submissions:  
November 1, 2003

It is time to solicit nominations for our DAC awards. Please spread the word as broadly as possible! In particular, the electrochemistry award, which had been discontinued for a year, needs candidates. The spectrochemistry award will not be given in 2004 since we have not found a corporate sponsor for it.

Current awards:

\*ACS Division of Analytical Chemistry Award in Chemical Instrumentation Sponsored by the Dow Chemical Company Foundation.

\*ACS Division of Analytical Chemistry Cole-Parmer Award in Electrochemistry.

\*ACS Division of Analytical Chemistry J. Calvin Giddings Award for Excellence in Education Sponsored by the Dekker Foundation.

\*ACS Division of Analytical Chemistry Arthur F. Findeis Award for Achievements by a Young Analytical Scientist Sponsored by the Philip Morris Companies.

\*ACS Division of Analytical Chemistry Award for

Distinguished Service in the Advancement of Analytical Chemistry Sponsored by Waters Corporation.

Specific information on each of these Awards can be found at the Division's web site: [www.acs-analytical.duq.edu/index.html](http://www.acs-analytical.duq.edu/index.html)

### ELIGIBILITY

Eligibility is not restricted to members of the Division of Analytical Chemistry. Nominees for the Award for Excellence in Teaching must have demonstrated excellence in teaching through at least five years at the time the award is presented. Nominating and seconding letters may be submitted by persons who are not members of the Division.

Send nominations no later than November 1, 2003 to:

Catherine Fenselau.  
College of Life Sciences  
University of Maryland  
College Park, MD 20742  
(301) 405-8616  
FAX (301) 405-8615  
[fenselau@wam.umd.edu](mailto:fenselau@wam.umd.edu)

## 2003 Division of Analytical Chemistry Sponsors

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Thanks!

## Nominate your deserving colleague for an award!

By Don Bly

I write to you as a former Chairman of the Division, last year's Service Awardee, the current liaison between DAC and EAS, and Canvassing Committee Chair for EAS.

It seems in the current generation of our very busy and hectic

lives, awards nominations have become a burden many of us don't want to deal with. But we need to.

Past winners especially should be willing to return the favor. In the golden age of my life, I was thrilled to receive last

year's Service Award, and there are many active chemists who would be thrilled to receive one of the Divisions science awards. Please, get out and help them and help the Division.

Also, I would appreciate suggestions for the EAS Fields Award\*. (I will do the canvassing). Thanks for your help.

\* For your information I include here in order the past awardees of the EAS Fields Award to

provide you an indication of the calibre of the people selected in the past and so that you do not suggest them again. The Fields Award is given for significant contributions in more than one field of analytical chemistry: Drs. George Morrison, Velmer Fassell, Calvin Giddings, David Hercules, Allen Bard, Alan Marshall, Gary Hieftje, Peter Carr, Henry Freiser, Royce Murray, James Winefordner, Richard Zare, Edward Yeung, Catherine Fenselau, Isiah Warner, Milos Novotny, and Charles Wilkins.

## Speakers for the Fundamentals of Electrospray Symposium at the 2003 New Orleans ACS Meeting



Photo by Prof. Akos Vertes

**Front Row:** Troy Wood, Gary Van Berkel, George Agnes, Gary Valaskovic.

**Back Row:** Richard Smith, Kelsey Cook, Akos Vertes, Richard Cole, Chris Enke, **John Fenn**, 2002 Chemistry Laureate, Nadja Cech, Scott McLuckey, Alan Marshall (not pictured: David Clemmer)

More pictures from this Symposium can be found at [www.ornl.gov/csd/Research\\_areas/obms\\_acspictures.html](http://www.ornl.gov/csd/Research_areas/obms_acspictures.html)

## Enhance Your Career at the Career Resource Center

The Career Resource Center (CRC) houses a wealth of professional development programs and services to enhance your career potential, including a library, resume reviews, mock interview sessions, and a variety of professional development programs. The CRC will be located at the Javits Convention Center and will be open Sunday from 10 AM to 7 PM, and Monday through Wednesday, from 8 AM to 5 PM. Workshop times and/or locations are subject to change. Please consult the web version at [chemistry.org/careers/newyork2003](http://chemistry.org/careers/newyork2003) for the final schedule.

## Pfizer Graduate Travel Award Winners

Alayna Goetsch  
Michigan State  
Advisor: Dr. Gary Blanchard

Matthew Miller  
Michigan State  
Advisor: Dr. Merlin Bruening

Sunnie Myung  
Indiana University  
Advisor: Dr. David Clemmer

Damien Narcisse  
Louisiana State University -  
Advisor: Dr. Kermit Murray

Each winner received a \$1,000 travel grant to the 2003 Fall ACS Meeting in New York City.

### Call for Applications. Pfizer Graduate Travel Award 2004

Applications are sought from graduate students who will present their research at the 228th National Meeting in Philadelphia, PA August 22-26, 2004. Award winners will receive \$1,000 to cover travel costs to the meeting.

Application instructions and forms can be found on the DAC website.

Application Deadline: March 12, 2004.

For more information contact Dr. Paul L. Edmiston, [pedmiston@wooster.edu](mailto:pedmiston@wooster.edu).

## List of Symposia at the New York ACS Meeting September 7-11, 2003

The Division is organizing the following symposia for the Fall 2003 meeting

- Homeland defense. Analytical support for first responders .
- Advanced analytical techniques for homeland security
- Analytical techniques defend the homeland
- New assessment technologies in assuring pharmaceutical process and product quality.
- New highlights in scanning electrochemical microscopy
- Six Sigma in Industry: Problem solving methodologies for success
- Chemometric analysis of complex NMR data.
- Nanoparticles and nanostructures in analytical chemistry
- Compatibility and stability issues for materials for analysis on a chip.
- Supercritical fluid chromatography for high speed and high efficiency separations.
- Diagnostic assays for prion diseases.
- Division of Analytical Chemistry Awards.

# Subdivision of Chromatography

## News from the SCSC

The program for the Fall 2003 National ACS meeting will include:

Separation and Analysis of Prions organized by Prof. Ira S. Krull of Northeastern University

Supercritical Fluid Chromatography organized by J. D. Pinkston Procter & Gamble

Since 2003 is the 100th anniversary of chromatography, the Division of History of the ACS plans to organize a joint session with cooperation from the SCSC. Prof. McGuffin is the lead contact.

Please see the final program which will appear shortly in C&EN, for the location, titles, and times.

Program planning for 2004 National Meetings (Spring in Anaheim, and Fall in Philadelphia) and beyond.

Dick Henry, past chair of the SCSC recalled that last year the SCSC had decided to hold technical symposia on specific topics on a continuing predictable basis. This is designed to provide a framework for those interested in some of the technique segments that do not have a self-standing meeting or supporting organization.

For 2004 the list of possible topics includes:  
Ion Chromatography  
Two-Dimensional Separations  
Proteomics/Genomics/etc.  
Comprehensive GC  
Chiral Separations  
Process Analytical Separations for the Pharmaceutical Industry

Nutraceuticals  
Combinatorial Chemistry and Separations  
Membrane Separations  
Denaturing HPLC

The Executive committee of the SCSC plans to continue the rotating (every two years) series of symposia started this year. Thus the 2005 spring meeting (San Diego) will have sessions on FFF and SEC and the 2005 Fall Meeting (Washington DC) will have a session on SFC.

### Young Investigator Award.

Agilent Technologies has agreed to sponsor the young Investigator Award organized by the Executive Committee of the SCSC. The Award will consist of a check for \$4000.00 plus a \$1000 travel grant for the recipient to attend the Award Ceremony at PittCon. Dr. Ron Majors of Agilent deserves special thanks for obtaining approval for this endeavor from Agilent's management.

**Annual Meeting of the SCSC**  
The annual meeting of the SCSC will be held at Noon, Monday, March 8, at the Pittcon 2004 site in Chicago. The exact room location will be revealed prior to the meeting. The Agenda will include:

Topics for meetings including  
•ACS and Pittcon  
•Update on the Young Investigator Award  
•Nomination of offices for the SCSC.  
•New business.

## Today's Chemist at Work Welcomes DAC members

The ACS magazine *Today's Chemist at Work* is being offered to ACS DAC members as a benefit of membership. DAC members can sign up to receive the magazine at [www.tcawonline.org](http://www.tcawonline.org). Every month, TCAW addresses the interests of industrial and academic chemists, and laboratory technicians. It covers the latest developments in pharmaceutical sciences, advances in GC, LC, separation sciences, and chemical instrumentation. In

addition, TCAW addresses personal aspects of today's chemists: the magazine regularly features advice on how readers can better manage their personal finances and health, and every September you can count on the Career/Salary/Employment issue to present employment trends, salary levels, and professional development advice. Sign up, change your address, or renew your contact and industry affiliation information at [www.tcawonline.org](http://www.tcawonline.org).



### Symposium in New York

Six Sigma is a set of problem-solving tools and a mindset originated in industry for achieving near perfect products and services. It combines some of the best techniques, including the scientific method, statistical analysis, and design of experiments, with recent breakthroughs in management thinking and plain old 'common sense'.

At this symposium, we will introduce the methodologies and show examples to prove that these tools are applicable to the resolution of real world problems.

The speakers come from the following Six Sigma practicing corporations: General Electric, Honeywell, DuPont, Lubrizol, OxyChem, and Dow Chemical.

#### Symposium topics

- \*Implementation of Six Sigma in analytical laboratories.
- \*Contributions of analytical laboratories in Six Sigma.
- \*The organizational culture needed for Six Sigma.
- \*Selecting a Six Sigma project.
- \*Define-Measure-Analyze-Improve-Control (MAIC) overview.
- \*Design for Six Sigma (DFSS) overview.
- \*The critical role of quality measurement systems.
- \*Development of customized Six Sigma learning for analytical laboratories.
- \*Implementation of Six Sigma capable methods across a corporation.
- \*The impact of analytical methods on Design for Six Sigma.
- \*Case study showing how Six Sigma in the analytical lab has delivered millions of dollars in financial impact.

This symposium is supported by an industrial programming grant from the

**ACS CORPORATION ASSOCIATES**

# Biological Warfare Detection

A host of detection strategies have been developed, but each has significant limitations.

David R. Walt, Tuft University and David R. Franz, Southern Research Institute. Reprinted from *Anal. Chem.*, December 1, 2000; pp. 738 A-746 A  
Published 2000 by the American Chemical Society. Reviewed by the authors for this reprint.

For years, biological agents were considered a weapon of last resort. As a result, other than a fluorescence-based detector program in the late 1960s, the US did little to develop detectors. All that changed during the 1991 Gulf War and with the domestic anthrax attacks in October 2001. Fortunately, biological weapons were not used during the Gulf War, but the Department of Defense (DoD) took the near miss seriously and began preparing for a future war (1). In fact, the Soviet biological warfare program was a threat long before the Gulf War. After the collapse of the Soviet Union, the West learned that the Warsaw Pact countries had produced detectors of unknown effectiveness and elaborate mobile labs to conduct classical microbiological and animal testing (2).

By the mid-1990s, it became obvious that the development of detectors with low false positive rates was more difficult than expected. The goal changed to detecting the agents so that the appropriate medical treatment could be used for those exposed. Success, even with less than a real-time capability, could facilitate triage and reduce the need for a reference laboratory during a conflict. Throughout this effort, the development of non-specific, remotely based detection systems has occurred in parallel with the development of point detectors.

## What are we attempting?

The threat is thought to include the major biological agents known during the Cold War -the causative agents of anthrax, plague, tularemia, Q-fever, viral encephalomyelitis, and smallpox- but also many other agents that might produce less mortality but potentially significant morbidity. Some of the agents, such as hemorrhagic fever viruses and *C. burnetii*, are highly infective, requiring only 1-10 organisms inhaled to cause disease. Even the easily produced alpha viruses may require only 10-100 organisms to cause disease. Others, like *B. anthracis*, are thought to be

infective at 10,000 spores inhaled (3). For example, assume that an adult human inhales 10-100 L/min of air and is exposed to a cloud of agent for 20 min. Even if the concentration (organisms/L) of a highly infectious agent is very low, those exposed can contract the illness. This "needle in a haystack" problem poses one of the most challenging sensitivity issues. Furthermore, unlike the military, the civilian population is neither immunized nor prepared to react to a biological attack. In addition, the use of biological agent detectors within a civilian population makes it mandatory that false positive results be kept to an absolute minimum to avoid panic.

The ideal biodetector would identify a multitude of agents including bacterial spores (*B. anthracis*), vegetative forms (*Y. pestis* or *F. tularensis*), a range of viruses (Venezuelan equine encephalitis and variola viruses), and toxins ranging from 150-kDa proteins (botulinum) to 300-Da nonproteins (saxitoxin). Although this wide spectrum of analytes complicates detection, careful analysis has made it possible to focus on a relatively small group of agents for which early detection is most critical. Experts generally agree that *B. anthracis* spores, *Y. pestis*, *F. tularensis* bacilli, and variola virus-all of which are highly pathogenic and require medical countermeasures within 24-48 h after exposure-must be near the top of the list for rapid detection. Simulants for a spore, a virus, and a protein toxin are typically used in the early development and testing of detectors.

## Fielding effective detectors

Compounding the technical difficulties surrounding the detection of biological agents released in a civilian population are the human factors. When do we tell the population to respond if we know there has been a release? Do we tell them as soon as an agent is detected, or do we wait until confirmation from the reference laboratory? How do we balance rapid response with

the potential public reaction or overreaction? How do we educate the public to understand the information an effective detector can provide? A false positive in a commuter train station at 5:00 p.m. might lead to a different result than a false positive at 5:00 a.m. Finally, how do we measure success? We need to detect a broad spectrum of agents with high sensitivity and specificity in as little time as possible. Achieving excellence in these areas will affect unit cost, technical complexity, size, collector noise, energy consumption, and maintenance requirements. Requirements differ for protecting a force on a battlefield and protecting the population of a city. Protecting untrained civilians from a broad spectrum of agents that may be delivered in a colorless, odorless, and tasteless cloud is extremely complex and difficult.

The battlefield goal is to warn soldiers of an imminent threat. The location of the enemy may be known, and the military situation may dictate the nature of the threat. In most military operations, protective gear and vaccinations for some agents are available. Therefore, it may not be critical for detectors to be in continuous use or be able to identify the agent, but simply provide an early warning; some false positives may be acceptable. It is hoped that standoff detection equipment (e.g., lidar-based systems that "interrogate" clouds remotely) may actually provide a warning that gives soldiers enough time to don protective masks. In addition, a mobile, definitive detection system is being developed for battlefield use.

A second military application is the protection of a force being deployed or in a garrison. This scenario, much like the civilian terrorism situation, will ideally provide early and fast identification and improve the chances of successfully applying medical countermeasures. Another potential role for the ideal detection system would be to assist in defining

the area covered by the lethal cloud. This ideal system will, no doubt, await the development of integrated webs of detection.

## Sample collection strategies

The biological warfare (BW) agents of greatest concern are those that can be deployed as aerosols, from either a point or a line source. A point source involves release from a particular location at a fixed source with either radial diffusion or dissemination by local wind currents. A point source typically results in a cigar-shaped plume. A ship, truck, or aircraft can deliver a line source, usually perpendicular to the direction of the wind, resulting in a roughly rectangular shape extending downwind from the line.

Sample collectors are necessary to concentrate a relatively small number of particles from a large volume of air into a small liquid sample. Collectors presently in use are based on filter, impactor, or cyclone technologies. Impactors are essentially sieves for air samples. Air is drawn into an impactor that consists of a series of parallel plates or stages containing different-sized holes, with large holes in the top plate and smaller ones in the lower plates. Each stage contains an agar Petri dish in which particles of a particular size are trapped. Smaller particles flow with the airstream around the collection plate to the next level. This approach preserves the viability of the living particles, enabling each Petri dish to be incubated and counted for active microbial agents. This method is time consuming and does not allow real-time detection. Some impactors do not collect on agar but in a user-defined medium.

In cyclones, a rotating liquid layer collects air particles as they enter the sampler, enabling relatively high-efficiency particle collection in the liquid layer. Hundreds of thousands of liters per minute of air are collected and concentrated into a small aqueous volume. In this manner, even at low aero-

Continued on page 7

# Biological Warfare Detection (continued)

sol concentrations, hundreds or thousands of particles can be concentrated into a few milliliters of liquid. These aqueous samples are then delivered, either manually or automatically, to the detection system.

## Detection strategies

Current detection methods are based on particle detection, immunochemistry, and DNA sequence. The particle detectors are designed to detect aerosols and look for particle signatures that indicate a BW agent. In general, they do not detect a particular BW agent; rather, they simply look for an elevated number of particles in the air. Other detection strategies can be used, which are based on the scattering or absorption of ambient light, the absorbance of a specific wavelength, or particle fluorescence. The key to any of these approaches is to distinguish between BW agents and naturally occurring particles such as nonpathogenic microbes (of the same genus), pollen, or dust. Because all biological systems contain amino acids such as tryptophan, which absorbs UV light, biologically derived particles generally can be identified and distinguished from inorganic particles using UV lasers.

Identification systems based on immunochemistry and are found in numerous formats, ranging from simple, single-use, handheld devices to the large, multianalyte "lab on wheels". One such system is the Biological Integrated Detection System (BIDS) developed by the DoD. BIDS is a biochemistry lab on wheels that can be transported on a cargo aircraft. It uses off-the-shelf instrumentation, requires a generator to provide electrical power, and is mounted on an all-terrain vehicle. It has been used in the field since 1996 (4).

In a typical scenario with BIDS, a UV aerodynamic particle sizer (APS) triggers the collection device when 1- to 10- $\mu$ m particles, which are the size of typical BW particles, are detected. APS is essentially a time-of-flight (TOF) analyzer that measures how long it takes different-sized particles to

traverse a given distance. Air is drawn through a nozzle to produce a jet. As particles travel in the jet, they are interrogated at two different positions by a split laser beam. Photomultiplier tubes record signals, and the travel time is calculated and correlated to the particle size. Particle detection triggers an impactor.

After collection, the liquid containing the sample is delivered to several analytical devices. Luminescence is detected by interrogating the sample with UV light. The emission spectrum of various components in the particle is indicative of a biological agent. The sample is then delivered to a manually operated, light-addressable potentiometric pH sensor (LAPS) immunoassay system, in which light is used to probe or activate the sensing surface (4). An ELISA is conducted using urease as the enzyme label. When urease is exposed to urea, a pH change in the medium is registered by the LAPS and correlated to a particular BW agent. An automated version of this system is now available.

Another fraction of the sample is treated with nucleic acid stains and possibly several specific stains, and then it is sent to a flow cytometer. The DNA stains distinguish living from nonliving particles; the specific stains may identify the particular BW agents. The P3I contains the UVAPS, a liquid sampler, a mini-flow cytometer, and a chemical biological mass spectrometer.

Because BIDS requires a trigger from the particle detector, it does not analyze continuously. It is capable, however, of collecting continuously and analyzing pooled samples later. Such a system is fine for battlefield operations; however, it may be unacceptable for detecting covert threats in civilian centers because of high costs, maintenance requirements, and the problem of false positives.

The Interim Biological Agent Detector (IBAD), a sea-based system, is a simplified version of BIDS. IBAD requires an elevated,

respirable particle concentration to activate its cyclone collector, which concentrates the sample for delivery to the DoD biosampling kit. The IBAD can presumptively identify 8 BW agents in 15 min.

The Long-Range Biological Stand-off Detection System (LR-BSDS) is a rapid, continuous aerosol detection system designed to provide an early warning; it cues other BW systems by detecting aerosols from up to 50 km. It uses active IR for long-range detection. It can determine concentration, range, location, and the path of an aerosol cloud, but not the identity of the cloud's constituents. Thus, the LR-BSDS is designed to alert military personnel to unusual clouds, but the system cannot determine whether a cloud is a threat. The system is mounted on a helicopter. The LR-BSDS was fielded in late 1996.

A third system, Portal Shield, is a point detector to protect fixed sites, such as ports and airfields. The system is approximately two-thirds the size of the typical office desk and can presumptively identify eight different agents simultaneously. It is deployed as an array of instruments, which significantly reduces false positives because the instruments are networked to provide users with a high degree of confidence in detection.

Portal Shield uses immunochromatographic assays called handheld assays (HHA). Following the concentration of air samples, liquid samples are prepared and placed on a card with all the immunoreagents attached to a solid support, similar to a home pregnancy test. The sample moves through the wicking matrix of the HHA via capillary action. Immunofocusing of colloidal gold-labeled antibodies containing the corresponding antigen forms a red line that is detected by reflectance.

Each HHA can only perform an analysis for a particular BW agent. Therefore, if multiple agents are suspected, the sample must be delivered to multiple HHAs. Portal Shield uses an automated sample-

handling and assay system. The assays are read by a laser scanner. Because most immunoassays are not reversible, the HHAs are not reusable. The system can identify up to 8 agents simultaneously in 20 min.

In general, the sensitivity of these HHAs is rather low compared with conventional laboratory-based immunochemistry techniques, with the exception of those developed to identify toxins. Another limitation is the discontinuous nature of the analysis. Discrete samples are analyzed, so the frequency of analysis must be high to avoid prolonged exposure when an agent comes into range. Nevertheless, Portal Shield offers a high degree of flexibility because it can be targeted to a particular threat. For example, during the Gulf War, officials believed that Iraq possessed a limited number of potential BW agents.

The Canadian Integrated Biochemical Agent Detection System (CIBADS II) is an automated system containing a fluorescence aerodynamic particle sizer (FLAPS) that can distinguish living particles from nonliving particles (5). The next version of CIBADS II is 4WARN, which is lighter, smaller, uses less power, and contains more powerful algorithms to reduce the rate of false positives and negatives (6).

## Near-term

As described, there are four underlying principles employed for BW detection methods. Particles are measured by shining light on a sample or using sunlight to illuminate the sample. Specific agents or toxins can be detected by various immunoassays. DNA can be amplified by the polymerase chain reaction (PCR) followed by detection with specific gene probes. Mass Spectrometry (MS) can detect all species by ionizing the various BW agents and examining specific fragments. New systems based on these principles are being field tested or are at a relatively advanced stage of development. Other technologies are being investigated for proof-of-concept (7).

Richard Dallinger  
Wabash College

## DAC Graduate Fellowships

The DAC Graduate Fellowship Committee is pleased to report that the following graduate students have accepted Division of Analytical Chemistry fellowships (nine-month and summer) for 2003-2004. We are extremely

grateful to the corporate sponsors listed below for their financial support of the graduate program and for supporting the attendance of their committee representatives at PittCon 2003.

### Nine-month Fellowship

**Recipients** (\$18,000 stipend):  
Listed are the fellow, followed by his or her institution, thesis advisor, and sponsor.

•Amanda Haes, Northwestern  
Richard Van Duyne  
DuPont

•Li Han, SUNY-Binghamton  
Chuan-Jian Zhong  
Merck  
•Laura Lucas, Kansas  
Cynthia Larive  
Lilly

Continued on page 9

## DAC at the New Orleans meeting



(left to right): Victoria McGuffin, Chair Chrom. Subdiv., Michigan U; Catherine Fenselau, 2002 DAC Chair; John Fenn, 2002 Nobel Laureate, Virginia C.U., and Carolyn Ribes, DAC Treasurer, Dow Chemical.



John Fenn with David Pinkston, DAC chair, Procter and Gamble.



Kolthoff Enrichment Awardee Undergraduate Student Varun Saxena.



David Pinkston, DAC Chair with Kolthoff Enrichment Awardee Undergraduate Student Amy Carr.



DAC Chair Elect, M. Bonner Denton University of Arizona.



Kolthoff Student Jamie Iannacone with John Richardson, DAC Secretary, Shippensburg University



DAC Councilor Michelle Buchanan (2003–2005) Oak Ridge Laboratory



DAC-ACS Regional Meetings Liaison  
Thomas Wenzel Chemistry Bates College



The touring periodic elephant of the elements.



## DAC Graduate Fellowships

(continued)

•Brent Mantooh, Penn State  
Paul Weiss  
GlaxoSmithKline  
•Jeffrey Stuart, Illinois  
Jonathan Sweedler  
Procter & Gamble

### Summer Fellowship Recipients

(\$6,000 stipend):

•Ryan Bailey, Northwestern  
Joseph Hupp  
SACP  
•Megan Frost, Michigan  
Mark Meyerhoff  
SACP  
•William Silveira, Cornell  
John Marohn  
Eastman  
•Jennifer Thomas, Cincinnati  
William Heineman  
SACP  
•Lianming Wu, Purdue  
Graham Cooks,  
J&J-PRD  
•Wei Zhan, Texas A&M  
Richard Crooks  
SACP

(SACP = Society for Analytical Chemists of Pittsburgh)  
(J&J-PRD = Johnson & Johnson Pharmaceutical Research and Development)

### Honorable Mention:

Listed below are the fellow, followed by his or her institution, and thesis advisor.

•Clay Davis, Clemson  
Kenneth Marcus  
•Ware Flora, Arizona  
Neal Armstrong  
•Kendall Powell, Duke  
Michael Fitzgerald

An article congratulating these recipients will appear in the September 1, 2003, edition of *Analytical Chemistry*.

Two of the thesis advisors for the 2003-04 graduate fellowship recipients, **Cynthia Larive** (1990 nine-month) and **Jonathan Sweedler** (1988 summer), were themselves DAC graduate fellows, as was current DAC Chair **J. David Pinkston** (1984 nine-month).

The members of the Graduate Fellowship Committee who generously gave many hours of effort in

evaluating applications and selecting recipients were:

**David Burinsky**—GlaxoSmithKline (sponsor)  
**Curt Cleven** – Eastman Chemical (sponsor)  
**Paul Edmiston** – College of Wooster  
**Patrick Epperson** – Lawrence Livermore National Laboratory  
**Rong Feng** – Johnson & Johnson Pharmaceutical Research and Development (sponsor)  
**Susan Forest** – Procter & Gamble (sponsor)  
**Gregg Gould** – Society for Analytical Chemists of Pittsburgh (sponsor)  
**Angela Harmon** – Merck (sponsor)  
**Mary Kaiser** – DuPont (sponsor)  
**Brian Nunnally** – Lilly (sponsor)  
**Jeanette Rice** – Georgia Southern University

The Committee would like to recognize the contributions made by **Dr. James Weber** from Johnson & Johnson Pharmaceutical Research and Development, who has completed his term on the Committee.

Further information about the DAC Graduate Fellowship Program can be found on the Program web site (<http://www.wabash.edu/acsgraduatefellowship/home.htm>).

## Biological Warfare Detection (continued)

For example, the Raptor is an automated fiber-optic biosensor that weighs 12 lbs. The system is based on a sandwich immunoassay in which capture antibodies are immobilized by passive adsorption onto a 4-cm fiber-optic polystyrene waveguide with a blackened distal end (8). Each capture antibody is selective for a different BW agent. Four different capture antibody probes are used in a coupon, which contains channels that allow samples and reagents to be

delivered to the probes. The only sample preparation that might be required is the filtering of large particles.

A sample is introduced into the coupon and allowed to incubate for ~7 min. After incubation, a cocktail of fluorescent antibodies is introduced into each channel and allowed to develop for 90 s. Probe binding rates to the surface are monitored during the 90-s incubation. The system is highly flexible—a 3-min screen can be conducted when samples are suspected to contain a high concentration of BW agent. The coupon can be used up to 30 times or until a positive result is obtained.

Reagent delivery, washing, data collection, and analysis are automated. A prototype system was deployed on a remotely piloted airplane that collected aerosols in flight, identified the collected bacteria, and transmitted the data to an operator (8). An alternative design by the Ligler group uses arrays of capture antibodies, thereby greatly increasing the number of simultaneous assays that are conducted by the Raptor (9).

Another system is the Igen Origin system, which is based on electrochemiluminescence (ECL) in conjunction with a sandwich immunoassay (10). An antibody to a particular agent is attached to a magnetic bead. After incubation and analyte binding, a second antibody reacts with a different hapten on the analyte surface to form a sandwich complex. The second antibody contains an ECL label, such as ruthenium(II) tris(bipyridyl). After analyte capture and sandwich formation, the beads are attracted to an electrode surface. Tripropylamine (TPA), a sacrificial redox species, is added to the system. A voltage is applied to oxidize the ruthenium and the TPA. The TPA loses a proton to form a reducing reagent that transfers an electron to the ruthenium complex, which goes into an excited state and decays by releasing a photon. Each cycle regenerates the ruthenium complex. TPA is oxidized irreversibly, and another equivalent of TPA is consumed for each additional ECL cycle. This system is a zero-background technique, but it is

susceptible to false negatives when an agent is present at high concentrations.

Another system being investigated is a sandwich immunoassay in which the antibody to the target pathogen is sequestered on an up-converting phosphor (UCP) bead. The beads are mixed rare-earth oxides that absorb near-IR radiation and, in a two-photon process, emit visible light. A substrate containing different capture antibodies is incubated with the sample. After capture, incubation with the UCP-labeled antibody generates fluorescence only where antigen is bound to the substrate. By tailoring the composition of the beads, it is possible to optically encode a distinguishing pattern for many bead types, in effect, labeling different antibodies. Rapid, highly multiplexed immunoassays can be performed in a small format device. If the beads prove effective, they can be readily incorporated into a flow cytometer assay system.

### DNA-based methods

The specificity and sensitivity of DNA-based diagnostic methods and their applicability to virtually any living system offer hope that a universal BW detector is on the horizon. Genomic DNA is present at 1 copy per nucleus in higher organisms, posing a daunting sensitivity issue (some bacteria have 15 copies of their genomic DNA, and ribosomal DNA is present in high copy numbers). Consequently, DNA-based techniques with high sensitivity and selectivity use amplification, generally PCR (11).

Significant recent advances in PCR chemistry and thermal cycling technology have compressed the timeframe for DNA analysis from several hours to a few minutes. Fluorogenic PCR now allows fluorescent signals to develop as the PCR proceeds through its heating and cooling cycles (12-16). Integrated spectrofluorometric thermal cyclers make rapid fluorogenic PCR and real-time monitoring possible (16-18).

At Lawrence Livermore National Laboratory (LLNL), a Miniature Analytical Thermal Cycling Instrument (MATCI) that performs fluorogenic, real-time PCR was reported by Northrup et al. (12, 13,

Continued on page 10

## Biological Warfare Detection (continued)

18, 19). This instrument contains a single silicon reaction chamber with integral thin-film heaters and uses all solid-state components for the excitation and detection of fluorescence, which enables battery-powered operation, rapid thermal cycling of the reaction chamber, and real-time data analysis. The MATCI's use for environmental and clinical testing was demonstrated by analyzing human, bacterial, and viral DNA (17, 20). Ibrahim at the U.S. Army Medical Research Institute of Infectious Diseases used MATCI to distinguish one orthopoxvirus from others based on a single-base difference in the hemagglutinin gene (20).

MATCI possesses a single analysis channel that limits the system's throughput. To handle multiple samples, the Advanced Nucleic Acid Analyzer (ANAA) uses an array of 10 microfabricated silicon reaction chambers, each with its own solid-state optical system. An ANAA engineered for efficient reaction rates and fluorescence detection provided rapid real-time PCR analysis. The portable instrument analyzed samples of 5-500 bacterial cells in as little as 7 min, performing cell lysis, PCR, detection of the PCR product with a target-specific fluorescence energy transfer probe, and automated "positive calling" (21). Thermal cycle times of only 17 s yielded good productivity at each cycle and indicated that still faster analyses could be performed. It took 7 min to detect 500 cells and 9 min for 5 cells to generate sufficient signal.

LLNL has subsequently redesigned the sample chamber to heat and cool the sample more efficiently and has developed a handheld, battery-operated device with four thermal-cycling chambers, each with its own solid-state optical system. This device is in field testing, and similar instruments are being commercialized. Existing systems are benchtop units, but one company is developing a fully automated handheld device con-

taining integrated microelectromechanical systems and microfluidics. A 10-chamber device recently detected a single live bacterium in only 7 min (22). This technology is being commercialized by Cepheid for field analysis. In addition, the company is developing an integrated system for the Postal Service.

Another PCR-based system is the Ruggedized Advanced Pathogen Identification Device (RAPID), which uses light cycler PCR technology with a fluorescence detection system (16). The RAPID cycler can perform 30 PCR cycles in ~10 min. Rather than standard sample tubes, the system uses glass microcapillary tubes or thin-walled microcentrifuge tubes to facilitate heat transfer. Air is the cycling medium, which provides for extremely high-temperature ramp rates.

The RAPID amplification products are monitored after each cycle by two fluorescence detection schemes using a blue LED. In the first method, SYBR Green, a DNA intercalant, is used. After each PCR cycle, the fluorescence is monitored. Dye intercalation occurs only into double-stranded DNA, so a high fluorescence signal is obtained only if the target sequence is present in the sample. The second detection method involves fluorescence resonance energy transfer (FRET). The sequences of two oligonucleotides are selected such that they hybridize to the amplified DNA in a head-to-tail fashion. Different dyes are at the head and tail ends of these two strands. The LED excites a fluorescence donor (fluorescein) on one oligonucleotide, and if the second oligonucleotide is also bound to the amplified DNA, fluorescein transfers its energy to the second dye, and the second dye emits light. FRET occurs only if the key sequence is amplified, and the extent of energy transfer depends on the quantity present in solution. Monitoring after each PCR cycle allows the progress (or lack thereof) of the amplification to be followed.

Overall, PCR systems are power-hungry, slow (because of sample preparation and cycling times), typically unable to perform analyses in real time, and unable to

detect toxins directly; and therefore they require a complementary detection method. Finally, PCR systems may produce false positives because they may amplify the DNA of dead, noninfective organisms. Because of these problems, existing fielded and soon-to-be deployed detection systems do not include DNA analysis as part of their complement of techniques.

An alternative nucleic acid analysis approach detects RNA, which is transcribed from DNA in multiple copies and does not necessarily require an amplification step. Argonne National Laboratory, in conjunction with Northwestern University, is developing the Micro Array of Gel-Immobilized Compounds. The chip consists of an array of gel pads attached to a solid substrate. Each pad contains an immobilized oligonucleotide that can selectively hybridize to an rRNA unique to a particular threat agent.

Because of the complex logistics required to keep immunologic or nucleic acid-based systems operational and the need for more timely detection of pathogens, the DoD has initiated programs to exploit reagentless systems. MS, for example, could address a broad range of agents. Several universities and contractors are developing a miniature field-portable TOF mass spectrometer system ([www.jhuapl.edu](http://www.jhuapl.edu)) with support from the Defense Advanced Research Projects Agency and the Defense Threat Reduction Agency.

A fully integrated mass spectrometer that combines collection and detection capabilities has been developed (23). The collector samples and concentrates air, separates particles 0.5- to 10- $\mu\text{m}$  apart in size, and deposits them onto a moving tape, which is a modified videotape driven by a stepper motor and drive shaft. The tape can be introduced directly into a TOF mass spectrometer, or it can be sprayed first with a MALDI matrix to increase sensitivity. In either case, after the tape is inserted, the vacuum chamber is evacuated rapidly, the sample is introduced and ionized by a UV laser, and the resulting mass spectrum is analyzed for biomarkers indicative of a BW agent. There is a growing database

of BW agent molecules and their fragments.

Much of the work to date has been devoted to establishing MS as a biological pathogen identifier. Like PCR, the technique currently requires sample processing. In addition, the database of biomass spectral signatures must be expanded, and a practical way of introducing the sample to the instrument needs to be developed. Nevertheless, MS offers significant promise for reagentless biodetection.

Effort is also directed at improving the particle collection and concentration steps. Smaller, more efficient cyclones and impactors that enable particle collection and sizing without Petri dishes are being investigated as front-end systems. Another system under development exposes intake air to an electrostatic particle-charging region. Water is then sprayed on the collector to wash the surface, and the resulting aqueous particle suspension is analyzed.

### The challenge

The technical challenges are daunting. These systems must be automated with little user intervention or servicing. BW agents need to be detected and identified at extremely low concentrations in complex, changing backgrounds in near real time with little power consumption and no reagents. Clearly, existing systems do not meet the needs of the military or civilian sectors for the purpose of "detect to warn". They suffer from relatively poor sensitivity, occasional false positives, and lengthy response times.

Solving the BW detection problem would have a host of dual-use spin-offs in such areas as medical diagnostics, environmental monitoring, food processing, and product tracking. The analytical chemist's toolbox, combined with some creativity can provide a genuine opportunity to make the world a safer place.

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David R. Walt is a professor at Tufts University. His research is in the area of high-density optical arrays, including oligonucleotide arrays and cross-reactive arrays for broad-based chemical sensing, nanomaterials, and combinatorial chemistry. David R. Franz is vice president in the Chemical and Biological Defense Division at Southern Research Institute. His interests include medical biological defense, nonproliferation, and cooperative threat reduction. Address correspondence about this article to Walt at [david.walt@tufts.edu](mailto:david.walt@tufts.edu) or Franz at [franz@sri.org](mailto:franz@sri.org).

# Recipients of the 2003 Division of Analytical Chemistry Awards

## Award in Spectrochemical Analysis

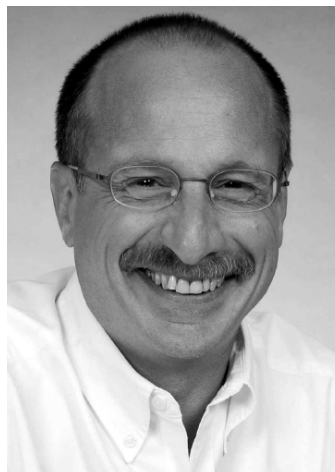
(This year's award is sponsored  
by the Division of Analytical  
Chemistry. This award needs a  
corporate sponsor for 2004 and  
beyond)

### NORMAN J. DOVICH

#### Endowed Professor of Analytical Chemistry University of Washington

Norman J. Dovichi is the Endowed Professor of Analytical Chemistry at the University of Washington. He received his BS degree with honors from Northern Illinois University in 1976 with majors in both chemistry and mathematics and a minor in physics. Dovichi then moved to the Chemistry Department at the University of Utah where he was Joel Harris's first student, graduating with a PhD in Physical-Analytical Chemistry in 1980. Dovichi spent two years at Los Alamos Scientific Laboratory as a postdoctoral fellow under the direction of Dick Keller in both the Physical Chemistry and Biophysics groups. Dovichi was appointed as an Assistant Professor in the Chemistry Department at the University of Wyoming in 1982. In 1986, he moved as an Associate Professor to the Chemistry Department of the University of Alberta, where he was promoted to Professor in 1991. He moved to his present position in January of 2001.

Dovichi's research interests have been focused on ultrasensitive analysis of biological samples.



Norman Dovichi

During his postdoctoral fellowship, Dovichi introduced the concept of single molecule detection to the analytical community. Dovichi began a series of projects to couple capillary separation techniques to ultrasensitive spectroscopic detectors, first for analysis of amino acids, then nucleic acids and carbohydrates, and most recently proteins. He introduced the concept of molecular shot-noise, where stochastic fluctuations in the number of molecules present in a sample provide a fundamental and irreducible source of noise in chemical measurements. His group also presented the first kinetic curve, Arrhenius plot, and Michaelis-Menten study of the reaction catalyzed by a single enzyme molecule. His group developed a very high throughput DNA sequencer, based on capillary array electrophoresis and laser-induced fluorescence, which was commercialized and used to generate the vast majority of the data used in the human genome project. In collaboration with Professors Monica Palcic and Ole Hindsgaul at the University of Alberta, Dovichi's group developed methods to monitor the biosynthesis and biodegradation of oligosaccharides in single

cancer cells. His group's research interest currently is focused on the development of two-dimensional electro-phoresis separations and analysis of the protein content of single cancer cells, with the goal of providing a molecular basis to cancer prognosis and diagnosis.

Dovichi has supervised 32 PhD theses, has published over 200 papers and book chapters, holds seven US patents, and has given over 350 invited talks. He has served on the editorial advisory boards of 16 international journals, and will begin serving as Associate Editor for *Analytical Chemistry* later this spring. He has served on the boards of directors for the Natural Sciences and Engineering Research Council of Canada and the Canadian Genetic Diseases Network.

Dovichi has received a number of honors for his work. These include the Chemical Instrumentation Award from the Analytical Division of the American Chemical Society and the McBryde, Noranda, and Fisher Awards from the Canadian Institute of Chemistry. He received the Heinrich Emanuel Merck Award for Analytical Chemistry from the Analytica Conference. He has been named as an Honorary Professor of the Chinese Academy of Sciences. Finally, the journal *Science* included Dovichi as the only chemist among their list of a dozen "Unsung Heroes of the Human Genome Project"

# Recipients of the 2003 Division of Analytical Chemistry Awards

Award for  
Distinguished  
Service in the  
Advancement of  
Analytical Chemistry  
Sponsored by  
Waters Corporation

FRED M.  
HAWKRIDGE

Professor and  
Chairman of Chemistry  
Virginia Commonwealth  
University

**Fred Hawkridge** received a B. S. from the University of Georgia in 1966 and a Ph.D. from the University of Kentucky in 1971, with Henry H. Bauer. After his postdoctoral work with Theodore Kuwana at Case Western Reserve University and at Ohio State University, he joined the chemistry faculty at the University of Southern Mississippi. In 1976 he moved to Virginia Commonwealth University where he is now Professor of Chemistry and of Biochemistry and Molecular Biophysics. He became Chair of the VCU Department of Chemistry in 1998.

In 1975 Hawkridge was Visiting Scientist at the Charles F. Kettering Laboratory, where he collaborated with Dr. Bacon Ke; and in 1981-82 he spent a sabbatical year at the University of Delaware. During the summer of 1987 he received a Fellowship of the Japan Society for the Promotion of Science to work



Fred Hawkridge

with Professor Isao Taniguchi at Kumamoto University. The NSF awarded him a Creativity Extension in 1989, he received a Ph.D. *causis honorarium* from St. Petersburg University, in Russia in 1993 and in 2002 he received the Benedetto-Pichler Award from the American Microchemical Society.

Hawkridge has served as a Program Officer in the Analytical and Surface Chemistry Program in the Chemistry Division of the NSF during 1989-90 and 1995-98. He was Treasurer of the Analytical Division of the American Chemical Society (1987-90). He served as Chairman of the Virginia State Acid Rain Technical Advisory Committee from 1985 to 1992 and was a member of the Metallobiochemistry Study Section of the National Institutes of Health (1987-91). He served as Secretary-Treasurer, Vice-Chairman and Chairman of the Organic and Biological Division of the Electrochemical Society (1989-95). He is a member of the Editorial Board of the *Journal of Electroanalytical Chemistry*.

Hawkridge's recent research has focused on the use of cytochrome c oxidase in lipid bilayers attached to electrode surfaces. Hawkridge has published over 75 scientific papers and he has given numerous invited and contributed talks at meetings, companies and universities

Award in  
Electrochemistry  
Sponsored by  
Cole-Parmer

MARK E.  
MEYERHOFF

Professor of  
Chemistry  
University of Michigan

**Mark E. Meyerhoff** is Professor of Chemistry in the Department of Chemistry at the University of Michigan, Ann Arbor. He received his Ph.D. from the State University of New York at Buffalo in 1979, working under the direction of Professor Garry A. Rechnitz. Following a short post-doctoral stint at the University of Delaware, he joined the faculty at Michigan as an Assistant Professor in the Fall of 1979. He was promoted to associate professor in 1985, and to full professor in 1990.

His long-term research interests have been in the field of analytical chemistry, particularly the development of new ion-, gas-, and bio-selective electrochemical sensors suitable for measurements of clinically important analytes. In the early 1980s, he and his collaborators developed of the first polymer membrane-based

potentiometric ammonia and carbon dioxide sensors, the latter of which formed the basis for the disposable differential style  $PCO_2$  sensors now used in several commercial portable blood-gas instruments in hospitals around the world. His group was also among the first to demonstrate the use of metalloporphyrins and other metal-ligand complexes as useful membrane active ionophores in the design of new anion-selective membrane electrodes, and to understand the response mechanisms of such devices. These same metalloporphyrin-based chemistries in thin polymeric films have now been adapted by his group and others to create new anion and gas sensing optical devices.

In the early 1990s, Meyerhoff and his coworkers reported the first polymer membrane electrodes that can be employed to detect clinically relevant levels of the anticoagulant polyanion heparin and its antidote, polycationic protamine, in undiluted blood. His group further elucidated the unusual non-equilibrium potentiometric response mechanism of such devices, and have gone on to demonstrate many additional bioanalytical applications of the basic polyion sensor technology, including selective measurements of protease activities, polyion binding to other macromolecules, detection of polyion food additives, and most recently, the measurement of newer low molecular weight heparin drug species directly in clinical samples.

In addition to his contributions in the field of potentiometric ion/polyion/gas sensors, Meyerhoff has maintained a long and

# Recipients of the 2003 Division of Analytical Chemistry Awards



**Mark E. Meyerhoff**

active research program in area of immunoassays. In 1994, he invented a new non-separation electrochemical enzyme immunoassay (NEEIA) technology that allows for the measurement of protein analytes at < ng/ml levels in undiluted whole blood, without need for any separation or washing steps. More recently, he has been engaged in a collaborative effort to devise a new class of electron relay enabled conductimetric immunoassays, that can be employed to rapidly detect large proteins, viruses and bacteria.

Meyerhoff also has active research programs on the use of immobilized metalloporphyrin as unique and highly selective stationary phases for liquid chromatography, and the development and characterization of novel nitric oxide (NO) releasing polymeric materials for biomedical applications. Indeed, his group has recently demonstrated that catheter-sized electrochemical sensors fabricated with the latter NO release polymers exhibit greatly enhanced biocompatibility and analytical performance when implanted intravascularly for continuous *in vivo* measurements of oxygen. Hence, use of the NO

release coatings could ultimately provide a solution to lingering problems associated with the poor analytical reliability of implantable electrochemical and optical sensors.

Since 1979, Meyerhoff and his collaborators have authored more than 220 original research papers on these and other topics. He was elected as a Fellow by the National Academy of Clinical Biochemistry in 2002, and currently serves on the editorial/advisory boards of *Clinical Chemistry*, *Biosensors & Bioelectronics*, *Electroanalysis*, *Analytica Chimica Acta*, and *Applied Biochemistry and Biotechnology*. He is also active as a consultant and/or is on the Scientific Advisory Boards of several biomedical companies.

## Award in Chemical Instrumentation Sponsored by The Dow Chemical Foundation

**J. MICHAEL RAMSEY**

**Corporate Research Fellow  
Oak Ridge National Laboratory**

Dr. J. Michael Ramsey received his B.S. in chemistry from Bowling Green State University in 1974 and a Ph. D. in chemistry from Indiana University in 1979 under the direction of Prof. Gary Hieftje. After completion of graduate



**Michael Ramsey**

school he was awarded a Eugene P. Wigner Distinguished Postdoctoral Fellowship at Oak Ridge National Laboratory (ORNL). He became a permanent staff member at ORNL in 1981. Presently, he is a Corporate Research Fellow and leader of the Laser Spectroscopy and Chemical Microtechnology Group in the Chemical Sciences Division at ORNL where he presently directs 16 staff scientists and engineers and 8 postdoctoral fellows. More than 40 postdoctoral appointees have been trained in his laboratory. His research interests include microfabricated chemical instrumentation, micro- and nanofluidics, ultrasensitive laser-based detection techniques, resonant multiphoton ionization, nonlinear spectroscopies, diode laser-based chemical instrumentation, and real-time chemical characterization of aerosols. Dr. Ramsey has published over 200 papers and presented over 300 invited or plenary lectures in addition to filing more than 70 patents in these areas. He has won several corporate technical achievement awards for his research activities including being named Oak Ridge Laboratory "Scientist of the Year"

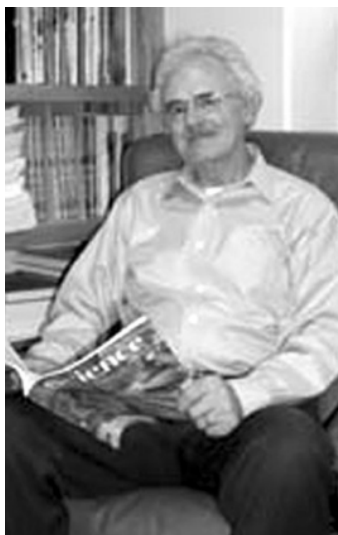
, a Lockheed Martin Corporation NOVA Award winner in 1996 and the Battelle Distinguished Inventor Award in 2003. He is a Fellow of the Optical Society of America, a recipient of a senior A. Von Humboldt Award, the Frederick Capillary Electrophoresis Award, the A. J. P. Martin Gold Medal for Separation Science, the Marcel J.E. Golay Award in Capillary Chromatography, the Jacob Heskell Gabbay Award in Biotechnology and Medicine, and the ACS DAC Award in Chemical Instrumentation. Dr. Ramsey is presently an Editorial Advisor to the *Journal of Proteome Research*, *Chromatographia*, *Assay and Drug Development Technologies*, *Combinatorial Chemistry & High Throughput Screening*, and *Biomedical Microdevices*. He recently chaired the Fifth International Conference on Miniaturized Chemical and Biochemical Analysis Systems,  $\mu$ TAS '01, past chair of the ACS DAC Division, and the 1999 Gordon Research Conference on Analytical Chemistry. He is a past member of the Editorial Advisory Board of *Analytical Chemistry*, *Electrophoresis*, *Spectrochimica Acta Reviews* and the Instrumentation Advisory Boards for *Analytical Chemistry* and past Associate Editor for the *Journal of Microcolumn Separations*. In addition he is a co-founder and Scientific Advisory Board Member of Caliper Technologies, Corp., a company leading the way to commercial Lab-on-a-Chip devices.

# Recipients of the 2003 Division of Analytical Chemistry Awards

J. Calvin  
Giddings Award  
for Excellence  
in Education  
Sponsored by the  
Dekker Foundation:

**CHRISTIE G.  
ENKE**

Professor of  
Chemistry  
University of New  
Mexico



Christie Enke

Professor Enke received his B.S. degree in Chemistry from Principia College (Illinois) in 1955 and his Ph.D. from the University of Illinois in 1959. His career in education spans more than four decades including teaching appointments at Princeton University (1959-66), Michigan State (1966-94), and the University of New Mexico (UNM), where he is currently Professor of Chemistry.

In addition to Prof. Enke's notable accomplishments in the area of education in analytical chemistry, he is also credited with the invention of the triple quadrupole mass spectrometer, which was developed, in his laboratory in 1978. This technique of MS/MS allows the direct analysis of pre-selected components of mixtures and can yield a wealth of molecular structure data not available in ordinary MS by providing direct information on ion fragmentation pathways. For this achievement, he was recognized with the ASMS Award for Distinguished Contributions to Mass Spectrometry. His current efforts in this area are being applied to the trace detection of environmentally and biologically

significant materials in mixtures, the development of new techniques for organic structure determinations, and the use of the mass distributions of various biomarker molecules for microbial characterization. His research group also focuses on the application and development of time-of-flight MS as a chromatographic detector. In addition, a recent focus is in the development of expert systems for the automatic elucidation of molecular structures from MS/MS data.

Professor Enke has received numerous awards including two previous ACS awards for Chemical Instrumentation and Computers in Chemistry, and the Distinguished Faculty Award (Michigan State). He has written 15 books, including his latest, "The Art and Science of Chemical Analysis," and has mentored nearly 70 Ph.D. students. In his nomination for this award, Prof. Enke was described as "an author of influential textbooks, a mentor to literally hundreds, an innovative thinker, and above all, a devoted educator."

ACS Division of  
Analytical Chemistry  
Arthur F. Findeis Award  
for Achievements by  
a Young Analytical  
Scientist Sponsored  
by the Philip Morris  
Companies

**STEPHAN J.  
STRANICK**

National Institute  
for Standards and  
Technology



Stephan Stranick

Stephan Stranick received a B.S. in Chemistry from Ithaca College in 1989 and a Ph.D. in Chemistry from The Pennsylvania State University in 1994 under the direction of Professor Paul Weiss. In 1995, he was a visiting scientist at DuPont's Central Research and Development Laboratory in Wilmington, DE. Stephan is currently a Research Chemist at the National Institute of Standards and Technology where his research focuses on the development of novel proximal

probe microscopies for surface physiochemical analysis. He has published over forty papers on the subject and has been awarded fourteen patents associated with scanned probe microscopies for chemical and electrical characterization. His awards include the American Chemical Society's Nobel Laureate Signature Award, the American Chemical Society's Procter&Gamble Award in Physical Chemistry, the BF Goodrich Collegiate Inventors Award, the Union Carbide Kenan Analytical Award, the Samuel Wesley Stratton Award for Excellence in Science and Engineering, the Department of Commerce Bronze Metal Award for Superior Federal Service, and a Xerox Award in Materials Research.

**Workshop  
at the NY Meeting:  
Information that  
you need on  
chemistry.org  
User tutorials**

Join the chemistry.org staff on Monday, September 8, 2003 from 9:00 AM to Noon at the Jacob Javits Convention Center for a half-day-long session of user tutorials on the re-designed ACS Website; including the best ways to make the most out of the new streamlined tab navigation. We'll discuss "real-life" search examples and present tips that will make it easier for you to quickly find the ACS departmental or program content that interests you most. For example, we'll investigate the "ACS Members" tab that lead to content resources most requested by members on benefits, ACS meetings, technical divisions, and more. Register by sending an e-mail to [webmaster@acs.org](mailto:webmaster@acs.org)

# Mark Your Calendars for EAS

Nov 17 - 20, 2003 Somerset, NJ



Henrik Rasmussen  
2003 EAS President

I was very pleased with the 2002 Symposium and Exposition. The exhibitors provided an outstanding venue for evaluating new instruments and acquiring technical product information and our technical sessions, short courses and workshops truly delivered on the promise of "providing practical solutions to our analytical chemistry problems."

As we look ahead to EAS 2003, I invite you to join us again or if you have not attended EAS in the past or recently, to come and share in the excitement. The Garden State Exhibit Center in Somerset is within easy driving distance for thousands of sci-

entists from industry, academia and government and the facilities are excellent.

In planning your attendance, our website ([www.eas.org](http://www.eas.org)) will continue to offer updates on which vendors are attending the Exposition, and updates on our Program, Short Course, Workshop and Seminar offerings. It is also an extremely convenient means of registering for the Symposium, whether or not you need housing accommodations. I would encourage you to bookmark the website and to use it in planning your EAS week: November 17-20, 2003, Somerset NJ

## "A Role for Mass Spectrometry in Homeland Security: Past, Present and Future"

A workshop on that topic will be hosted by the Oak Ridge National Laboratory at the Marriott Hotel in Knoxville, TN, September 16-18, 2003.

For additional information please contact Gary J. Van Berkel ([vanberkelgj@ornl.gov](mailto:vanberkelgj@ornl.gov) or phone 865-574-1922).

Visit our Webpage <http://www.ornl.gov/divisions/cas/d/obms/bioorganicms.html>



Minutes of the DAC-FECS (Federation of European Chemical Societies) meetings are posted on the website [www.dac-fecs.org](http://www.dac-fecs.org) or may be obtained from the DAC-ACS representative, Andrew Zander at [atzander@earthlink.net](mailto:atzander@earthlink.net).

# FACCS 2003



## The 30th Annual Meeting: Ft. Lauderdale, FL October 19-23, 2003

This year's program includes over 80 sessions with renown speakers covering cutting edge topics such as ·Pharmaceuticals Analysis and BioAnalytical with strong emphasis into ·Process Analytical; outstanding sessions on the state of the art ·Raman, Infrared, Atomic, Mass Spectroscopies, and Chemometrics. We will also have sessions on ·Forensic Analyses, and ·Detecting Weapons of Mass Destruction. Other sessions will include ·Chiral Chemistry, and ·Materials Research.

In addition there will be outstanding Award Symposia offered by our Member Organizations: ISA will feature a session on ·Process Analytical Chemistry, Royal Society of Chemistry will sponsor ·Chemometrics in Process Analysis and Coblenz Society will organize a symposium on ·Spectroscopic Imaging, Society for Applied Spectroscopy will sponsor Meggars Award Symposia and Wednesday Posters

session including SAS student posters. ACS and Anachem will provide their much needed excellent support and awards. We will also feature a ·Student Awards Symposium and sessions on ·Teaching Analytical Chemistry, ·Electrochemistry and ·Separations.

And new concept for FACCS this year: ·ePresentations! These will be organized on Sunday and Monday and feature laptop presentation in an informal setting with the opportunity to bring examples of interfaces, products and other visual aids to generate conversation and interest. For other topics please take the opportunity to visit our web site at <http://facss.org/>.

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