Leadership Change and External Review Among Recent Highlights

Last fall, I was honored to have my colleagues recommend me as the next chair of the Department of Chemistry. I was humbled by their trust and excited to serve in the footsteps of past leaders, including Karabatsos, Dye, Babcock, Hunt, and McCracken.

We thank John McCracken for his eight years of leadership. From new faculty hires to the massive infrastructure improvements, John’s accomplishments would rate as terrific during ordinary times. The fact they occurred during a period of continual budget cuts warrants our warmest appreciation.

Among John’s last objectives as chair was to conduct an external review of the department. Six eminent chemists from across the country spent several days in East Lansing. They learned much about how we operate, teach and research, and the group of scholars concluded that, despite the serious economic challenges of our time, “the faculty, students, and staff of the MSU chemistry department are performing in an exemplary fashion.” Their review validates the hard work of many students, faculty and alumni whose dedication and service have helped earn us such a strong endorsement.

We continue to engage more undergraduates in learning chemistry beyond the traditional classroom or textbook. From Ned Jackson’s freshmen seminar on green chemistry to Jetze Tepe’s senior seminar on pharmaceutical chemistry, our students are getting hands-on experience that will benefit them greatly. Similarly, our faculty research labs are increasingly home to undergraduates with more than 20 undergraduate students enrolled in independent research and working with faculty this semester.

Two student groups received national recognition. The Younger Chemists Committee won the ACS Outstanding or Creative Local Section Award in 2010. Similarly, the student chapter of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers received the Excellence in Service Award for their contributions to the secondary education program initiative and for hosting the Fall Midwest Regional Conference.

The department hosted the eighth consecutive Project SEED summer research internship program last summer. Led by Babak Borhan and graduate student Mercy Anyika, the program for economically disadvantaged high school students provided them the chance to study the overexpression of starch biosynthetic enzymes, polymer brushes for protein purification, solid state electrolytes for dye-sensitized solar cells, the synthesis of a potential NiCVD precursors, Wittig rearrangements, and methods for the determination of absolute stereochemistry.

Being a core discipline, our lecture and laboratory courses are a key part of MSU and the faculty involved are among the most dedicated. Among them, Amy Pollock was recently named a Fellow of the MSU Walter and Pauline Adams Academy for Instructional Excellence and Innovation in recognition of her commitment to teaching.

Robert LaDuca was recognized by the MSU Alumni Club of Mid-Michigan with the Quality in Undergraduate Teaching Award. His research in the application of hydrothermal methods for the synthesis of novel solid-state materials is carried out largely with undergraduate students, nine of whom were co-authors of one or more journal articles in 2010.

The doctoral program for chemistry was among five programs in the MSU College of Natural Science programs to score among the best in the nation, according to the National Research Council’s rankings released in 2010.

The department faculty are among the most entrepreneurial at MSU in helping create companies and jobs. In 2010, two of these companies, Draths Corporation and BioPhotonic Solutions, won Corp! magazine’s Science and Technology Award. Draths Corp. is based on the biocatalysis research of John and Karen Frost. BioPhotonic Solutions was founded by Marcos Dantus (see page 4).

The department did suffer a loss in 2010 with the death of Gene LeGoff. A faculty member since 1965, Gene’s research on the synthesis of various substituted porphyrins and expanding macrocycles containing pyrroles and thiophenes resulted in more than 60 papers and 46 graduate dissertations.

Finally, on behalf of all the students and faculty, I want to express my gratitude for the generous gifts made to the department over the past year. I realize the economic challenges facing our alumni and friends, and your gifts have a lasting impact on the students and the lives touched by our research. Thank you.

Rob Maleczka, Ph.D.
Chair, Department of Chemistry
Michigan State University
Wayne Wolsey, Chemistry ’58, received the Senior Chemist Award for professional activities since formal retirement from the Minnesota ACS Section in 2010. He is also co-author of the 10th edition of Chemical Principles in the Laboratory which will appear in early 2011.

Virginia (Eyres) Ainslie, Chemistry ’64, has operated her own lobbying firm in Washington, D.C., since 1982. This January, her firm affiliated with Miller/ Wenhold Capitol Strategies, LLC.

Mike Nametz, Chemistry ’69, is Coordinator of Patents, Trademarks and Copyrights for Exxon Mobil Corporation.

Joseph Cardarelli, PhD Chemistry ’71, recently retired after a 40-year career in the chemical and pharmaceutical industries, and in consulting services for FDA-regulated industries.

Bill Rothwell, Chemistry ’76, retired last year after 29 years with Shell. At the time of retirement, he was heading up all of Shell’s global chemical and innovation R&D as Vice President of Innovation and Chemical Technology. He recently started a new position as Vice President of Biobased Chemicals working for Codexis - a California-based biotech firm.

David Nagi, Chemistry ’78, left the automotive industry after 28 years in 2007 and is Senior Director of Manufacturing at SolFocus - a start solar industry company and leader in concentrator photovoltaic technology which combines high-efficiency solar cells and advanced optics.

John McMahen, PhD Chemistry ’82, has been studying electrode surfaces with a variety of spectroscopic techniques, especially Surface Enhanced Raman Scattering (SERS). In 2010 he was awarded two patents both titled “Photocatalytic electrode and fuel cell” that offer an economical photoelectric alternative to platinum catalysis of the oxygen reduction reaction in fuel cells.

Daniel Mindiola, Chemistry ’96, received the Recent Alumni Award in 2010 from the MSU College of Natural Science Alumni Association. Mindiola is a professor of inorganic chemistry at Indiana University and has a remarkable track record of publications and awards over the eight years he has been with IU.

Matthew Gardner, PhD Chemistry ’97, is a principal in Sustainserv, a consulting firm with offices in Boston and Zurich, and works with companies around the world on sustainability strategy, programs and communications. One project he has been recently working on is the design of a sustainable theme park in Houston, Texas, that is dedicated to education and communication about energy and the environment.

Patrick Lofy, PhD Chemistry ’03, is a Senior Scientist with the Defense Threat Reduction Agency - the Department of Defense’s Combat Support Agency for countering weapons of mass destruction. His emphasis is in radiation detection.

Lindsay Beth Willett, Chemistry ’06, graduated from the MSU College of Law in 2009, passed the Pennsylvania Bar Examination, and is an attorney in Philadelphia, Pennsylvania.

Kheireddine El-Boubbou, PhD Chemistry ’10, received the Alberta Ingenuity Centre for Carbohydrate Science (AICCS) International Young Investigator Award in 2010. The award encourages carbohydrate research by young investigators around the world.

Aman Desai, PhD Chemistry ’10, won the award for the best student talk at Boron in the America’s XII for a talk on asymmetric aziridinations. He is currently a research chemist at Dow in Midland, Michigan.

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Dave Morrissey, University Distinguished Professor of Chemistry, will received the 2011 Glenn T. Seaborg Award for Nuclear Chemistry presented by the American Chemical Society Division of Nuclear Chemistry & Technology. The award recognizes and encourages research in nuclear and radiochemistry or their applications. Morrissey joined MSU and the National Superconducting Cyclotron Laboratory faculty in 1989. He is the principal investigator on a recent $3.28 million NSF grant developing an electromagnetic trap to snag and quickly extract rare isotope ricochets from high-speed particle collisions they create. “We’re going to provide these small ions that have never been studied before to experimenters,” he said. The research will lay useful groundwork for the half-billion dollar Facility for Rare Isotope Beams, planned for construction at MSU.

Gary Blanchard, professor and associate chair, is the 2011 recipient of the Gold Medal Award from the New York Section of the Society for Applied Spectroscopy. Established in 1952, the award recognizes outstanding contributions to the field of applied spectroscopy.

Blanchard’s research focuses on interfacial science and the development of spectroscopic methods for the characterization and detection of interfacial species at the sub-monolayer level. Work in this area has involved the development of synthetic strategies for the growth of individual molecular layers at interfaces as well as the application of linear and nonlinear spectroscopies to the characterization of interfaces.

Blanchard has received continued support from the NSF, DOE, NATO, PRF and private organizations. He has published more than 150 papers and has presented more than 240 talks. Blanchard has graduated 24 PhD and 6 masters’ students during his 20 years at MSU. He earned a PhD from the University of Wisconsin – Madison in 1985.

Scott Bankroff, scientific instrument facility coordinator, was selected as the recipient of the Wale Award for the outstanding technical poster presentation by the American Scientific Glassblowers Society. His poster, titled “The Cut, Ten Ways to Separate Glass from Itself,” was judged against a field of other technical poster presenters by the ASGS.

Many alumni fondly remember long time physical chemistry secretary Naomi Hack. In 1999, the department created the Naomi Hack Distinguished Staff Award in Chemistry. This award is given in honor and memory of Naomi Hack in recognition of significant assistance and contributions staff make to the department, students and the university. The 2010 recipient of the award was Dianne Karsten. Her contributions are very much in the spirit of Naomi Hack and as the scientific stockhandler for our undergraduate teaching labs, she is at the frontline of our teaching mission.
Smart Lasers Lead to Noninvasive Biopsies

Biopsies in the future may be painless and noninvasive, thanks to smart laser technology being developed at Michigan State University.

To test for skin cancer, patients today must endure doctors cutting away a sliver of skin, sending the biopsy to a lab and anxiously awaiting the results. Using laser microscopes that deploy rapid, ultra-short pulses to identify molecules, doctors may soon have the tools to painlessly scan a patient’s troublesome mole and review the results on the spot, said Marcos Dantus.

The results touting this new molecule-selective technology can be found in the current issue of *Nature Photonics*, which Dantus co-authored with Sunney Xie of Harvard University.

“Smart lasers allow us to selectively excite compounds – even ones with small spectroscopic differences,” said Dantus. “We can shape the pulse of the lasers, excite one compound or another based on their vibrational signatures, and this gives us excellent contrast.”

In the past, researchers could approach this level of contrast by introducing fluorescent compounds. With the breakthrough using stimulated Raman scattering microscopy, fluorescent markers are unnecessary.

“Label-free molecular imaging has been the holy grail in medicine,” Dantus said. “SRS imaging gives greater specificity and the ability to map a particular chemical species in the presence of an interfering species, such as cholesterol in the presence of lipids.”

Additional potential applications include allowing researchers to closely examine how compounds penetrate skin and hair. Smart lasers also can better identify how drugs penetrate tissue and how drugs and tissue interact, thus mitigating the chances of potential side effects and helping reduce the time required to bring new drugs to market.

Dantus also is using smart laser imaging technology at MSU for detecting traces of hazardous substances from a distance.

“The ability to image with molecular specificity and sensitivity opens a number of applications in medicine as well as in homeland security,” he said.

Collaboration for the paper began when Harvard graduate student Christian Freudiger contacted Bio Photonic Solutions, a high-tech company Dantus launched in 2003 based on his research at MSU. Dantus was not only able to provide the laser pulse shaper Harvard needed to conduct the research, but he also was able to lend his expertise as well as the support of his MSU laboratory, Dantus said.

“I like to say that we enable technology,” he said. “Controlling ultrashort pulses, which once required PhD experts, can now be done with push-button simplicity by a small computer-controlled box. This instrument is now being used in the most prestigious research laboratories in the world.”

Dantus’ research is funded in part by the National Science Foundation.
Faculty Host Support Group for High School Chemistry Teachers

In a YouTube video titled “Viking Exploding Jack-o-Lantern,” students in Rich Lund’s chemistry class at St. John’s High School are thrilled as the gases inside the pumpkin ignite. This ignition of acetylene gas is the exciting side of chemistry – one which Kathy Severin and Gavin Reid think more high school students should experience.

Severin, academic specialist, and Reid, associate professor, host a forum for mid-Michigan high school chemistry teachers to share their best lab exercises and teaching methods. Their goal is to support the teachers who are working to improve how high school students learn chemistry. For teachers like Rich Lund, the forum helps keep the students excited about learning chemistry.

Severin and Reid started the monthly support group in 2008 as a place where local teachers could network, share resources, and learn more about chemistry. The two do this as part of their work with the local chapter of the American Chemical Society. The chapter hosts contests, tours of MSU facilities, and other outreach events to increase the community’s awareness of chemistry.

Severin is a long time resident of Michigan and sees the forums as a way to give back to the community. “We are helping teachers who conduct many classes a day,” says Severin. “We aim to give them proven exercises they can work into their teaching.”

Reid participated in similar forums at the University of Melbourne before coming to MSU in 2004. “I want students to be prepared when they come to MSU or wherever they go,” says Reid. “Hopefully they’ll better understand chemistry thanks to the work done by their high school teachers.”

Severin and Reid recruit other MSU faculty to present difficult or exciting topics, like nuclear chemistry and lab safety. The ACS chapter donates chemistry materials to the high school teachers who sometimes have limited resources.

Severin notes that liquid nitrogen and dry ice are often in demand for the wow factor they provide in lab experiments. She also makes equipment like portable spectrometers available for teachers to borrow.

For the teachers who can’t make the monthly meetings, Severin and Reid offer online resources and communications. The group has become a support group among local teachers working together to help each other. The resources include chemistry problems, simulations, and teaching materials. Among these is a link to the popular “Viking Exploding Jack-o-Lantern” video.

Startup Earns Top Entrepreneur Prize

InPore Technologies, a startup company formed by Thomas Pinnavaia, University Distinguished Professor of Chemistry, won the top prize in the 2010 Statewide Business Plan Competition from the Great Lakes Entrepreneur’s Quest.

Pinnavaia’s research at MSU led to the development of InPore’s Silapore™ product - a plastic additive which helps make a plastic stronger, lighter, scratch resistant and flame retardant. InPore was chosen by venture capitalists from a field of 22 finalists. According to Pinnavaia, winning the competition is the result of the hard work put into developing a viable business along with a viable technology. The business acumen for InPore is provided by CEO Gerry Roston. Technology is the result of Pinnavaia’s research in porous structures and nanocomposites.

Silapore™ is an inorganic, sub-micron sized silica particle that bonds to the polymer strands of the plastic to increase the stability of the final product. It is engineered to have a greater number of pores which give the polymer strands more places to bond, and the plastic is lighter as a result.

InPore is working with wind energy companies to use the light and strong plastic for better wind turbine blades. The automobile industry has also shown interest in the scratch-resistant and lightweight plastics. The company is using investment funds to produce small batches of the product at a pilot plant in Lansing and is scaling up production. InPore currently employs six people and Pinnavaia sees the company expanding soon.
Aafter six decades of research, Jim Dye shows no signs of slowing down. While he officially retired from teaching at MSU 17 years ago, Dye has found a new way to package energy – more specifically, alkali metal silicides to produce hydrogen for fuel cells.

2011 looks to be a breakout year for the science veteran as his lifetime work with alkali metals is gaining mainstream attention as the company SiGNa Chemical launches several products. Dye is a co-founder of SiGNa and serves as director of its Scientific Council. The start-up received the EPA’s Presidential Green Chemistry Award in 2008 for developing stabilized alkali metals for safer and sustainable syntheses.

Building off of Dye’s development of alkali metals in silica gel, SiGNa has developed a power platform which produces hydrogen gas upon demand and then converts the hydrogen to electricity using a low-cost fuel cell. The hydrogen is produced at low pressure and the only emission is water vapor. The sodium silicide in the fuel cell is converted by the reaction to environmentally friendly sodium silicate.

SiGNa introduced the fuel cell on an electric bike last fall. A similar hydrogen fuel cell cartridge was introduced by SiGNa several months ago and caught the eye of the New York Times and other media. The cartridge generates hydrogen upon addition of water and is designed for charging mobile phones and computers. It is expected to go on sale this summer.

Six decades of progressively successful chemistry by the Dye Lab has led to these innovations. The synthesis of a room-temperature stable organic electride five years ago served as a major game-changer for the inorganic chemistry community. It was a search for stable inorganic electrides that led the Dye group to develop the new materials now being produced by SiGNa. The insertion of alkali metals into the nanoscale pores of silica gel has “tamed” them to the point that they can be safely handled in dry air, in contrast to the metals themselves. Later, this led to the preparation of air-stable sodium silicide, the power source for SiGNa’s fuel cell development.

Dye’s research program has kept pushing forward and building off their success, as evidenced by the 49 papers he has published since “retiring”. While external federal funding ceased years ago, the Dye Lab remains strong thanks to a Dreyfus Senior Mentor Award, which funds a cadre of undergraduate students in the Dye lab.

“Having undergraduates in the lab gives them a jump on their graduate research,” says Dye. “Everyone who has come through the lab and gone on to graduate school has had glowing reviews on how this experience helped their career.”

In January, Dye submitted a paper for publication in a professional journal. Seven of the co-authors on the paper were undergraduate students.

Dye and his undergraduate students are busy trying to make further use of alkali metals in porous oxides. One aspect of their current work focuses on converting Freons into useful products that are not harmful to the atmosphere.

In the basement of the Chemistry Building, the Dye Lab shows no signs of slowing down as Dye is the office daily. In February, he will travel to Japan where he will present an invited seminar on electrides at an advanced materials conference.

Dye’s career at MSU began in 1953. His legacy continues to grow as evidenced by the 56 PhD and 23 MS alumni, plus dozens of undergraduates, who have worked in his lab and the success of SiGNa Chemical. In addition, the James Dye Endowed Chair in Materials Chemistry is continuing to grow thanks to the generous support of alumni. Once fully funded, the chair will forever reflect on the contributions made both before and after his “retirement.”

Dye riding on the electric bike powered by the SiGNa fuel cell developed from his sodium silicide research.
Virtual Textbook is Free Resource on Organic Chemistry

Search for “organic chemistry” on the internet and one of the top results belongs to Bill Reusch, professor emeritus, and his online textbook used by faculty and students around the world. The site has been an ongoing work for Reusch who retired more than ten years ago.

The Virtual Textbook of Organic Chemistry has become one of the premier chemistry resources available online. The site is free and has a creative commons license allowing users to share the work.

Reusch built the online textbook to cover topics typical of a sophomore-level college course. It includes chemistry concepts, graphics, animations, molecular models and interactive problem. Over time it has expanded to include advanced topics, and has become a reference resource rather than an introductory textbook.

Reusch retired in 2000 after 42 years with MSU. He began coding the chemistry problem sets before retirement. “I knew I was going to be retiring and I was looking for something to do,” he says.

Reusch was inspired by Abby Parrill, a visiting professor who was primarily interested in teaching and had written computer based problems. Reusch taught himself to write code and began developing interactive problems. At the time, most chemistry problems available online were simple flashcard problems with a question and an answer. His interactive problems have multiple parts. Students receive feedback as they move through the problem, mimicking the interaction of a student with a teacher.

“During office hours, instead of just answering the question, I would try to get students to respond to simple questions that lead them to an answer,” says Reusch. “This means you need an interactive relationship. You don’t normally get that on the computer, and I wanted to do that with the questions.”

There are more than 1,000 distinct problems in the question bank on the site. The textbook portion slowly took shape as Reusch received feedback from users. He decided that an explanation of the concepts behind the problems would be helpful and the resulting text content is now the majority of the site.

Reusch is proud of the depth of information available. Users can begin using the site as a novices and still find it useful as graduate students. Users from universities all over the world contact Reusch to offer feedback on the site. Their comments have helped keep the site relatively error free.

Reusch also receives requests from instructors looking to use the site as a free textbook. Although several universities and community colleges are using the problem sets for their students, the site is not organized to function as a true textbook and serves primarily as an adjunct for conventional textbooks. Reusch has an agreement with Great River Technologies to offer support for a revised textbook version of the text, accompanied by additional multiple choice problems, printable PDF pages and PowerPoint slides.

Reusch has worked five days a week for the last 10 years to create the site. More than a decade into retirement, Reusch hopes to travel more with his wife in the coming years and spend less time maintaining the Textbook. He already has offers from other universities to mirror the site and ensure that it remains available and relevant to students and teachers around the world.

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Reusch's Virtual Textbook of Organic Chemistry

Bill Reusch retired in 2000 and has spent the years developing one of the Internet's premier resources on organic chemistry. The site has more than 1,000 distinct problems in the question bank and is used by college instructors around the world.

On the Internet: http://www.cem.msu.edu/~reusch/vtxtindex.htm
**Chemistry Awards and Recognition**

Matt Fhaner, doctoral student, was awarded a pre-doctoral fellowship from the American Heart Association to help start his career in cardiovascular and stroke research by providing research assistance and training. The two-year fellowship started in July 2010.

Doo Young Kim, research associate, and Vernon Swope, research associate, each received awards from the MSU chapter of Sigma Xi - the international honor society of science and engineering. Kim received a Postdoctoral Fellow Award and Swope received a Graduate Student Award.

Piotr Piecuch, University Distinguished Professor, was selected as a panelist for the Department of Energy workshop on Computational Materials Science and Chemistry for Innovation.

Amy Pollock, academic specialist, was selected as an Adams Academy Fellow for 2010-2011 in recognition of her work as a teacher-scholar. The fellowship is given by the MSU Walter and Pauline Adams Academy for Instructional Excellence and Innovation.

Gavin Reid, associate professor, received the 2011 Bowie Medal from the Australian and New Zealand Society for Mass Spectrometry in recognition of outstanding achievement in the field of mass spectrometry. Reid’s research focuses on developing new methods and chemical strategies in proteomics and lipidomics. Reid presented a keynote lecture, *Development of Alternative Ion Activation Strategies to Improve the Capabilities of Bioanalytical Mass Spectrometry for Phosphoproteome Analysis*, at the biennial ANZSMS conference in January. The early career award is presented every two years to an Australian or New Zealand researcher under the age of 45.

Chemical and Engineering News highlighted the research by Dana Spence describing a possible mechanism for the efficacy of hydroxyurea, the only proven therapeutic for people with sickle cell disease. This was the fourth such highlight on the Spence group’s work in the past 4 years.

Greg Swain, professor, has been appointed editor of *Diamond and Related Materials* - an international, interdisciplinary journal which publishes articles covering both basic and applied research on diamond materials and related materials. He had previously served as associate editor for the journal.

David Weliky, professor, was invited by the National Institutes of Health invitation to serve as a member of the Biochemistry and Biophysics of Membranes Study Section, Center for Scientific Review. The Study Section reviews NIH research applications concerned with aspects of membrane structure and function.