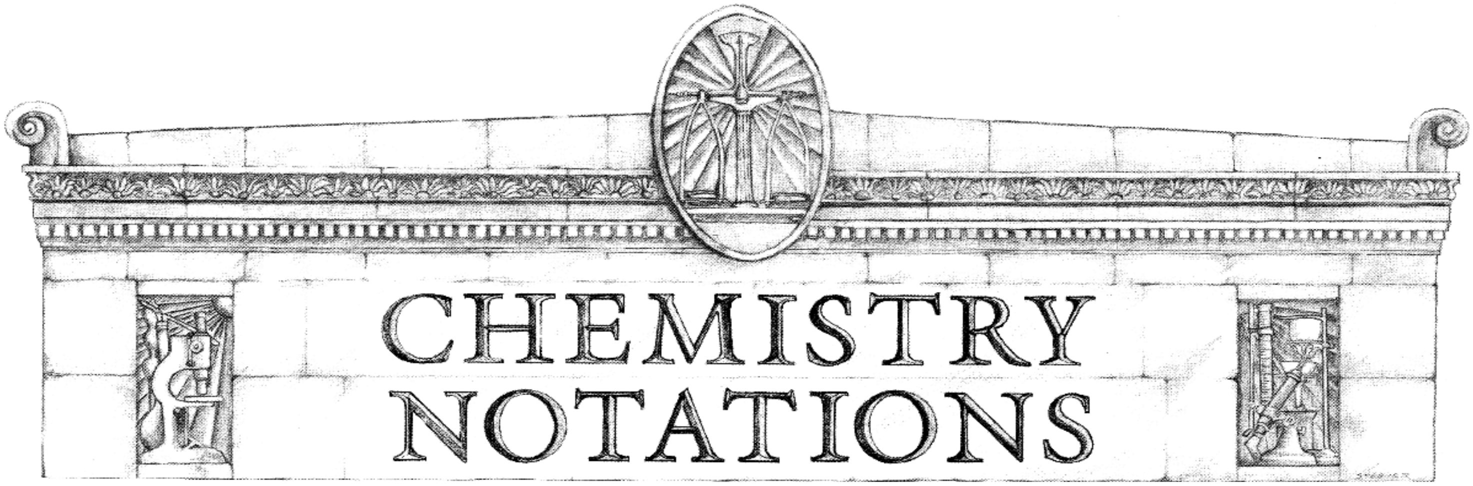


A publication of the Chemistry Department at Washington State University

Fall Semester, 2008

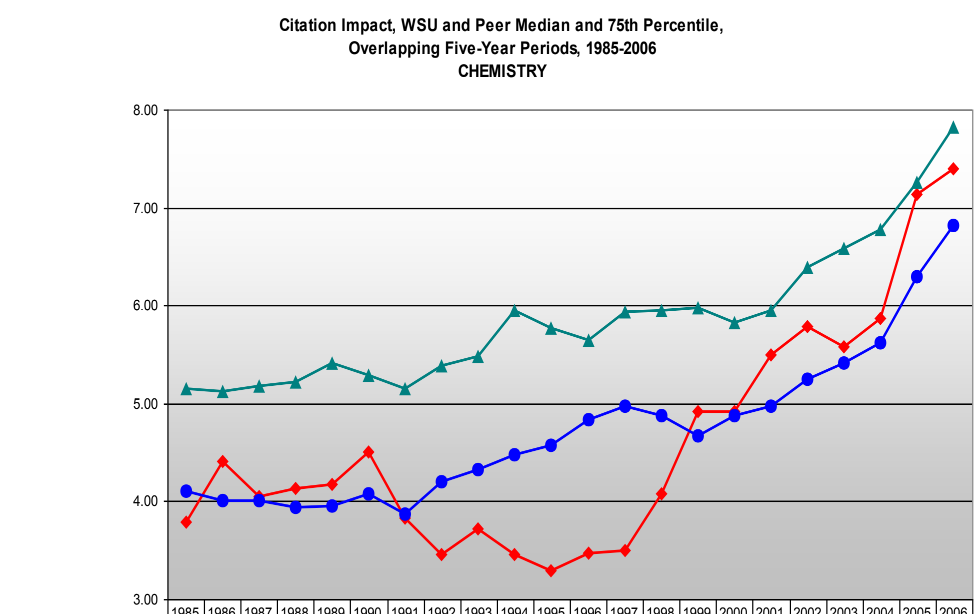
A Message from the Chair

Hello fellow Cougar Chemists! It has been too long since our last newsletter and we have a lot to catch up on. This letter is not just for Chemists, but also for any other students who spent a big part of their educational time in Fulmer Hall, including the Chemical Physics and Materials Science students who studied in Fulmer. I want to provide all of you a brief glimpse of life here in 2008, and to also tell you about some planned changes. In later sections we will focus on just a few of the changes that are helping to make our department truly world class.

As a department we have been rapidly building our national and international research stature. Figure 1 is one metric for this growth ~ a comparison of the impact of our literature articles in comparison with our peer institutions. Notice that in a few brief years WSU has risen from a bit below average to the upper 25% level.

Another measure of our growth and success is in the number of graduate students entering the Chemistry Ph.D. program. Table I shows that we are experiencing dramatic growth in this area as well. The origins of this growth are many: a) with the growth in our research recognition (see Figure 1) there has been a parallel but delayed growth in our reputation with graduate applicants, b) we have added a number of research active faculty; c) we have increased the financial support for our graduate students (more about this later), and d) Carrie Giovannini, Jeanne McHale, Jim Brozik and the recruiting committee have done a wonderful job.

Good things are happening at the undergraduate level also! Over the last few years, the department has heavily relied on tenured faculty to teach the Freshman courses. Rather than replace instructors like Helen Place and Brian Weissbart when they left WSU, we have cycled in Full and Associate Professors to teach those classes. Under the expert guidance of our Associate Chair for Undergraduate Education, Scot Wherland, the structure of our 100 level courses have been modified to give senior faculty easier access. It is our hope that having research active faculty teaching these classes will inspire our students to learn and, we hope, motivate a few to major in chemistry.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
WSU	3.79	4.41	4.05	4.13	4.17	4.5	3.83	3.46	3.71	3.46	3.29	3.47	3.49	4.07	4.92	4.92	5.49	5.78	5.57	5.86	7.13	7.39
Peer Median	4.1	4.01	4.01	3.93	3.95	4.07	3.87	4.2	4.32	4.47	4.57	4.83	4.97	4.88	4.67	4.88	4.97	5.24	5.41	5.62	6.29	6.81
Peer 75th Percentile	5.15	5.12	5.18	5.22	5.41	5.29	5.16	5.39	5.48	5.95	5.77	5.65	5.94	5.95	5.98	5.83	5.95	6.40	6.58	6.77	7.26	7.82

TABLE I	Grant Expenditures	Permanent Funding	Tenure Track FTE	# Ph.D. students
CHEM 2003	2,634,048	2,737,189	18.9	34
CHEM 2004	3,628,914	2,708,393	17.7	49
CHEM 2005	3,845,134	2,788,084	19.2	38
CHEM 2006	4,558,372	2,714,565	21.4	49
CHEM 2007	4,524,016	2,346,162	21.5	56
CHEM 2008			**22.5**	**67**

Other good news for undergraduates is their participation in research and the rewards it brings them. Every chemistry major MUST take at least one semester of undergraduate research, and many take 3-5 semesters. These students get hands-on training in state of the art techniques and become involved in science where "the rubber meets the road". During the last 5 years, more than 40 publications in first class journals have featured WSU undergraduates as co-authors. Because successful undergraduate research is the best predictor of success in graduate school, letters of recommendation from research advisors can give a WSU grad entry to schools that might not consider him or her based on GPA alone. For those going to work with a BS, their research experience is a huge advantage. Often this is the only technical job they have ever had. Having a faculty member who can knowledgably answer questions about a students work habits, people skills, creativity, communications, and independence is often the difference between getting a position and not.

Of course all of this growth is expensive. As you can see from Table I, we have been steadily getting less support from the state, and the next few years should exaggerate the trend. While we have been using overhead recovery on external grants to fund the teaching operation, there is a limit to how far we can go with this. Some of you have been very generous in supporting our student programs, and we hope that will continue and grow. Let me give you a couple of examples of where we use your financial support to impact education.

Undergraduate summer research support: Students make real progress when they can work on their project through the summer. Usually the chemicals, lab space, personal direction, and instruments are provided by one of our research faculty. The salary for these students is hard to find. The College of Sciences offers a few competitive summer research awards and we also have a small number of National Science Foundation funded Research Experience for Undergraduate awards, but the number of students who want to do research in the summer exceeds the available funds.

Graduate Salary Supplements: Our peers are paying graduate students several thousand dollars a year more than the current Graduate School standard TA and RA salary. The College of Sciences (COS) has managed to find funds to help us supplement the salary level, but that is still almost two thousand dollars short of our peer average. In order to save our graduate program, we have been supplementing this COS salary level out of operations. The good and the bad news is that this is clearly working to increase our graduate student body. It's great because we really need at least four students per tenure track faculty member (about 90), but it's bad because we don't have enough to pay for all those supplements.

If you would like to donate, it's as easy as pointing your browser to http://www.chem.wsu.edu/donor

I would like to close with some personal information about faculty members who have retired during the last few years. **Manning Cooke:** Manning still maintains a lab on the 5th floor. He makes frequent trips to Germany to work with John Gladish (maybe to Texas in the future) and he is becoming an expert in the German language. Any of you that know Manning well will be glad to hear that his GC is still working! **Glenn Crosby:** Glenn, Jane, and Karen are living in a great house on a hillside just outside Spokane. Glenn is still active in the ACS and is currently collaborating with John Kenney at Concordia College on undergraduate research projects. Glenn and Jane just received the Charles Lathrop Parsons Award sponsored by the American Chemical Society. **Ron Poshusta:** Ron and Caryl are living in a rental house in Spokane while their designed home is being finished. **Kirk McMichael:** Kirk and his wife still live in Pullman. He occasionally forwards me a notice of vacancy for teaching positions at various colleges, so he must still be tuned to the educational hot line. I miss his bagpipe serenades at the end of each semester! **Roy Filby:** The last time I heard from Roy he was enjoying his home on the Oregon Coast. Send us an update, Roy. **Harold Dodgen:** They recently renamed the radiation center after its chief designer and builder, Harold Dodgen. It was a nice ceremony and he and his wife looked happy and well. They are still living in Pullman. **John Hunt:** I occasionally see John at Dissmores. He is still living in Pullman.

If I missed anyone, please let me know. Write and tell me what you are up to so I can share it in the next Newsletter. That goes for students, too! While I probably won't have room to write about everybody every time, I am always being asked "what happened to so and so?" We are proud of all our past students, faculty, and staff and we want to know what you are doing these days. Please do write us or email to our alumni coordinator, Nikki Clark, at nikki_clark@wsu.edu.

Lastly, we would like to hear from you. We have a new alumni page on our website where you can enter your information. The website is http://chem.wsu.edu/alumnis/new.

With my warmest regards,

K W Hipps, Professor and Chair

Chemistry Matters

WSU Chemist Working to Revolutionize Solar Panels

By Dr. E. Kirsten Peters

The common solar-electric panels you've seen on the roofs of travel trailers are made of pure silicon crystals, which are produced in an energy-intensive manufacturing process. The crystals are semiconductors doped with impurities to make them work—impurities that are often toxic metals that require mining to obtain. These "first generation" panels are costly both to our pocketbooks and to the environment.

Just a few years ago, hopes were high for "second generation" panels made of light-weight thin films. They are so flexible you can bend them. These devices now make up roughly 10 percent of the market for solar panels. They are often used for powering satellites, because they weigh little. But the cost of second generation panels has not dropped as engineers and investors had hoped, so the price of electricity from them is still far from economic.

Looking for inspiration for a fundamentally different type of solar cell, some researchers are turning to Earth's vegetation for ideas. Plants, after all, have been making a living from sunlight for four billion years. And part of what they accomplish each day in their cellular chemistry involves the flow of electrons.

WSU chemistry professor Jeanne McHale is one the world's leaders in this area. She and her team of students hope to better learn how molecules from plants can promote electron flow. If McHale is successful, a potential "third generation" of solar panels could be manufactured in wholly new ways—and potentially at vastly lower cost.

McHale's professional interest is embedded in fundamental science. "In physical chemistry, we don't usually produce 'deliverables,'" she says with a laugh. Her research includes manipulating materials on the nano-scale and studying them via advanced spectroscopy. But the work always begins quite simply for McHale or her graduate student team—by going to the grocery store and buying a bag of beets.

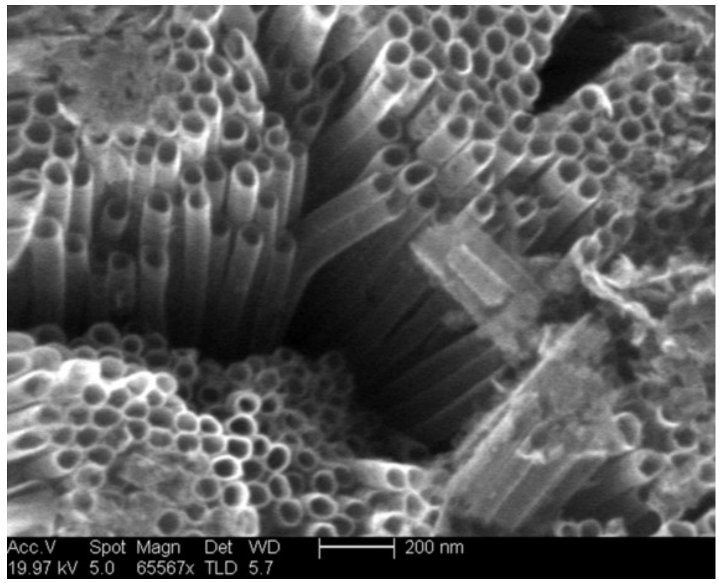
The red color of beets comes from a molecule called betanin, a natural anti-oxidant. Anti-oxidants, as the name implies, moderate cellular processes of oxidation, or the loss of electrons. Betanin is also a natural dye that interacts with light. Dyes are strongly colored substances whose color stems from the part of sunlight's spectrum they reflect while absorbing all the other wavelengths. Betanin isn't directly a part of beet photosynthesis—in fact its function is to protect cells from too much light, like a natural sunscreen—but betanin does react to the photons of sunlight, the keystone to any hopes for solar power.

The fundamental trick for "dye-sensitive" third generation solar panels is to get the dye molecules to give up an electron when they are hit by sunlight and then not instantly take it back, as they would normally do. If they give, without taking back, the dyes produce a tiny but steady stream of electrons, which is a form of electricity.

McHale and her team take the betanin from beets and put it onto a layer of a mineral called anatase. "My students are sometimes better than I am at getting a thin and flat layer of the anatase distributed across a glass plate," McHale said. "There's a knack to it."

Anatase is a natural material in the Earth made of titanium and oxygen. McHale's group uses a synthesized version of the same mineral that is made of particles 20-30 nanometers in size. The nano-particles of anatase create a good surface for the betanin to cling to, and the anatase also acts like a semiconductor. The anatase, which can be in a simple layer or can be formed into nano-tubes that more easily pass along electrons, sits on a conducting layer below.

When the photons from sunlight hit this layered sandwich, a little bit of net electron flow results. Even a small amount of electrons is fine, because with manufacturing materials as cheap as beets and minerals, society can afford a great number of solar panels. Indeed, if this route to the third generation works out, making electricity via betanin could be cheaper than burning coal.



Nano-particles formed in the shape of tubes and made of anatase are used in solar-panel research.

The scale bar shows a 200 nanometer length.

"And if dye-sensitized panels were 10% efficient, as we think reasonable, you could generate all the electricity the United States uses each year with about 2 percent of our land devoted to such panels," McHale said.

But there are many problems to be solved before third generation panels are covering roofs near you. Complex organic molecules don't typically last for a long time if they are taken out of their natural realm, and the betanin in beets is no exception. So, at the moment, the beet-powered solar cells are up and running for only a few hours before they peter out. "One of the challenges is to understand what's going on. We want the chemistry to be regenerative," McHale said. That could well work, because betanin in living beets stands up to a lot of intensive chemistry. It's now up to researchers to understand the particular chemical pathways that act as a restoration system to keep the betanin in good shape for long periods.

McHale's groundbreaking work in the third-generation research field has attracted both interest and financial support from across the nation and around the world. With several graduate students and often an undergraduate chemistry major or two on the research team, the work is moving forward. Although the research is still at the early and fundamental stage, the promise of the technology is potentially enormously bright—as bright as the midday sun.

The Future's So Bright, I Gotta Wear Shades

By E. Kirsten Peters

With only a handful of American universities maintaining doctoral degrees in radiochemistry, WSU's radiochemistry program has sometimes accounted for half of the annual total of people graduating with doctorates in radiochemistry in the United States. That arresting fact gives a sense of urgency to the work of Sue Clark and Ken Nash, the two pillars of WSU's radiochemistry effort. Other faculty who also contribute to research and teaching in the field include Paul Benny, Aurora Clark, and Nathalie Wall.

By any measure, radiochemistry at WSU is significant. In addition to training a major number of the national supply of specialists in the field, the radiochemists just named accounted for over $3.6 million in grant expenditures at WSU in the past four years.

But Nash readily admits that nuclear power is highly controversial and that he and his colleagues face a major public relations challenge in getting their message across to students and the public. "We're coming out of a bad news period for nuclear," he said with an easy smile.

During the Cold War, citizens feared nuclear war with the Soviet Union. At the same time, America was coming to grips with the dangerous nuclear legacy left at places like Hanford. In 1979, there was a partial meltdown of the nuclear power plant at Three Mile Island, near Harrisburg, Pennsylvania. In 1986, a vastly more destructive meltdown and explosion in the Ukraine at Chernobyl added to the public's perception that all things nuclear led to grievous suffering.

"The Chernobyl disaster resulted partly from that reactor's design, which was fundamentally different from American reactors," Clark said. "But there's no doubt that an event like that turns society's views around on a dime."

"The public's fear is not illogical," Nash said. "But I think it's uninformed. Nuclear technology is not inherently evil. The technology is challenging and demanding, so we need talented and committed people to do it, but I'd say it's only one step more complex than space travel." Nash quickly explains that the American nuclear power industry has never suffered a single fatality and that almost 20% of all the electricity generated in the country comes from nuclear power plants.

Although hydroelectric dams are important in the Pacific Northwest, they represent only 7% of the electricity used by the United States as a whole. And Americans cannot build more major dams to substantially increase that figure, simply because the best dam sites have been taken already.

Using the technology that is known and proven today, the United States can generate substantially more electrical power only via fossil-fuel combustion or nuclear energy. We haven't built a nuclear plant for decades, a fact that may soon change in part because of climate concerns, according to Nash.

Just as your father's Oldsmobile is not the one you'd buy today, so nuclear power technology has changed over the years. What's possible now bears little resemblance to the 1950s and 1960s when most of America's nuclear power plants were built, Clark said. There are now multiple pathways by which "spent" or used fuel-rods from a nuclear reactor can be reprocessed to create more electricity. This not only creates more energy, but it can decrease both the volume and the hazards of the nuclear waste remaining.

Reprocessing technologies, collectively referred to as the "closed fuel cycle," are used abroad. They are not used in the United States because of a policy decision made under the administration of Jimmy Carter. The idea in the late 1970s was to limit nuclear weapons proliferation by avoiding all reprocessing of nuclear fuel. This committed the United States to the "open fuel cycle" that runs uranium through reactors only once, Nash said.

The open fuel cycle results in large volumes of high-level radioactive waste that will be dangerous for hundreds of thousands of years. Currently the national plan is to store our high-level waste, from both power plants and the legacy of weapons production, at the Yucca Mountain site in Nevada.

Many people in the nuclear industry hope that the Carter-era decision will be revisited soon. If it is, what is now "waste" could be used again as fuel to generate electricity in a manner that moves us closer to a closed-fuel cycle in the future, Clark said. "I think the United States will eventually start reprocessing, because we simply have to. We'll always need a repository for some waste, but the volume can be reduced a lot by reprocessing."

France, Japan, and a number of other nations generate more of their electricity from nuclear plants than we do, and they reprocess their spent fuel rods to use them again in reactors. In part because of this fact, both Clark and Nash travel internationally on a frequent basis, and all of their graduate students attend at least one international meeting while they are at WSU so they can interact with researchers abroad. Whichever way the politics are sorted out in the United States, WSU's expertise in radiochemistry will be in demand throughout the new century for everything from fuel design to environmental remediation.

Clark is a national leader in research into ways to better address the remediation of land and groundwater contaminated by nuclear waste. She has spent many years working at the Hanford site, Washington's legacy from early national ventures into the production of nuclear weapons. She came to WSU in part because of its proximity to Hanford and to a similar site in southern Idaho, and in part because of WSU's own nuclear reactor. "And the chemistry department here has always had a clear commitment to radiochemistry," she said. "It's a strong tradition, and one I'm proud of because our students at every level earn chemistry, not radiochemistry, degrees—they have a broad background in chemistry as a whole discipline, which serves them well in whatever direction their careers may go."

Radiochemistry also has applications in realms beyond energy and remediation. Increasingly, medical examinations and treatments make use of radioactive isotopes. Many Americans have seen images of themselves at their doctor's office that result from radioactive materials tuned to interact with the body in particular ways. Research in the field of nuclear medicine is on-going at WSU and promises to help physicians of the future be able to better diagnosis and treat some of the most intransient illnesses we face.

Nash is optimistic about the future of radiochemistry. "But if we're going to have a renaissance for nuclear research and nuclear applications, we need a new generation of young people who know and understand radioactive materials," he said.

Clark and the students in her research group are upbeat about the future. The lab's theme song is from the 1980s rock group Timbuk3. The lyrics of the piece are not without irony, but are enjoyed by WSU radiochemists nonetheless. As the song says, "The future's so bright, I gotta wear shades."

Donald S. Matteson Symposium

The first annual Donald S. Matteson Symposium in Organic Chemistry was held at Washington State University Saturday, September 13, 2008, in Pullman, Washington. More than 80 people attended this inaugural event that honored Professor Matteson's lifetime contributions to synthetic organic and organoboron chemistry. Funding was provided by the College of Sciences, the Department of Chemistry, and matching donations from a number of colleagues and past students.

Distinguished organic chemists from around the world delivered plenary lectures at the symposium. Keynote speakers were Professor Bill Roush, Scripps-Florida; Professor Ed Vedejs, University of Michigan; Professor Norio Miyaura, Hokkaido University; Professor Paul Blakemore, Oregon State University; and Professor Victor Snieckus, Queen's University.

College of Sciences Undergraduate Research Showcase

A total of 53 posters were presented at the College of Sciences Undergraduate Research Showcase in April of 2008. Eight were Chemistry majors and four were students from other departments working with Chemistry faculty. Two of them, Andrew Hansen and Leslie Shuhler, won prizes 2nd and 3rd place, respectively. Congratulations all!

Student	Faculty Mentor
K. B. Dorrance	Kirk Peterson
Marcus Faber	Pat Meier
Andrew Goodin	Herb Hill
Brandon Greene	Jim Brozik
Heather Hamilton	Pat Meier
Andrew Hansen	Jeanne McHale
Cayla Jewett	Jim Brozik
Walter Johnson	Louis Scudiero
Jessica Ketrenos	Pat Meier
Brandon Kvamme	Aurora Clark
Sean Richardson	Pat Meier
Leslie Shuhler	K. W. Hipps

College of Sciences Faculty Awards

Scot Wherland

Professor of Chemistry in the Inorganic Division and associate chair for undergraduate education in the department, Dr. Wherland received the Outstanding Advisor Award in the College of Sciences for 2007.

Aurora Clark

Assistant Professor of Chemistry in the Physical Chemistry Division. Dr. Clark received the Outstanding Young Faculty Member Award in the College of Sciences for 2007.

New Faculty

Cliff Berkman

In fall 2007 Professor of Chemistry Cliff Berkman joined us from San Francisco State University where he was professor and chair of the Department of Chemistry and Biochemistry. Cliff earned his bachelor's degree from Lake Forest College, Lake Forest, Illinois in 1986 and his doctorate in chemistry from Loyola University in Chicago in 1993. He completed postdoctorates at Seattle Biomedical Research Institute and IGEN Research Institute in Seattle. The focus of Berkman's research group is on developing diagnostic and therapeutic agents for cancer and heart disease. His group is particularly interested in targeting enzymes or biomarkers unique to these diseases. Applications of his work include in vitro and in vivo imaging technologies as well as cell-capture devices for cancer and heart disease. Students in his research group learn techniques in organic synthesis, cell and molecular biology, biochemistry, and computational modeling. Cliff has already been very successful in acquiring NIH funding both alone and in a joint proposal with Paul Benny, one of our Assistant Professors in the Chemistry Department. Berkman is joined in Pullman by his wife, Noreen Ryan, and their two year-old son Evan, and infant daughter Antonina.

James Brozik

In 2007 Associate Professor James (Jim) Brozik joined the Physical and Materials Division of the Department of Chemistry. Jim came to WSU from the University of New Mexico where he had made a name for himself in the area of biomaterials imaging. If Jim's name seems familiar, it's because he did his Ph.D. here under Professor Glenn Crosby, graduating in 1996. Besides leading a large and active research group, Jim is also associate chair for graduate research. Jim and his wife Jenna stay busy with their 2 year old twins, Sophie and Reese. Glad to see you back, Jim!

Aurora Clark

Assistant professor of chemistry and materials science, Aurora Clark joined the Department of Chemistry in the fall of 2005. She knew where she was coming since she had earned her BS at Central Washington University. Her Ph.D. in physical chemistry was awarded by Indiana University in 2003, followed by a postdoctoral fellowship at Los Alamos National Labs. Since coming to WSU she has won several national awards including the ACS Progress/Dreyfus Lectureship Award in 2008, a DOE Nuclear Science, Engineering and Health Physics Junior Faculty Award in 2007, and (most recently) the ACS HP Award. She has a current DOE grant on computational studies of aqueous surface chemistry and several other grants are pending. She has published nine papers based on her work here at WSU. Aurora and her husband have just welcomed their third child (a girl!) to their family.

Phil Garner

In the fall of 2007, Professor of Chemistry Philip Garner came to WSU from Case Western Reserve University in Cleveland, Ohio. Garner was raised in Greensburg, Pennsylvania, where he developed an early interest in science. He received both his bachelors degree in chemistry (1977) and doctorate degree in organic chemistry (1981) from the University of Pittsburgh. He did postdoctoral work at Indiana University. In 1983 Garner took up his first faculty position at the Illinois Institute of Technology in Chicago and then joined the Department of Chemistry at Case in 1985. His research focus is the building of molecules, which is akin to architecture on the molecular scale. He has established a broad research program that includes the total synthesis of natural products, the development of new methodology for organic synthesis, and the invention of novel drug platforms. His scientific accomplishments include the development of a widely-used synthetic building block, now called "Garner's aldehyde." In addition to his well known research program, Phil is also working within the department. He is currently the convener for the Organic Division. Garner's move west brings him closer to his two children, Alex and Naomi, who live in Seattle and attend the University of Washington.

Nathalie Wall

Nathalie is currently an assistant clinical professor and will be joining the tenure track ranks as an assistant professor next August. Prior to joining Washington State University, Nathalie worked at the French Commissariat a l'Energie Atomique (Atomic Energy Agency), in the division for the study of nuclear waste repositories; at Florida State University on a post-doctoral appointment; and, at Sandia National Laboratories, studying the Waste Isolation Pilot Plant, the first deep geological repository for transuranic wastes. Her research focuses on the environmental behavior of radio-contaminants, in particular the actinides. Nathalie's husband, Don, is the Director of the Dodgen Nuclear Radiation Center.

Ming Xian

Ming Xian, assistant professor of chemistry, joined the Department of Chemistry in the fall of 2006 and is a member of the Organic Division. He obtained his Ph.D. in organic chemistry at Wayne State University and his B.S. at Nankai University, China. He did his postdoctoral study at the University of Pennsylvania. His research focus is examining and solving medical and biological problems by combining organic synthesis with bioorganic chemistry, particularly in the areas of (1) synthetic methodology development and natural product synthesis; (2) protein molecular recognition and interaction; and (3) the development of new therapeutic agents. Ming's research is going well with six papers published since coming to WSU with three of those having an undergraduate, Brian Shuhler, as co author. Ming's wife Jackie works in the Chemistry Department in the LBB2 Lab. Their daughter, Michelle, will be 3 in March.

Choong-Shik Yoo

Professor Yoo joined the faculty at WSU in 2007 with a joint appointment in physics and chemistry. Choong-Shik's is a world renowned expert in chemistry and spectroscopy at very high pressure, and he is now working closely with physics Professor Yogi Gupta in the Center for Shock Dynamics. While he has only been here a short time, he has submitted a number of large grants and is planning to offer the solid state chemistry (Chem 480) course in 2009-2010. He is a member of the Physical Chemistry Division, but also works closely with the radiochemists. Before coming to WSU he worked at Lawrence Livermore National Laboratory where he was group leader for the High Pressure Physics Group and principle investigator for LDRD, PDRP, DOE, and DoD projects. Choong-Shik is joined by his wife, Myung-Joo. Their daughter, Elisa, works in the Bay Area and is a Stanford graduate, and their son, Bryan, is currently a junior at Stanford.

Two New Searches

We are currently searching to hire an inorganic and a bio-analytical faculty member. As I write this we are starting to interview inorganic candidates and the analytical candidates will follow shortly. If you would like further information, please contact Professor Ken Nash (inorganic) or Professor Jim Schenk (analytical).