

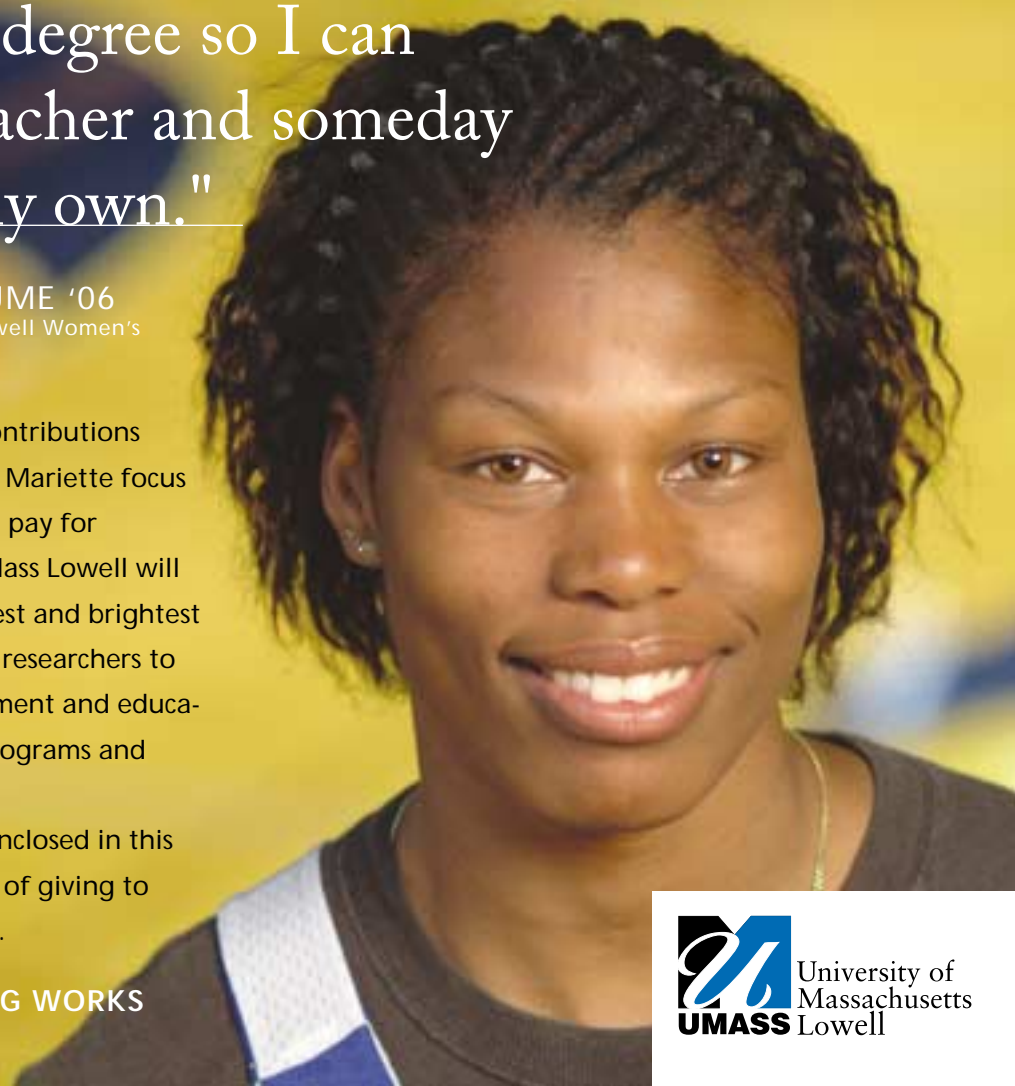
" I want to get my degree so I can become a teacher and someday coach a team of my own."

MARIETTE GUILLAUME '06
Psychology Major, UMass Lowell Women's
Basketball Team Member

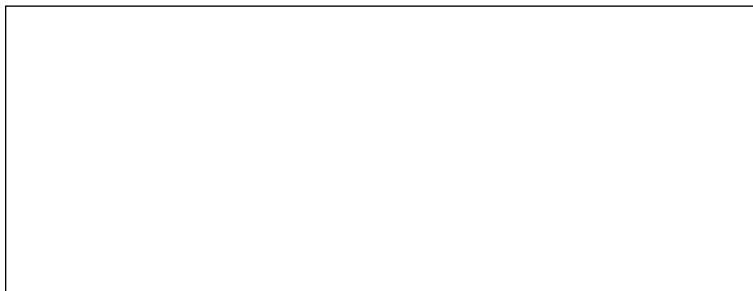
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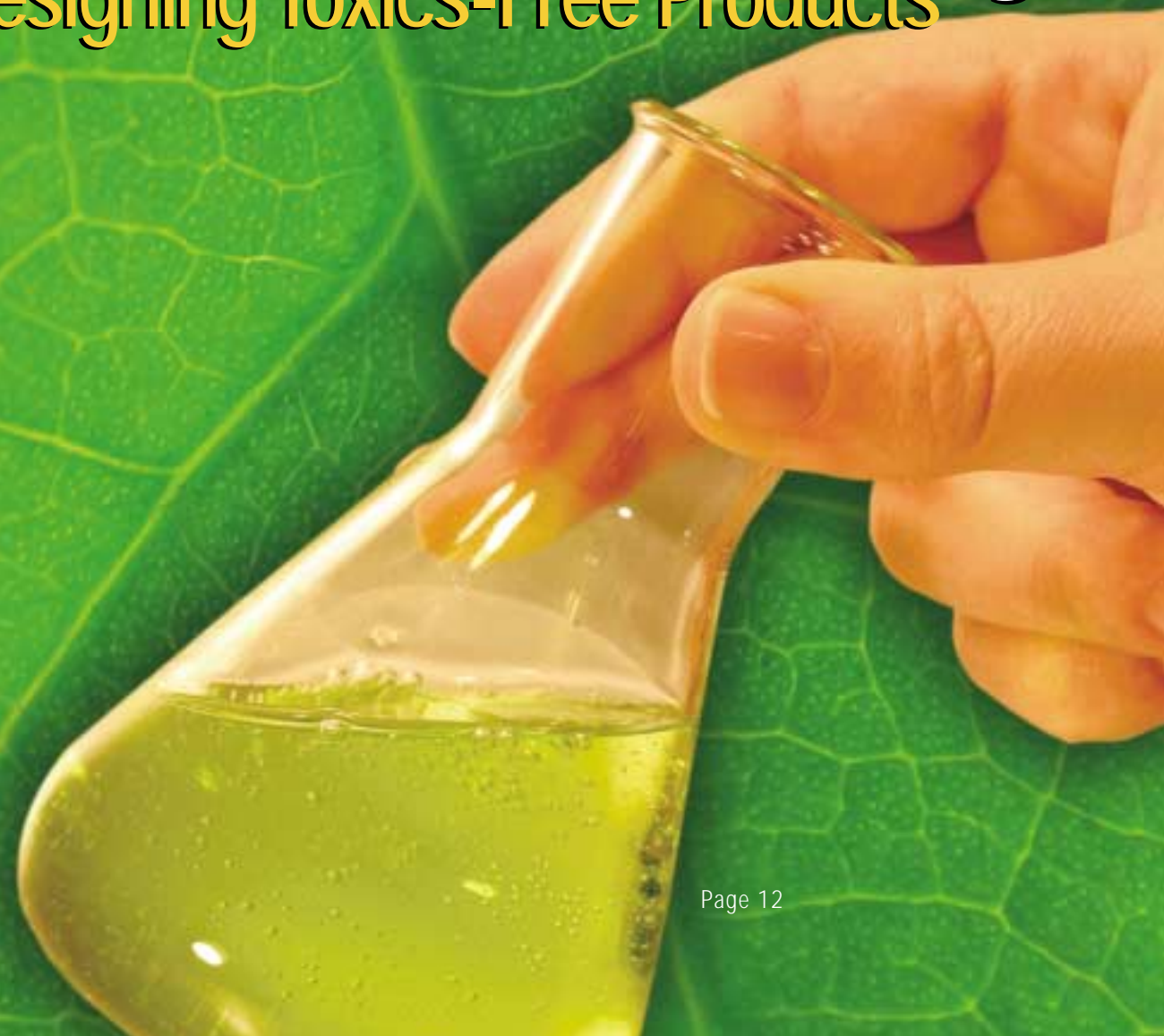
UMass Lowell

M A G A Z I N E

SPRING 2005
VOLUME 8
NUMBER 2

Green Chemistry

Designing Toxics-Free Products



By Geoffrey Douglas

John Warner Knows It Isn't Easy Being Green,



Prof. John Warner

As a student at UMass Boston in the early eighties, John Warner was a music major. He played guitar and keyboard in a band called The Elements. When he wasn't studying or in classes or working his full-time job, he was mostly writing songs. His future, in his own mind, was never in question—"I wanted to be a musician," he says.

Then one day in early 1981, as he tells it, he followed another student named Paul into a chemistry research lab to oblige a professor who had asked for a volunteer. And over the course of the next hour or so, there occurred for him an epiphany that could only have been the product of a most unusual mind:

"It just came to me that designing the synthesis of a molecule was exactly the same as composing a song."

Green Chemistry

Designing Toxics-Free Products

But He Still Makes That His Mission.

Everything changed after that. The music major was traded for chemistry, as John began spending his free hours in the lab. The lab work led to published papers, then to lectures—almost unheard of for a UMass undergrad. The world began taking notice—in the spring of 1984, anointed as a member of "Boston's Best and Brightest," he appeared on the cover of *Celebrity* magazine.

From that point on, life's focus narrowed. But the bar remained high. From UMass he went on to Princeton—

changed again. His son, John, two years old, died after a long battle—and in his view, inexplicably—of a rare and poorly understood liver disease.

"It's hard to explain what happened in my head," he says today of that time. "I just started thinking things, asking questions—why he died, what might have caused it, whether there might have been something toxic involved. I'm really not sure what took me in that direction. When you're lying awake at night after your child dies, your mind goes to different places..."

"I just know that, at some point in there, I became aware that I had no idea what made a substance toxic—and that not many other people did, either. And over time, that thought just kind of took me over, it wouldn't let go."

— John Warner

where, as a Ph.D. student in the mid-'80s, his lab research led to a cancer drug that, 17 years later, would ease his own mother's pain in her battle with the disease ("It's amazing," he says, "the relationships things seem to have in life.")

In 1988, on the completion of his doctorate, came the next major turn in the road: a call from Polaroid, which wanted him to apply the same principles—of medicinal chemistry—to the field of photography. This led to an eight-year relationship, out of which grew yet another forward leap: an arcane but critical new process—known formally as "non-covalent derivitization," or more simply, "the Warner Complexes"—that controls the behavior of molecules in film.

Then, five years later, the real world intruded cruelly. And John's path

this time as a professor of chemistry—and, perhaps for the first time ever, with a clear and unshakable vision of his mission in the world: "I just wanted to teach students about toxicity as a part of the chemical learning process. It was really as simple as that."

That mission hasn't changed, though it has widened as the years have passed, and taken on urgency. John left his position in the Chemistry Department at the Boston campus earlier this year, after an eight-year teaching stint, to join the faculty of the School of Health and Environment at UMass Lowell—where, he says, "the right pieces and the right people were all committed and in place." (UMass Lowell, and its faculty, have been involved with Warner and his work since long before he came here from Boston. Chemistry Prof. Sukant Tripathy, who died in 2000, worked with him for more than a year before his death. The first Green Chemistry Conference, says Warner, was dedicated to his memory.)

But whatever the campus or particular emphasis, the priorities remain the same: the broad issue of chemical toxic-



Doctoral student Abby Johnson is designing titanium dioxide photo catalysts for arsenic removal in drinking water.

ity— where it is found, how best to avoid or prevent it, the ignorance that surrounds it across academia—has become, for John Warner, as much a signature as a cause.

“Do you know,” he says, “that when I was going for my [chemistry] doctorate at Princeton, I had to translate an article from French to English, but there was no requirement that I know what makes a molecule toxic? The same is true at every university in the country, as far as I know. That’s always seemed kind of backward to me.”

The longer he lingers on the subject—and it is a consuming subject for him, so the lingering comes naturally—the more passionate his delivery



Sophia Trakhtenberg, a postdoctoral research associate, is characterizing DNA mimic templated conductive films.

question—‘Is this molecule toxic?’...

“There’s a very good chance he wouldn’t begin to know the answer. And he might not even know where to go to find out. And it wouldn’t be his fault. That kind of information just isn’t part of our education today.”

It would probably be fair to say that, in the course of his quest to reverse the ignorance he sees around him, John Warner is on his way to redefining the field of chemistry. He is doing this through the propagation of a brand-new concept, a new ideology that could shake some assumptions as

Center’s mission statement—“will learn the skills necessary to design materials and processes with minimal or reduced environmental or toxicological impact.”

becomes: “If you drew the diagram of a molecule on a piece of paper, and you took that to the Chemistry Department of most any university in the country and knocked on the door of most any professor there, and asked him the

old as science itself. Known as Green Chemistry, it was developed jointly by Warner and an EPA scientist named Paul Anastas—the same Paul Anastas, as it happens, he followed into that UMass chemistry lab back in 1981—

then formalized in the seminal work, co-authored by Warner and Anastas, *Green Chemistry: Theory and Practice*, published in 1998 by Oxford University Press.

“A revolutionary new philosophy,” as defined by the UMass Lowell Green Chemistry Web site, its focus is “to unite government, academic and industrial communities by placing more emphasis on tending to environmental impacts at the earliest stage of innovation and invention.”

Or, as Warner puts it: “We’re not just studying the impact of industry on the environment—the environmental sciences have been doing that for years. We’re actually looking to find ways to create products that can be compatible



Research associate Kevin Dye assembling economic valuation models for industrial collaboration.



Catherine Yu, an undergraduate student, is seen here designing hands-on green chemistry learning modules for K-12 and community outreach.

TURI, Green Chemistry, Put UMass Lowell in the Vanguard in U.S.

On the first Thursday of last November, faced with mounting evidence that the chemicals used in flame retardants were showing up in the environment — especially in fish and human breast-milk — roughly 75 representatives from Massachusetts businesses came together at a hotel in Worcester to discuss ways to make their products safer.

Mostly from the state’s electronics or wire and cable industries, they were being hosted that day by the UMass Lowell Toxics Use Reduction Institute (TURI), which, together with representatives of the Environmental Protection Agency (EPA) and others, was there to assist the companies in finding more compliant, less toxic ways to keep their products safe from flame.

The mission of that day, says UMass Lowell Professor and former TURI Director Ken Geiser, today co-director of the Lowell Center for Sustainable Production, is fairly typical of the role in which TURI finds itself — and for which it was created: “Chemistry, as it’s evolved, is a pretty rigid science. It’s driven largely by costs, as well as by performance questions — What chemicals will retard flame? What particular molecular configuration will remove a fat globule from a surface? When things get this narrow and results-oriented, you can lose sight of a lot of other stuff. How do you make industry responsible? How do you recycle chemicals? What’s the best way to conserve for the next generation? — questions like these, most of the larger social questions, just get stripped away...”

“That’s a lot of what we’re about. We try, not only to come up with ways to



Prof. John Warner and Pam Cive of TURI

reduce [toxic chemicals] from the environment, but also, more generally, to keep some of those larger questions on the table.”

TURI came into being 16 years ago, as an outgrowth of the Toxics Use Reduction Act, passed by the Massachusetts state legislature in 1989 as a national model for reducing environmental pollution at its source. Since



then, in cooperation with the EPA and other sources, it has worked with state businesses to help them reduce their dependence on toxic materials. In large part as a result of these efforts, Massachusetts businesses, over the past 10 years — even in the face of a 45 percent increase in production — have seen their use of toxic chemicals reduced by well over one-third.

“That’s the beauty of what TURI and the University are doing together,” says Karen Angelo, who works with TURI in developing community outreach. “It goes past the classroom and the lab experiments to provide practical solutions for industry, to create a real, vital linkage between the University and the community at large.”

And now, with the recent addition of John Warner and his Center for Green Chemistry (see accompanying

story) to TURI’s already-impressive results, the UMass Lowell environmental initiative has placed itself in the vanguard among U.S. academic institutions.

“Certainly now, with the work TURI has done to reduce the hazardous chemicals in production, and the addition of John [Warner] and the Center [for Green Chemistry] and their emphasis on finding alternatives — you’d have to say we’re among the leaders in this country, among the very few, really, in the field of sustainable chemistry,” Ken Geiser says.

“John is a frontier person. He sees the patterns in knowledge, the relationships among things that are not always obvious to the rest of us. That’s very attractive to students, I think, the social relevance of that.”

“Other chemists, some of them, are threatened by the idea of Green Chemistry. They see it as boundary-setting, as something that limits their work. The other sciences, too — like toxicology — can be just as narrow, just as reluctant to see the big picture. Because a lot of those people, the toxicologists, the industrial hygienists, the environmental scientists — they don’t talk to each other much, they just kind of exist within their own narrow spheres.”

“With Green Chemistry, though, what John is trying to do, what we’re all trying to do, is to go back to the way it was at the beginning, to reawaken that larger social conscience, where people see themselves as parts of a bigger whole.”

with the environment from the start. In other words, let's figure out how not to generate [pollution] in the first place, rather than just treating or disposing of it after it's created."

As a practical means to this, students of green chemistry—again, according to the Center's mission statement—"will learn the skills necessary to design materials and processes with minimal or



Doctoral student Vineet Dua is creating environmental benign coatings for the electronics industry.

reduced environmental or toxicological impact." Part of this process will be a mastery of "the entire molecular life-cycle of any commercial endeavor."

"My vision is that it will be a collaboration between the School of Health and Environment and the various [related] departments—Chemistry, Physics, Engineering, Work Environment, Psychology."

— John Warner

The concept of all this, says Warner, "sounds like the sort of thing that would have grown out of the environmental movement, then have been applied to industry. Actually, it's the other way around—it's been industry that's been behind it from the start."

As evidence, he cites the "many millions" being spent by drug and chemical giants Pfizer, Dupont, Rohm and Haas and others to fund research on developing toxic-free products—some of which has been allocated to the work of the Center. Pfizer, he says, "actually pays for

workshops that introduce students to the [principles and methods] of green chemistry. These companies really are interested in doing the right thing—we just have to find ways to make it possible."

The UMass Lowell program remains in a fledgling stage. While 12 UMass Boston students have transferred here to continue it under Warner's guidance—in addition to the students who started here new—the details, he says, have yet to be finalized.

"My vision is that it will be a collaboration between the School of Health and Environment and the various [related] departments—Chemistry, Physics, Engineering, Work Environment, Psychology. The idea is that a student in one of these can take a course in, say, toxicology or environmental law and policy that will supplement the work he or she is already doing. The aim is to

create a multidisciplinary student body—but one that understands and can anticipate the effect of industry and innovation on the environment. 'Multi-disciplinary'—that's the key word in all this."

Meanwhile, while the precise shape and future of UMass Lowell's Green Chemistry program remain in the hands of the University's hierarchy, John Warner just keeps honing his message. In a recent, typical two-week period—in addition to teaching his classes—he headed an exhibition at the Boston

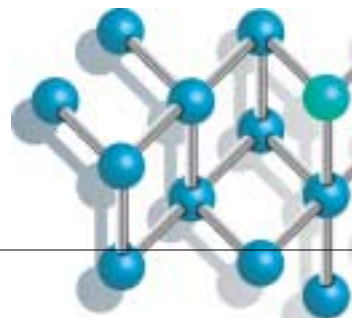


Prof. John Warner, right, observes while graduate students John Pyers, standing, and Rami El-Hayek evaluate data for dissolution kinetics for pharmaceutical formulations.

Museum of Science for 200 area high-school students, a second at the Leominster Plastics Museum, and made appearances at both Brockton and Dedham high schools. Over spring break, along with several UMass Lowell grad students, he served as guest speaker at a Green Chemistry conference in San Diego.

"We've got to get the word out, we've got to keep talking to people. If we keep on educating them the old way, we're going to keep on getting the old result. That's where you wait till 100,000 people have shown adverse effects, then the government decides to regulate, and the scientists—only then—start working on a plan to find a replacement.

"That system isn't going to work anymore. We need to start getting it right the first time. We need innovation. We need chemists talking to biologists; we need the 'idea-makers' talking to the 'thing-makers' about how to make better, safer things. We need a more diverse set of hands and eyes on the whole scientific process..."



UML Strives to Become the Country's 'Greenest' Campus

UMass Lowell is working on a number of fronts, says Diana Prideaux-Brune, to make this "the greenest urban campus in the country within 10 years."

"Green" in this case refers not to lawns and shrubbery but to buildings, laboratories and machinery that function in the most environmentally responsible way.

The "greening" of the campus is one part of the University's Transformation Project, which seeks to identify internal mechanisms to strengthen and promote the partnership between the University and the community.

The Transformation Project is an extension of the Realignment Program, a multi-year project that repositioned the campus and estab-

"Greening can be simply put as cutting pollution by reducing energy consumption and building with materials that can curb health problems."

— Mark Lukitsch

lished new priorities that have been supported by the reallocation of resources.

"Thanks to Realignment, we're now in an organizational and financial position to decide how to proceed with our environmental initiatives," says Prideaux-Brune, the vice chancellor of Facilities.

"We have organized a Greening of the Campus Committee — with representatives from Facilities, the office of the Provost, the Toxics Use Reduction Institute (TURI) and the Research Administration — to find



Diana Prideaux-Brune



Mark Lukitsch

out what technologies are available to us and to determine how to implement various initiatives," she says.

The first step will be to concentrate on a number of programs to help move the campus toward a greener future. These will include using green processes in construction programs and expanding on the work of Mark Lukitsch, the energy and utilities manager in the Office of Facilities.

Greening will be a prime consideration in two major projects now on the drawing board. One is the rehabilitation of the St. Joseph's Hospital building, which the University is acquiring, and the Nanomanufacturing Research building slated for construction on UML East across the street from Lelacheur Park.

The hospital project will be the more difficult of the two, Prideaux-Brune says, because buildings constructed when the hospital was built were not designed to be environmentally correct. On the other hand, the

nanomanufacturing building, which will be built from scratch, will be a "smart" building with maximum energy efficiency.

"The Olney Environmental System Management project has given us a lot of information that we can use campus-wide in this new program," says Prideaux-Brune. "The formal program lasted a year but we're still evaluating the results and implementing upgrades. Olney was ideal for this kind of project because the building contains both offices and laboratories."

One important factor in all of these greening initiatives is that they must be funded with savings the University can realize through increased efficiencies in the use of utilities.

That's why Mark Lukitsch's work is critical.

Lukitsch has identified five potential projects to continue moving the University toward the achievement of a green campus.

The five are an energy savings performance contract, an awareness campaign, the purchase of green power, the establishment of what the Environmental Protection Agency (EPA) calls Energy Star Facilities, and the support of other projects that involve both faculty and students.

The energy savings performance contract, says Lukitsch, "would be a contract on the order of \$10 to \$20 million to replace systems such as lighting, steam plants and chillers. And we'd add building management systems to control air conditioning and heating remotely. This lets us diagnose a building and reduce its energy usage by placing it on schedules so that heating and lighting, for

example, would be reduced when the building is not in use.

"This contract is a good way to achieve a lot of conservation fairly efficiently," he says.

The awareness campaign would be an informational project by which faculty, staff and students would be reminded to use energy wisely and be sensitive to the objectives of the program. The campaign would use University publications, signs, posters, e-mail and the UMass Lowell Web site.

Buying green power would be an initiative wherein the University would seek to purchase a certain percentage of its energy — say for electricity — from renewable sources, such as wind

power, rather than from nuclear, oil or natural gas sources.

The EPA recognizes Energy Star facilities as those buildings that keep energy use per square foot below a specific threshold.

"We want to have at least five of our buildings in this category by the end of fiscal 2008," Lukitsch says. "That's a reasonable goal."

And, finally, he says, "From time to time there will be projects that we'll support because they would provide energy from renewable sources. For instance, we're talking with Prof. Ziyad Salameh and the Massachusetts Energy Collaborative about installing photovoltaic cells atop one of our buildings

as a source of electrical power.

"As an example of a step toward greening the campus, Joe Caulfield (project manager in the Facilities Department) installed new high efficiency lighting and controls in the Olney building hallways, the O'Leary Library media center and several lecture halls in Weed Hall. This new lighting and its controls reduce electrical consumption by 50 to 60 percent, while producing the same or more illumination.

"Greening," Lukitsch concludes, "can be simply put as cutting pollution by reducing energy consumption and building with materials that can curb health problems."

Emeritus Prof. Dan Golomb of the Department of Environmental, Earth and Atmospheric Sciences, in an article about global warming published in the journal *Chemistry World*, contends that a process known as sequestering is "the only way forward" for reducing human-source carbon dioxide from the atmosphere.

Assoc. Prof. Caryn Cossé Bell of the History Department described the Haitian revolution's legacy in Creole New Orleans at a session of Salon, the faculty colloquium in fine arts.

Emeritus Professor Charles Levenstein of Work Environment and **Dean David H. Wegman** of the School of Health and Environment were named co-recipients of the Alice Hamilton Award for 2004 by the American Public Health Association's Occupational Health and Safety Section.

Louis DiNatale, formerly director of UMass Boston's Center for State and Local Policy, has been named executive director of Public Affairs at UMass Lowell where he is guiding public policy initiatives, providing marketing strategies, and researching and analyzing economic and social issues.

Susan Moir, a faculty associate of the Center for Women and Work, has completed research on women in the construction trades in preparation for outlining a plan for a pre-apprenticeship model to serve as a guide for women who want to enter the industry.

Krishna Vedula, former dean of Engineering, and **Prof. Julie Chen** of Mechanical Engineering have returned to the University classroom after having served with the National Science Foundation in Washington.

Science magazine recently published the research of **Prof. Jayant Kumar**, director of the Center for Advanced Materials, whose research team synthesized greatly improved flame-retardant materials.

Assoc. Prof. David Kriebel of Work Environment has co-authored a textbook, *Research Methods in Occupational Epidemiology*.

The National Institutes of Health has bestowed a \$15,000 Health Disparities Research Service Award on **Asst. Psychology Prof. Khanh Dinh** for separate studies involving Mexican American Women and Asian Americans.

Mechanical Engineering **Prof. Sammy Shina's** project to help companies in the Massachusetts Lead Free Consortium convert their operations to lead-free production was the subject of an article in *Surface Mount Technology* magazine.

Assoc. Prof. Paula Telesco of the Music Department has been appointed to the editorial board of the *Journal of Music Theory Pedagogy*, which has published several of her articles.

The latest book by the Music Department's **Prof. John Ogasapian**, *Music of the Colonial and Revolutionary Era*, has been published by Greenwood Press and is available, as he says, "in all the usual places."

Oneida Blagg, the former director of Student Services and an assistant to the dean of the College of Education at Northern Arizona University in Flagstaff, has been named director of UMass Lowell's office of Affirmative Action Compliance and Equal Opportunity.

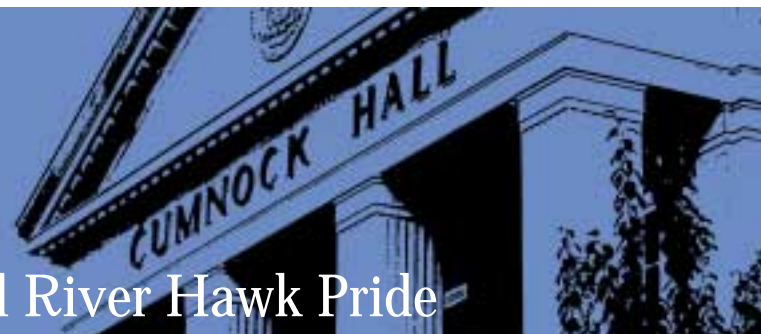
Asst. Prof. Chad Montrie of the History Department was named this year's Scholar in the City to complete a history of Lowell's Concord River corridor.

The Florida Department of Transportation invited **Prof. Sam Paikowsky** of the Civil and Environmental Engineering Department to provide assistance in designing plans to rebuild an elevated expressway in Tampa that was damaged during construction because of the failure of piers.

The photography of **Prof. Arno Minkinen** was featured in exhibits in New York and Paris this academic year and he was an invited lecturer at the Rochester Institute of Technology, Holy Cross College and Plymouth State College.

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