JANUARY 4, 2010

C&EN

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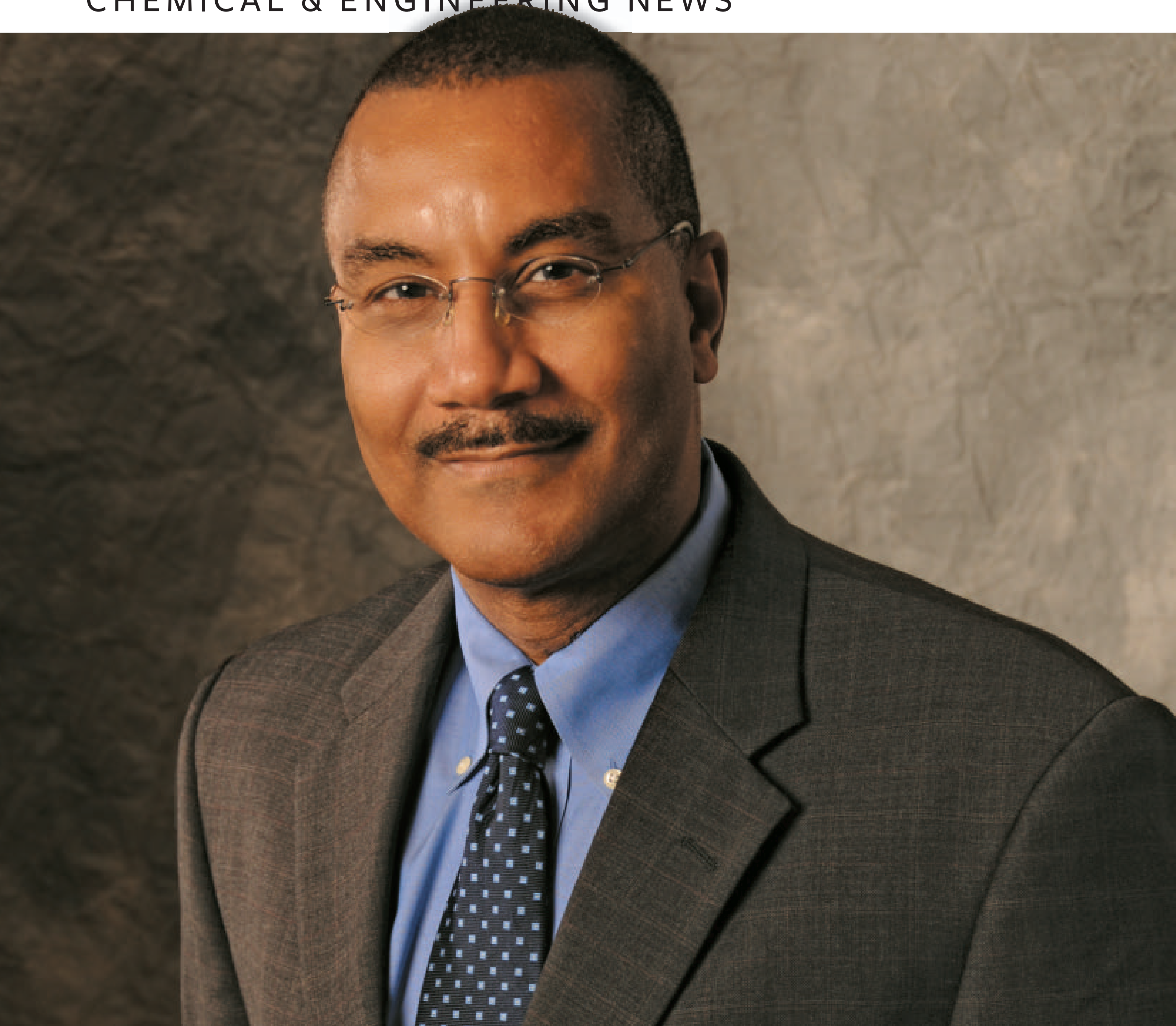
FAKE PHARMACEUTICALS
Fighting counterfeit medicines **P.27**



JOSEPH S. FRANCISCO

ACS president on global competitiveness **P.2**

PUBLISHED BY THE AMERICAN CHEMICAL SOCIETY

VOLUME 88, NUMBER 1
JANUARY 4, 2010

C&EN

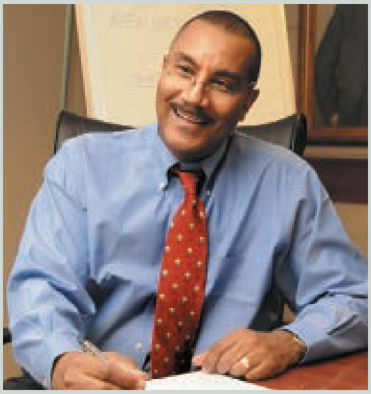
CHEMICAL & ENGINEERING NEWS

Serving the chemical, life sciences, and laboratory worlds

COVER STORY

PRESIDENT'S MESSAGE

ACS President Joseph Francisco lays out his plan to ensure that chemists develop the skills needed to compete in a global marketplace. PAGE 2



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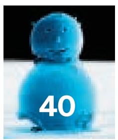

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THIS WEEK ONLINE

WWW.CEN-ONLINE.ORG

REEL SCIENCE

"Whiz Kids" documents two years in the lives of some of the smartest science-minded high school students around.

PLUS: See a photo gallery complement to Sarah Everts' fake pharmaceuticals article at cenblog.org.

SANDBAR PICTURES

BEING COMPETITIVE IN THE GLOBAL MARKETPLACE

JOSEPH S. FRANCISCO, ACS PRESIDENT

IT IS AN HONOR and privilege to have the opportunity to serve as the 2010 American Chemical Society president. The coming year will be exciting as together we explore new opportunities that will further define ACS as the premier organization for chemists and chemical engineers and help position us as a pivotal partner in ensuring our members are ready to take their place in the global marketplace.

My role, and the role of all ACS elected officials and staff, is to serve our members and improve our society. Of course, that must be done in accordance with ACS's congressional charter, which states, in part, that we also serve the overall chemical enterprise. In short, ACS has a dual role: to advocate for its members and simultaneously to serve the overall chemical enterprise. I believe there is congruence in these two aims.

A key part of my decision to seek the society's presidency was my desire to be a catalyst for helping our members and future members develop the skills necessary to meet the needs and expectations of employers, especially those in the global chemical enterprise. There are four areas that I will focus on that will have an underlying global perspective: education, innovation, employment, and partnerships.

NEW AGE FOR GLOBAL EDUCATION

It's been more than a quarter century since the National Commission on Excellence in Education issued its dire warning about a "rising tide of mediocrity" in the U.S. in its seminal report, "A Nation at Risk: The Imperative for Educational Reform." Although we have made strides toward reversing that trend, we now face another equally critical education challenge: preparing our chemistry and chemical engineering students with the skill sets necessary for them to be competitive and successful amid a growing tsunami of globalization.

PETER CUTTS PHOTOGRAPHY (BOTH)

One way for us to prepare for and be competitive in the global marketplace is to ensure that ACS takes a strong leadership role in the education system for the chemical sciences. To start, we need to determine what we can do to better prepare our students for a chemical enterprise that requires global skills. I propose three steps:

■ Engage leaders of the global chemical enterprise and ask them what training we need to give our young students so that they can be successful employees in the global marketplace. This might involve bringing together chief technical officers and heads of R&D from some of the leading global chemical companies and asking them to identify the skill sets they value and look for when they are recruiting new scientists and engineers.

■ In concert with the input from industry leaders, engage leaders of academia and government in a dialogue about new curriculum directions that can best prepare students for the challenges they will face in the global marketplace. It would be beneficial to also include in this dialogue young entrepreneurs who have achieved success through their introduction of new ideas and innovations. Sometimes I think we are stymied by trying to recycle old ideas rather than looking at new out-of-the-box ways of doing things.

■ Finally, determine what competitors in other countries are doing to better prepare their students for the future global workplace and, at the same time, what we might learn from their approach to innovate our growth and future.

Once we have taken these steps, we need to develop a document that spells out the changes needed in our various academic institutions for training and preparing our students to be successfully competitive in the world marketplace. I have asked Ronald

Breslow of Columbia University and Pat N. Confalone, vice president for global R&D at DuPont, to bring in the key players from academia and industry who have been thinking about these issues. They will begin discussions and come up with a road map of what we need to do to ensure that our future graduates are going to be prepared for and competitive in the global marketplace. In addition, the Committee on Professional Training is going to organize a symposium at the Boston national meeting in August on "Excellence and Rigor in Undergraduate Chemistry Education: A Global Perspective." It will also examine what our international partners are doing to prepare their students for job competition in the global chemistry marketplace, something that will play a complementary role with future global skills.

ACADEMIA, INDUSTRY, AND GOVERNMENT SUSTAINING INNOVATION

To me, the big picture on the horizon for chemists and chemical engineers and our country's overall chemical enterprise boils down to what we need to know to be competitive and to be a leader in the global marketplace. We need a meaningful dialogue among the leaders of academia, industry, and government. The challenge is figuring out how best to bring these three pillars together to work on the challenges that our country faces in the fields of chemistry and chemical engineering.

In 2005, ACS released a forward-looking report entitled "The Chemistry Enterprise in 2015," which anticipated how chemistry will change by 2015. The objective was to gather information about what the 2015 landscape will look like so that chemical scientists might better prepare for those changes and take appropriate action. Among the projections made in the report is that our enterprise will expand globally.

"Many companies traditionally thought of as American or European have built capacity in developing countries to serve both developing and traditional markets—a phenomenon called globalization," the report cited. "Globalization has led some companies to utilize contract organizations in developing countries for research or other technical functions—a process commonly called contract manufacturing. Large companies are also building research laboratories overseas, integrated within their global enterprise."

RENAISSANCE COUPLE The Franciscos, Joseph and Priya.

Underscoring the report's projections was the notation that "approximately 95% of the world's population, and thus 95% of the potential market for products of the chemical industry, lies outside the United States."

ACS INTERNATIONAL CENTER

Today, more than ever, research is international. But, as I have stated on more than one occasion, declining funds for research in this country are compromising our contributions to discovery, leadership, and innovation—areas in which the U.S. traditionally has been an unquestioned leader. If the shortage of research dollars continues, I believe it will strain our ability to attract new talent into the chemical sciences pipeline, both from within our domestic base and from other countries. Added to this is the fact that many foreign students and scientists, whom we have routinely relied on to augment our research labs, are electing to return to their own countries. Because they are leaving, we are losing a valuable knowledge base.

One of my goals is to work toward creating an ACS International Center. The focus for the center would be to look at how we can keep the pipeline populated and keep ideas for innovation flowing into the U.S., either by exchanging our own talent or by bringing in talent. This would involve not only students but also researchers who are doing innovative things that they could share with our domestic students. The center, which would be chemistry-centric, would provide our students with experiences they will need to be competitive in the international workplace and give them an awareness of innovative advances being made in other countries. I envision that our International Center might provide cultural training for researchers, entrepreneurs, and students across all disciplines, helping ease their transition into the global workforce.

I have put together a working group to be led by ACS Board of Directors member Peter K. Dorhout, vice provost for graduate affairs and assistant vice president for research at Colorado State University, in Fort Collins, to look into the idea of an ACS International Center.

- Phase one: Evaluate the idea of such a center and how it would fit within the ACS direction, as outlined by our strategic plan, assess whether to proceed with establishing a center, examine how it might operate and function, and how it would serve the chemical enterprise and ACS members.
- Phase two: If the findings are favorable, our strategy would be to develop an actionable plan on how to go about implementing such a center.

CREATION OF NEW JOB OPPORTUNITIES

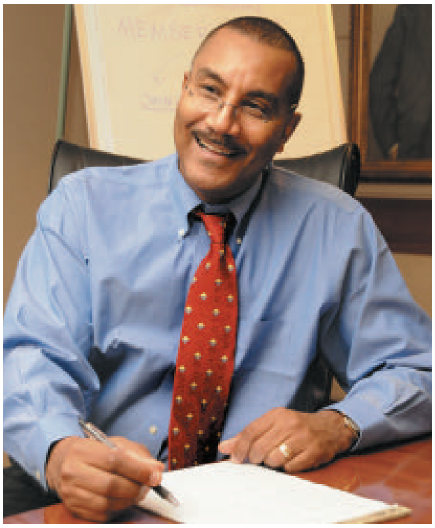
In the final analysis, after all the assessments, evaluations, dialoguing, and training are done—all with the goal of better preparing our students and country to be competitive in the world marketplace—the realistic questions remain:

- Will there be jobs in the chemical enterprise in the future, and are we preparing our students with the right skills?
- What will the job landscape look like?

My response to the first question is, yes; I believe there will be plenty of job opportunities for the well-prepared future chemist or chemical engineer. As to the follow-up question, I imagine some of those jobs in the future landscape will be very different from what we are accustomed to and will require tomorrow's job seeker to be interdisciplinary, versatile, flexible, and a global thinker, and perhaps a little untraditional and entrepreneurial.

President Barack Obama's American Recovery & Reinvestment Act of 2009 created a goal of saving more than 3.5 million jobs over a two-year span. It is lauded as a strategic and significant investment for our country's future growth and innovation. One of the purposes outlined in the act is "to provide investments needed to increase economic efficiency by spurring technological advances in science and health." A quick scan of the actual legislation enacted by Congress and signed by the President shows billions of dollars slated for science and technology in various federal agencies, including the National Institute of Standards & Technology, the National Oceanic & Atmospheric Administration, the National Aeronautics & Space Administration, the National Science Foundation, and the Department of Energy.

This recognition of the need to support science and technology both fiscally and through the creation of new jobs represents an opportunity for the chemical sciences that we must seize. ACS should be proactive in taking advantage of this new


PETER CUTTS PHOTOGRAPHY

climate in Washington on behalf of our current members as well as future members coming into the chemical enterprise.

I have brought together a task force headed by George Whitesides of Harvard University, who, with his team, will be tackling the daunting task of answering:

- What will our chemical enterprise look like 25 years from now?
- Will new entrepreneurs change the current landscape, and how can ACS be a catalyst for those entrepreneurs?

The future landscape of the chemical enterprise will be defined and shaped by entrepreneurs. When I look at the next generation, Generation Y, this group will make up a component of the U.S. workforce equal in size to my own generation, the baby boomer generation. This new generation will also dominate the workforce for the next 40 years. One in four of the Generation Y group wants to be an entrepreneur or own a company, according to a 2008 *Harvard Business Review* article, "The Outlines of Your Generation: Demographic Characteristics of Generation Y." So, what is ACS doing today to help create these opportunities for the next generation? As I mentioned

PURSUING OPPORTUNITIES

A Profile Of Joseph S. Francisco

It is my belief that an individual's character and life decisions are developed through opportunities they are provided, along with the abilities to capture those opportunities when they are made available. Looking at my life, I realize these opportunities are what helped me grow into the person I have become today.

As I was growing up in Beaumont, Texas, my possibilities were limited because of who I was and what I looked like. My life consisted of day-to-day tasks and was never about future planning. College was a far-fetched dream, so I never paid much attention to it. In short, I didn't have a clue of where I was going or what I would be doing. Despite the uncertainty, my grandparents—in particular, my grandmother, Sarah Walker, who was a strong woman and a great role model for me—were supportive and encouraged me to get an education.

I was blessed with opportunities that helped shape my career and life, one of the earliest occurring when I was a teenager. One Sunday after dinner, I noticed a man standing with a map in the front yard. I went outside to inquire if he needed any assistance. Instead of just pointing to the destination on the map, I decided to walk with the man, who happened to be Richard B. Price, a mathematics professor at Lamar University. In our brief conversation, we discussed future opportunities, and he encouraged me to pursue a college education.

Several years later, I entered the University of Texas, Austin. It was, and still is, an excellent large university, and growing up in a small town in Texas, I had never experienced anything like that before. I have to admit that it was frightening because it put me outside my comfort zone; however, I was fascinated to be in this new environment. My agenda was simply to attend class, do my work, and go unnoticed. My first chemistry class had 350 students, which was perfect. I thought I could be lost in the numbers. Unlike a lot of kids, I never wanted to be singled out. But it didn't work out that way.

One day, I picked up my exam, and my professor, Raymond Davis, said he wanted to talk to me. I thought, "I couldn't have done that bad." To my relief, though, he took me into his lab and showed me an X-ray spectrometer. He explained how researchers use it to find the structure of chemicals, something that can never be learned simply through textbooks. After a fascinating discussion, he asked me if I wanted to do an undergraduate research project for him—as a freshman!

I solved my first crystal structure and loved it. I realized then that I would be happy with a career in research, and I decided to pursue a graduate education. I did graduate work at Massachusetts Institute of Technology under Jeffrey I. Steinfeld, who has helped me through my years as an adviser and mentor.

An Australian chemist, Robert G. Gilbert, invited me to spend six months in Australia, following up on a collaborative research interest. After a fun and successful research experience at both the University of Sydney and the University of Adelaide with Keith D. King, I was not sure what to think when my Australian colleagues suggested I look outside the U.S. for postdoctoral work. They reasoned that in addition to the postdoctoral work, the experience would expose me to a much broader point of view. I received three offers and ultimately chose Cambridge University.

I met people from around the world at Cambridge. We talked about science over tea, generating ideas and discussing what were the important things to do. These discussions also made me think about what I considered to be important problems. I would soon be an assistant professor somewhere; what problems did I want to work on? In what way did I want to contribute? At the time, atmospheric chemistry was a fairly unusual area for physiearlier, one of the first places to start is to bring together the leaders from academia, industry, and government for meaningful, progressive discussions. Collectively, they hold the pieces to the puzzle that will allow us to develop a viable plan for the future success of our country's contributions to the chemical enterprise on the world stage.

LOOKING TO THE FUTURE: A SENSE OF EXCITEMENT

As I have traveled around the U.S. during this past year as president-elect, talking with members at local sections and regional meetings and outlining my proposals for this global focus, I have made it a point to ask for feedback and input. The response has been wonderful. I have seen rooms full of members having spirited discussions among themselves and tossing around novel ideas about a potential ACS International Center or more expansive curricula that offer instruction on how to work in a global marketplace, or the prospects of opportunity that small businesses hold for the future in the chemical enterprise. I have received e-mails from people asking what they can do to contribute. From this, I have come away with a sense of real excitement and enthusiasm among our membership, especially about the International Center and the need to integrate global aspects into the chemistry curricula.

As I mentioned earlier, my job is to represent you, the ACS member, so that the society has overall growth and sustainability. We need to give our members the skills, opportunities, and guidance to succeed and advance chemistry. I hope you will take the time to let me know your thoughts about what I have discussed in this article. I encourage you to use C&EN's Letters to the Editor section to tell us about these ideas or send me an e-mail. If you see me in the hallway at a meeting, do not hesitate to take a moment to tell me what you think.

I also encourage you to share your love and knowledge of the chemical sciences with youngsters. We need to provide opportunities and develop skill sets to capture those opportunities to ensure a continuous flowing pipeline of students who represent the full demographics of our country. I urge you to be a role model, a mentor, or both. Together, I believe we can ensure that our country's chemical enterprise will continue to prosper and that our future generation of chemists and chemical engineers (or interdisciplinary chemists) will have opportunities to enjoy what we all love—chemistry.

Editor's note: Dr. Francisco can be reached at joefrancisco@sbcglobal.net. To read further about Francisco, go to web.ics.purdue.edu/~francisc.

cal chemists—although there is a natural fit—and I saw others struggling to understand how to judge this interdisciplinary field. I joined the faculty at Wayne State University, in Detroit, which was a great place for me to start my career. It was a chance to forge my own uniqueness, and I considered the area of atmospheric chemistry to be a field in which I could make a unique and important contribution. I had some important help along the way from Stanley P. Sander and the Lab Studies & Modeling group at the Jet Propulsion Laboratory at California Institute of Technology.

As I gained experience at this interface, Purdue University provided me with an opportunity to integrate my experience in chemistry with the atmospheric sciences through a joint appointment in the departments of chemistry and earth and atmospheric sciences. This has been a very important opportunity because it has allowed me to combine the best of both disciplines to stay on the cutting edge of the field of atmospheric chemistry.

I have been very fortunate to have had some great students work with me, and together we have mapped the complete pathway for chlorofluorocarbon (CFC) breakdown in the atmosphere using state-of-the-art techniques in experimental and theoretical physical chemistry. The Francisco group, along with collaborators, discovered a whole new class of fluorinated radicals. This work provided new avenues for further experiments by other scientists; it also laid the foundation for understanding the chemical consequences of new materials that were being considered as replacements for CFCs.

Currently, my research group is tackling the problem of understanding the role clouds play on chemistry in the atmosphere. I used to be able to go on an airplane and say, "Oh, look at the nice clouds." Now I look out the window and say, "Look at all the fantastic and fascinating chemistry going on there, in and on those clouds." My group's focus is on understanding what chemistry takes place on the surface of a cloud droplet and how that chemistry is different from chemistry taking place in the gas phase. This research complements our previous and ongoing research studies of atmospheric oxidation mechanisms.

When I learned that I would be promoted as a distinguished professor, I requested that the professorship be named after William E. Moore, the first African American to earn a Ph.D. in chemistry from Purdue. I feel strongly that we have to do more to honor our African American pioneers. Having this professorship named after Moore enhances the sentimental value behind this achievement. "There are very few African Americans who hold chaired positions or professorships at major research universities, especially in the sciences, and even fewer for whom a distinguished professorship has been named," says Willie Pearson Jr., a professor of history at Georgia Institute of Technology. For me it was a small tribute to all those who have gone before and sacrificed to create opportunities for me, and others like me, to succeed.

Congratulating me on the honor, a colleague told me, "You did it, and you did it your way." I laughed, not because it was hilarious but rather because of the truth behind that statement. I did not take the straight path. Nor did I take a path that my professors had conceived for me. I traveled the world and pursued opportunities I never thought possible. This wonderful journey took an unsuspecting 17-year-old boy from Beaumont to places he never would have dreamed of.

The moral of this story is that I am a result of the opportunities I was provided. In addition, I gained the proper skill sets through my education, experiences, and mentors to achieve things I never thought possible. Now I believe it is my turn, along with the people of my generation, to use knowledge, resources, and influence to be mentors for the next generation, across the full demographic range, to stir their imaginations about the excitement of math and science, especially chemistry. Not only do we have the power to make a difference, but I believe we also have a responsibility to do so.

SUPPORT ACS SCHOLARS

I THANK MY FRIEND Sibrina N. Collins for her guest editorial on "African Americans and Science" (C&EN, Oct. 26, 2009, page 3). I can attest to her "true passion to learn about African Americans' contributions to the chemical sciences," and I urge her to continue teaching us about these great examples.

We all should know about the significant and important role that the National Organization for the Professional Advancement of Black Chemists & Chemical Engineers plays in helping African American science students reach their full potential. The Society for the Advancement of Chicanos & Native Americans in the Sciences and the American Indian Science & Engineering Society are fulfilling similar roles for Hispanic/Latinos and Native Americans.

I very much agree with her statement that "funding and effective mentoring are two critical factors for increasing the number of minorities in the chemical sciences." This statement opens the door for me to write about the ACS Scholars Program.

In 1992, then-ACS president S. Allen Heininger established the Task Force on Minorities in the Chemical Sciences. Every task force member agreed that mentoring, in addition to the monetary award, had to play a very important role in the proposed ACS Scholars Program.

The 15th anniversary of the ACS Scholars Program will be celebrated in 2010 with events at the San Francisco and Boston national meetings. In its very short life, the program has accomplished the following: Of the 2,269 scholarships awarded, 54 % have gone to African Americans, 40% to Hispanic/Latinos, and 6% to Native Americans. In addition, more than half—54%—of scholarship recipients have continued in graduate school.

To date, 62 scholars have obtained Ph.D. degrees and nine of these recipients are in tenure-track positions, most of which are at research-intensive universities

ACS Scholars are very appreciative of all the mentors who over the years have made, and are making, a difference in their lives. They also appreciate the contributions made by the ACS Board of Directors, ACS members, ACS local sections, and individual and corporate contributors.

I trust you will agree that this is a program worth keeping to ensure we will have a talented and diverse future workforce in the chemical sciences to solve many of our world's challenges. If you agree with me, you can help in three important ways: First, promote the program so that we have a continual strong pool of applicants; second, give or help identify potential donors (contact Kathy Fleming in the ACS Development Office at k_fleming@acs.org); and last but not least, mentor one of our outstanding scholars (contact me, moralesz@fiu.edu).

Zaida C. Morales Martinez
Miami

CLIMATE-CHANGE REDUX

IN A C&EN ARTICLE on climate change, the average lifetime of carbon dioxide molecules in the atmosphere was said to be many decades, and in other articles and textbooks, the average lifetime for CO_2 is given as 100 years. The implication is that lowering the CO_2 concentration in the atmosphere is not a good measure of the time needed for changes in CO_2 concentration, and the 100-year estimate is not correct anyway.

On a timescale of years, the atmosphere can be considered well mixed, and for a well-mixed system, the average lifetime of any species is the holdup divided by the rate of removal. For CO_2, the atmosphere now holds about 700 gigatons (Gt) of carbon, and the natural process of photosynthesis and absorption in cold ocean waters removes an estimated 100 Gt per year. Without human activities, this would normally be balanced by emissions of 100 Gt per year due to decomposition of organic matter, desorption of CO_2 from warm waters, and volcanic activity.

Dividing 700 Gt by 100 Gt per year gives an average CO_2 lifetime of seven years. The incorrect figure of 100 years may have come from dividing 700 Gt by the estimated anthropogenic contribution of 7 Gt per year, due mostly to fossil fuel combustion. Although 7 Gt per year is a small part of the total emissions of 107 Gt per year, the CO_2 molecules released by burning fossil fuels have the same probability of removal as the naturally emitted molecules and an average lifetime of seven years.

A simple model that neglects the effects of other greenhouse gases and the complicated feedback mechanisms shows why a very long time is needed for major changes in CO_2 concentration of about 2 ppm per year (current value is 380 ppm). The other half is removed by a combination of absorption, adsorption, and increased photosynthesis, making the total removal 103.5 Gt per year. If our yearly CO_2 emissions could be halved, a difficult but achievable goal, the total emissions and removal might be balanced, and the CO_2 level would not change. If we could achieve the more difficult task of lowering our net CO_2 emissions to 1.5 Gt per year (80% reduction) and the natural processes of CO_2 emission and removal do not change appreciably, total emissions would be 2 Gt less than the current removal rate (103.5–101.5).

In one year, this would decrease the CO_2 concentration by only about 0.3% or 1 ppm per year (2/700 × 380). Since the CO_2 concentration is bound to increase for many years as limits in emissions are slowly adopted, it will take a long time to reach the new Intergovernmental Panel on Climate Change goal of 350 ppm CO_2.
Peter Harriott
Ithaca, N.Y.

THANK YOU for announcing ACS's stance on climate change (C&EN, July 27, 2009, page 5). Despite efforts by propagandists (climate-change deniers) to selectively pick data from larger studies and draw their own conclusions, organizations like ACS need to remain diligent and draw conclusions based on all available data.
Jake Neubauer
Warrensburg, Mo.

WHY BOYCOTT ISRAEL?

DAVID MENDENHALL certainly knows how to pick his battles (C&EN, Sept. 21, 2009, page 3). Journalists and human rights activists are "disappeared" in Russian streets with alleged government involvement, and Chechen cities are reduced to rubble with tens of thousands of casualties, but Russia doesn't seem to be high on Mendenhall's boycott list. China enables the slaughter of hundreds of thousands in Sudan and is attempting the wholesale destruction of Tibetan civilization, but that doesn't seem to concern him too much, either.

But Israel is a different matter. After all, an Israeli TV exposé alleged a racist motive to the termination of an accounting program in a school in Haifa! Well, then, to the barricades!

Mendenhall's careful mention that some supporters of the boycott-Israel movement are Jewish should also not go unnoticed. What, exactly, does this prove? That not all Jews think alike? Amazing!
Joseph Kushick
Amherst, Mass.

I AM AMAZED at how mindless bias forms conclusions without considering facts that counter that bias. It is absurd to call Israel an apartheid state when it has a large Arab population that votes, is involved in politics, and has a higher income and better life than most of the other Middle East residents. As for apartheid, the Jews who have lived in the Middle East for millennia were expelled by the Arabs, and their land, homes, businesses, property, and lives were appropriated by the various Islamic governments.

If I as a Christian or Jew were to set foot on Islamic "holy ground," I would stand a good chance of having my throat slit. (And if they didn't have me, the Shias could always murder the Sunnis and vice versa). That is apartheid!

Why don't the so-called academics consider both sides? Why are the bombardments, pogroms, and massacres of Jews by Arabs swept under the rug? Blaming the Jews for the failures of the Arabs to help themselves is false and twisted logic. The Arabs have the oil money and were given many opportunities to govern themselves, which, because they are so driven by the dogma that Jews must be eliminated, they ignored. As for the West boycotting a country, that is at the least immature.
Martin L. Kantor
Mamaroneck, N.Y.

THE DEBATE on a boycott of Israeli institutions is interesting from a number of viewpoints. First, are Jewish scientists smarter than everyone else? If not, why bring it up? Even if every Jewish member of ACS supported a boycott, would that make it more desirable or sensible?

Second, where do all the pro-boycott scientists stand on a boycott of China for suppression of dissent and occupation of Tibet, on a boycott of Saudi Arabia for total exclusion of Christian literature and ritual in the country, on a boycott of Iran for openly threatening a nuclear Holocaust, or on a boycott of Russia for repression in Chechnya and invasion of Georgia. The list could go on for pages. Why this obsession with Israel?

Third, it seems there is some separate set of rules for one nation on Earth. I am sure many of the people who are pro-boycott are well meaning, but I think it is appropriate to remember that having a specific religious orientation bestows neither truth nor intelligence, and that international standards of behavior should be applied to all nations, not just one.

Bias in international affairs is no less crippling and wrong than bias in data-point selection. One ends up with erroneous or at the very least suspect conclusions.
Harold B. Reisman
Carlsbad, Calif.

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COPENHAGEN CONSTERNATION

CLIMATE CHANGE: Nonbinding deal lets countries make their own pledges on greenhouse gas limits

THE UNITED NATIONS-SPONSORED Copenhagen conference on climate change came to an end with more of a whimper than the bang that was anticipated at the start.

Two weeks of debating, posturing, protesting, and round-the-clock negotiations yielded only a three-page, nonbinding accord, reached on Dec. 18, 2009. It sets a goal of holding average global temperature rise to the level needed to stop the worst impact of climate change, and it contains a pledge for the industrialized world to provide mitigation funds to help developing nations adapt to climate change.

The nations of the world are now left to sign on to the accord and make individual pledges to reduce their greenhouse emissions. However, not all countries are accepting the new climate-change deal that was brokered in large part by President Barack Obama in an 11th-hour negotiating session. So far, about 30 nations have pledged.

Obama hammered out the nonbinding political deal after consulting with the leaders of China, India, Brazil, and South Africa—countries with emerging economies and fast-growing greenhouse gas emissions. The pact says the world should hold human-induced average global warming below 2 °C and calls for developed nations to provide $10 billion per year, beginning this year through 2012, to aid developing countries in lessening the impact of climate change. That support would ramp up to some $100 billion annually by 2020. Where the money will come from is unclear.

"We have sealed the deal," said UN Secretary General Ban Ki-moon, who pushed world leaders hard through 2009 to get a legally binding climate-change treaty completed in Copenhagen. "This accord cannot be everything that everyone hoped for, but it is an essential beginning," he said. Although most other nations embraced the pact, several developing countries, including Sudan and Venezuela, resisted the deal in large part because they weren't involved in negotiating it.

Obama emphasized the precedence of the new accord. "For the first time in history, all major economies have come together to accept their responsibility to take action to confront the threat of climate change," Obama told reporters in Copenhagen. The actions spelled out in the agreement "will not be by themselves sufficient to get to where we need to get," Obama acknowledged, calling the deal a first step.

NEWSCOM

The nonbinding Copenhagen Accord is a first step, President Obama said, that could lead to greenhouse gas reductions.

"This accord cannot be everything that everyone hoped for, but it is an essential beginning." —BAN KI-MOON

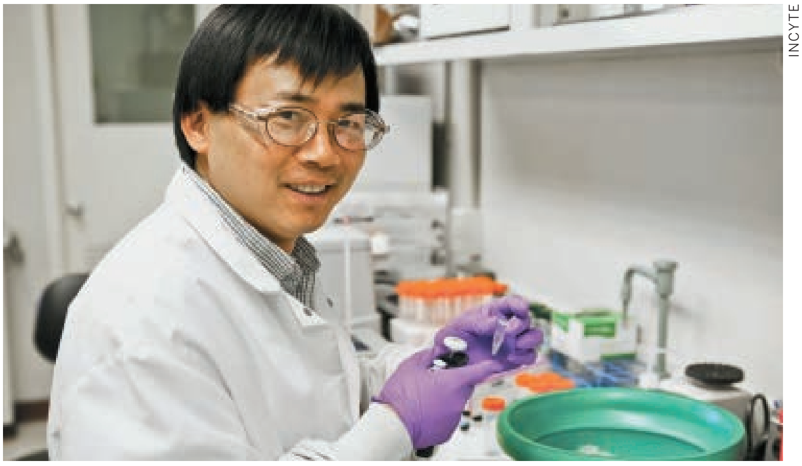
"It will not be legally binding," Obama pointed out. Nonetheless, it will "allow for each country to show to the world what they're doing," he said. "There will be a sense on the part of each country that we're in this together, and we'll know who is meeting and who's not meeting the mutual obligations."

The accord will set the stage for the U.S. Senate's passage of a clean energy and climate-change bill, according to Sen. John F. Kerry (D-Mass.), chairman of the Senate Foreign Relations Committee.

Eyes will now turn to Mexico, where the next round of UN climate-change negotiations is scheduled to take place in November, although there are calls for the talks to happen earlier, in the summer. Hopes remain that a new global, legally binding climate-change treaty will emerge from those discussions.—CHERYL HOGUE AND JEFF JOHNSON

BIG PHARMA'S YEAR-END SPREE

ACQUISITIONS: Flurry of deals bolsters drug companies' late-stage pipelines



As part of a new deal, Incyte's labs, such as the one shown here, will allow Lilly access to a rheumatoid arthritis drug candidate.

AS 2009 DREW to a close, pharmaceutical companies opened their pocketbooks for several drug candidates. The highest price tags were on late-stage compounds intended to help offset revenue losses when generic drug competition hits key products.

In the biggest end-of-season deal, AstraZeneca is paying up to $505 million for Novexel, a private French anti-infectives company. When the deal is complete, Forest Laboratories will pay AstraZeneca half of the acquisition costs in exchange for the rights to codevelop two of Novexel's antibiotic therapies.

One combines ceftazidime and NXL-104, Novexel's β-lactamase inhibitor for gram-negative infections. The other combines NXL-104 with ceftaroline. The ceftazidime/NXL-104 combination is likely to move into Phase III trials by late this year.

Both Forest and AstraZeneca are in dire need of new drugs. Forest loses exclusivity on the antidepressant Lexapro in 2012 and on the Alzheimer's drug Namenda a year later. AstraZeneca's antipsychosis drug, Seroquel, is slated to lose patent protection in 2011.

Novexel's products could be lucrative: The treatment options for gram-negative infections are dwindling, and few drugs in the pipeline address the problem (C&EN, April 14, 2008, page 15).

In a separate deal, Novartis is buying San Francisco-based Corthera for $120 million. Novartis is after relaxin, a heart failure drug in Phase III trials that, if successful, could bring Corthera shareholders an additional $500 million in milestone payments.

Relaxin is a naturally occurring polypeptide hormone that "relaxes" women's reproductive tracts and mediates cardiovascular and kidney changes during pregnancy. When administered during heart failure, the peptide widens blood vessels. Novartis expects to submit relaxin for regulatory approval in 2013, the same year it loses patent protection on the multi-billion-dollar oncology drug Gleevec.

Meanwhile, Eli Lilly & Co. has agreed to pay Incyte Pharmaceuticals $90 million up front for access to INCB28050, which is in Phase II trials as a rheumatoid arthritis treatment. INCB28050 blocks JAK1 and JAK2, critical enzymes in the immune system's complex signaling network. Lilly already has JAK inhibitor candidates through its 2008 acquisition of SGX Pharmaceutical.

Lilly faces its own revenue drain in 2011, when the patent expires on Zyprexa, its blockbuster schizophrenia drug. "Given the patent expiries Lilly faces over the coming years, we see them as a highly motivated and suitable partner" for Incyte, says Joshua Schimmer, a stock analyst at Leerink Swann.

In another deal, Teva Pharmaceutical Industries, a generic drug firm that is trying to get into branded pharmaceuticals, licensed a late-stage cancer therapy from OncoGenex. Teva handed over $60 million, including $10 million for a stake in the biotech firm, to share the rights to OGX-011, a second-generation antisense drug that blocks the cell-survival protein clusterin. The drug is currently in Phase III trials to prevent cancer from developing resistance to chemotherapy.—LISA JARVIS

FINANCE Court approves new lending for Tronox reorganization

Bankrupt titanium dioxide maker Tronox has more time to pursue its reorganization strategy with new debtor-in-possession and exit financing provided by Goldman Sachs.

Tronox filed an emergency motion to obtain new financing on the eve of a planned Dec. 21, 2009, auction of many of its manufacturing assets. The U.S. Bankruptcy Court for the Southern District of New York issued an interim order approving the financing deal and the cancelation of the auction.

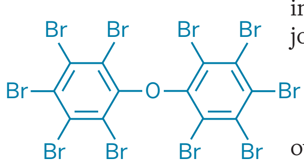
When it filed for Chapter 11 bankruptcy on Jan. 12, 2009, Tronox originally obtained 12 months of debtor-in-possession financing from Credit Suisse. With the new $425 million in senior secured loans from Goldman Sachs, Tronox can repay the existing loan and continue to operate while implementing its reorganization plan.

Under the plan, Tronox and a committee of bondholders and other unsecured creditors will raise additional debt financing, plus $115 million for environmental remediation trusts and a litigation trust. In a Dec. 22, 2009, filing, the U.S. attorney for the district agreed with the motion for the reorganization plan, saying it "will permit a reasonable and responsible resolution of Tronox' environmental liabilities." Tronox pointed to environmental problems dating back to its spin-off from Kerr-McGee as a major reason for its bankruptcy filing.

Rival titanium dioxide maker Huntsman Corp. had hoped to acquire most of Tronox' assets for $415 million but has withdrawn its request that the court force the company to hold the auction. In a statement, Huntsman CEO Peter R. Huntsman said, "While we are disappointed in the result, it became clear that to prevail over the ad hoc bondholders, we would have to overpay for these assets."—MELODY VOITH

INDUSTRY DROPS FLAME RETARDANT

TOXIC SUBSTANCES: Producers of decaBDE will shift to green alternatives



DecaBDE

FOLLOWING NEGOTIATIONS with the Environmental Protection Agency, three companies have agreed to phase out production and sale of the flame retardant decabromodiphenyl ether (decaBDE) for most uses within three years.

Albemarle and Chemtura, which produce decaBDE in the U.S., and Israel's ICL Industrial Products, a major supplier to the U.S. market, say they will end sales for all remaining "essential uses" by the end of 2013.

DecaBDE, one of the world's most widely used flame retardants, has been the focus of controversy over the past several years. In letters to EPA describing their phaseout plans, the companies insist that decaBDE is safe and effective but say they will shift production to green alternatives.

DecaBDE is a polybrominated diphenyl ether, a class of flame-retardant chemicals that has been under regulatory scrutiny for its potential health risks.

"Though decaBDE has been used as a flame retardant for years, EPA has long been concerned about its impact on human health and the environment," says Steve Owens, EPA assistant administrator for the Office of Prevention, Pesticides & Toxic Substances. "Studies have shown that decaBDE persists in the environment, potentially causes cancer, and may impact brain function."

Under the companies' agreement with EPA, the phaseout will focus initially on consumer segments such as electronics and home furnishings, followed by transportation and industrial uses. Certain transportation and military uses, which might need more time to qualify suitable substitutes, have up to 12 additional months to transition to alternative flame retardants.

"While hundreds of science-based and peer-reviewed studies have shown decaBDE to be safe in use and one of the most efficacious flame retardants in the world, Albemarle is committed to delivering safe and effective products with increasingly smaller environmental footprints," says Brian Carter, global business director of Albemarle's flame retardant group.

"We welcome the chance to help transition our customers to other alternatives, including new products we are piloting and plan to introduce in 2010," notes Craig A. Rogerson, Chemtura's chairman and president.—GLENN HESS

DIRT TELLS RESISTANCE TALES

ENVIRONMENTAL CHEMISTRY: Antibiotic resistance genes in soil are increasing

Antibiotics are frequently added to livestock feed to prevent disease.

ISTOCK

DESPITE MEASURES aimed at curbing antibiotic resistance, a study in Europe suggests that resistance might still be on the rise in the environment (*Environ. Sci. Technol.*, DOI: 10.1021/es901221x). The work provides data spanning nearly 70 years, and it complements public health data from patients.

For years, studies have shown that antibiotic resistance is up at hospitals, apparently due to clinical use of antibiotics. But antibiotics are also used in agriculture to increase productivity and prevent disease in livestock. In theory, excessive use of antibiotics could expand reservoirs of resistance in soil microbes. Antibiotic resistance genes naturally exist in soil and sewage microbes, but no long-term studies have been performed to gauge how resistance might have changed since the 1940s, when antibiotic mass production kicked in.

Now, environmental engineer David W. Graham of Newcastle University, in England; molecular ecologist Charles W. Knapp of the University of Strathclyde, in England; and colleagues have found a way to delve into that past. "We thought that by extracting DNA from soil archives, we might be able to learn something about the longer term history," he says. In collaboration with TAGA, a soil archive maintained by research institute Alterra at Wageningen University, in the Netherlands, the team quantified antibiotic resistance genes for five sets of soil samples from across the Netherlands, with one set dating back to 1940.

For every drug class the team examined, levels of resistance genes have significantly increased since 1940. In particular, genes that confer resistance to tetracycline antibiotics have spiked in recent decades, becoming 15 times more abundant than in the 1970s.

The work suggests that resistance research should be broadened to include environmental reservoirs so that resistance can be more efficiently mitigated in the future, Graham says. This study was relatively local, he notes, but "we suspect similar patterns also are occurring in soils from other locations around the world."

"In retrospect, we should have anticipated the environmental outcome that this study documents," says Shahriar Mobashery, who studies antibiotic resistance at the University of Notre Dame.—CARMEN DRAHL

TITANIA'S PROWESS

CATALYSIS: Gold's surprising reactivity may be partly due to oxide support

GOLD NANOPARTICLES, a relatively new class of surprisingly active supported catalysts, may owe key aspects of their catalytic prowess to the titania (TiO_2) support on which they are commonly dispersed, according to scientists in New Orleans (*J. Am. Chem. Soc.*, DOI: 10.1021/ja907865t). The mechanistic details uncovered by the investigation may lead to strategies for designing improved industrial catalysts.

The unexpected discovery several years ago that gold—generally considered an inert metal—can function as an active catalyst when prepared in nanoparticulate form touched off a wave of research into the precious metal's catalytic capabilities.

For example, in 2006, researchers in Valencia, Spain, reported that nanoparticles of gold supported on titania selectively convert nitro groups to amino groups in multifunctional organic molecules. Those researchers later found that the same catalyst can also be used in a two-step reaction for hydrogenation of nitrobenzene to aniline followed by oxidation to azobenzene. Various explanations have been proposed to account for the catalytic system's good performance, with much of the attention focused on gold.

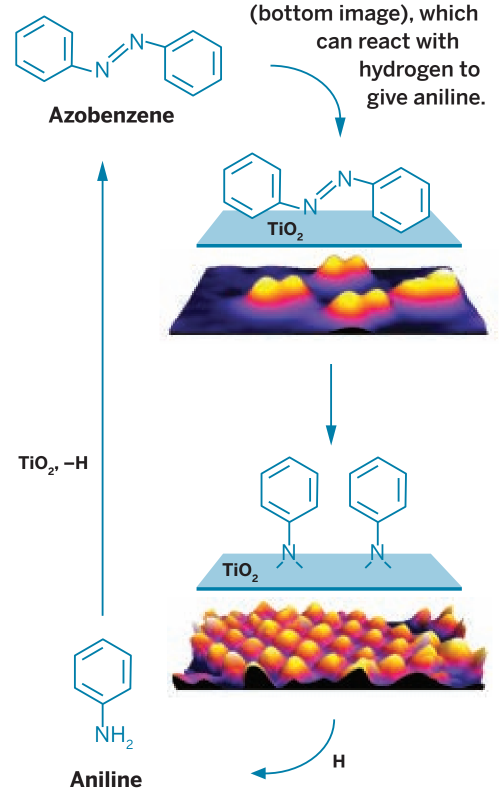
Now, Tulane University physicists Shao-Chun Li and Ulrike Diebold report that titania alone facilitates the key steps in interconversion reactions between aniline and azobenzene and that the role of gold, at least in those reactions, may simply be to activate oxygen or hydrogen.

The team explains that depositing azobenzene on titania at sufficiently high concentration causes the molecules to adopt a configuration that leads to cleavage of the N=N double bond. That process forms surface-bound phenyl imide (C_6H_5N) intermediates, which can react with hydrogen to form aniline. The same intermediate, or a very similar one, forms on titania when aniline is dehydrogenated and converted to azobenzene, the team says.

This collection of mechanistic details—the N=N bond scission, hydrogenation of the phenyl imide intermediate, and the catalyst's proclivity to facilitate the reverse reaction "is a very significant first observation of the complex catalytic function exhibited by titania surfaces," according to D. Wayne Goodman, a catalysis specialist and professor of chemistry at Texas A&M University.

Goodman adds that these properties of titania are likely applicable to a broad range of catalytic reactions. As such, he says, future studies should focus on the active role of titania itself in the overall catalytic chemistry mediated by titania and titania-supported metals such as gold in hydrogenation and dehydrogenation reactions.—MITCH JACOBY

THE BREAK-UP At low concentrations, azobenzene remains undissociated on TiO_2 (top image). At sufficiently high concentration, azobenzene dissociates to form phenyl imide intermediates (bottom image), which can react with hydrogen to give aniline.



SHAO-CHUN LI/TULANE U

PHARMACEUTICALS Sanofi will buy Chattem, targeting U.S.'s over-the-counter market

The French drug giant Sanofi-Aventis has agreed to buy Chattem, a U.S. manufacturer of over-the-counter (OTC) drugs and personal care products including Selsun Blue shampoo and Gold Bond foot powder. The deal, for about $1.9 billion, will create the world's fifth-largest consumer health care company, Sanofi says.

The OTC acquisition follows a string of generic drug deals for Sanofi as the company moves to expand its global presence and gird against patent expiries. Its generics purchases over the past year include the Czech Republic firm Zentiva, Switzerland's Helvepharm, Brazil's Medley, and Mexico's Laboratorios Kendrick.

"The acquisition of Chattem will be a significant milestone in Sanofi-Aventis' transformation strategy and will provide us with the ideal platform in the U.S. consumer health care market," says Sanofi CEO Christopher A. Viehbacher.

After years of eschewing OTC and generic drugs, big pharmaceutical firms now see them as a way to reduce their reliance on blockbuster prescription drugs. For example, Pfizer exited the OTC sector with the 2006 sale of its consumer health unit to Johnson & Johnson but is back in with the acquisition of Wyeth. Pfizer also has marketing deals with two Indian generics firms. Merck & Co. reentered the OTC segment with its 2009 acquisition of Schering-Plough. GlaxoSmithKline recently bought a stake in South Africa's Aspen.

Zack's Investment Research estimates that Sanofi generated OTC drug sales of about $2 billion in 2009 but little of it in the U.S. Zack's puts the U.S. market for OTC health care products at about $20 billion, growing at a rate of 3% annually.—RICK MULLIN

CHEMTURA WILL SELL PVC ADDITIVES

Chemtura, in bankruptcy reorganization since last March, has secured a "stalking horse" bid from private equity firm SK Capital to buy its polyvinyl chloride additives business for $34 million. The bid is subject to a court-authorized auction in February and could be scuttled by a higher bid. The PVC additives business had revenues of $374 million in 2008 and $177 million for the first nine months of 2009 from products such as tin stabilizers, mixed metals, and phosphate esters. According to court documents, Chemtura has been looking for a buyer for the business since May and initially contacted 83 strategic and financial buyers. SK bought Solutia's nylon business last year (C&EN, April 6, 2009, page 16).—MSR

NUFARM DROPS SINOCHEM, LINKS WITH SUMITOMO

The Australian agrochemical firm Nufarm has ended talks to be acquired by China's Sinochem and instead is planning to cooperate with Japan's Sumitomo Chemical. This past September, Sinochem offered to acquire Nufarm for $13.00 Australian per share, or about $2.5 billion. In December, to Nufarm's chagrin, the Chinese firm dropped the offer to $12.00 Australian. Under the alternative plan, Sumitomo will acquire a 20% stake in Nufarm for $14.00 Australian per share. The companies will cooperate in R&D, distribution, and other areas.—MM

BRAZILIAN COMPLEX GETS FINANCING

PetroquímicaSuape, a subsidiary of the Brazilian state oil company Petrobras, has received a $1.5 billion credit line from Brazil's development bank BNDES to help it build a $2.3 billion chemical complex in the northeastern Brazilian state of Pernambuco. When it starts up later this year, the complex will consist of a 700,000-metric-ton-per-year purified terephthalic acid (PTA) plant, a 450,000-metric-ton polyethylene terephthalate (PET) unit, and a 240,000-metric-ton polyester filament yarn facility. The project will double Brazil's PET capacity and reestablish domestic production of PTA.—AHT

BOTTLE BATTLE BREWS

Eastman Chemical has filed a lawsuit against Indorama Polymers charging the Thailand-based polyester producer with stealing manufacturing trade secrets and using them in a just-opened $140 million polyethylene terephthalate (PET) plant in Decatur, Ala. In a complaint filed in federal court on Dec. 18, 2009, Eastman seeks unspecified damages and a court order to prevent Indorama from infringing on three patents that encompass Eastman's IntegRex technology. Indorama did not respond to C&EN inquiries by press time, but according to its website, the 432,000-metric-ton-per-year Decatur facility, known as AlphaPet, uses technology called melt-to-resin (MTR) from the engineering firm Uhde Inventa-Fischer. MTR, like IntegRex, is touted as producing PET, used to make soda and water bottles, in half the footprint of a conventional PET plant and at a much lower cost. Uhde says it cannot comment on the legal dispute. In early 2008, Eastman sold Indorama two European PET plants that use older conventional technology. The U.S. firm alleges that former Eastman employees now working for Indorama were familiar with the IntegRex technology and that they "improperly used and disclosed Eastman's confidential, proprietary, and trade secret information."—MSR

SHUTTERSTOCK

OM GROUP TO ACQUIRE EAGLEPICHER UNIT

Cobalt and nickel compounds maker OM Group is buying EaglePicher Technologies, a battery maker, from EaglePicher for $172 million. EaglePicher Technologies, which had $125 million in sales in its last fiscal year, makes batteries for aerospace, defense, and medical applications. The technologies at its disposal include nickel-hydrogen, silver-zinc, and a variety of lithium-based batteries. "We believe EaglePicher will provide us a strong and portable base from which we can accelerate our growth in battery materials," OM CEO Joseph M. Scaminace says.—AHT

KRATON CUTS IPO PRICE

Kraton Performance Polymers netted $140 million in its initial public offering (IPO) with shares priced at $13.50. In a filing with the Securities & Exchange Commission in October, the firm initially said it hoped to offer the shares for as much as $18.00. Kraton says it will use the proceeds to repay a portion of its $323 million in debt and to fund projects related to its manufacture of isoprene rubber. Kraton's main owners will continue to be the private equity firms TPG Capital and JPMorgan Partners.—MV

TEIJIN FIBERS GO TO INDONESIAN FIRMS

Japan's Teijin will transfer ownership of its Indonesian polyester subsidiary Tifico to four Indonesian firms with interests in the textiles business. Unprofitable for at least three years, Tifico posted a net loss of $58 million in 2008 on sales of $301 million. Teijin says it will continue to support Tifico by offering technical assistance and importing its polyester fiber. The Japanese firm expects to post a $175 million restructuring charge. Teijin launched Tifico in the early 1970s, but the unit has been unable to compete against China during the past decade.—JFT

AIR LIQUIDE, PRAXAIR WIN CHINA CONTRACTS

Shanghai Chemical Industry Park Industrial Gases, a 50-50 venture of Praxair and Air Liquide, has won a 15-year contract to

supply hydrogen and carbon monoxide to a Bayer unit that produces polyurethanes in Shanghai. The partners will build a new plant in Shanghai that is expected to come on-line in 2012. Separately, Air Liquide has signed contracts to supply carrier and specialty gases to 13 Chinese manufacturers of polysilicon-based solar cells. Air Liquide will invest about $14 million in new facilities and equipment to supply them.—JFT

TWO 'CLEANTECH' FIRMS TO GO PUBLIC

Thin-film solar system maker Solyndra has filed paperwork with the Securities & Exchange Commission for an initial public offering (IPO) of stock that it hopes will bring in $300 million. Solyndra makes solar panels from copper-indium-gallium-selenide photovoltaics deposited on the inside of glass tubes. Meanwhile, the industrial biotech company Codexis filed for an IPO with which it wants to raise $100 million. Codexis works with Shell to develop fuels from biomass and with various drug companies to make pharmaceutical ingredients via biocatalysis. Codexis tried, but failed, to go public in April 2008.—MV

BASF, KIT LINK FOR MATERIALS RESEARCH

BASF and the Karlsruhe Institute of Technology have founded IP3, a joint laboratory for nanostructured functional materials in Karlsruhe, Germany. IP3—which stands for innovative products, intelligent particles, integrated processes—will receive funding of about $12 million over five years. Rainer Diercks, who heads BASF's competence center for chemicals research and technology, says the nanomaterials could have applications in organic electronics, pigments, agrochemicals and medicines, or catalysts.—MM

JAPANESE DRUGMAKERS SIGN WITH U.S. FIRMS

Japan's Astellas Pharma and Ambit Biosciences will codevelop AC220, Ambit's treatment for acute myeloid leukemia, a fatal form of blood cancer. Astellas will make an initial cash payment of $40 million to San Diego-based Ambit and pay as much as $350 million to the firm if the product gains approval. AC220 is a kinase inhibitor that recently entered Phase II clinical trials. Separately, Japan's Eisai will pay $255 million to acquire New Jersey-based AkaRx, which has developed AKR-501, an agonist for thrombopoietin receptors, which stimulate platelet production.—JFT

NEW ENGLAND PEPTIDE DEBUTS INSTRUMENT

New England Peptide has launched a peptide synthesis instrument designed for the scale-up and process development of customers' peptide-based drugs. The Gardner, Mass.-based firm says it built PepScale using its chemistry knowledge at both the research and preclinical levels. The instrument is optimized to make tens of grams.—MM

NEP

NEP scientists work on the PepScale.

PFIZER SHEDS VICURON AND CHOLESTEROL DRUG

Pfizer has sold Vicuron Pharmaceuticals to Durata Therapeutics, an antibiotics-focused drug company recently formed by a five-member venture capital syndicate. Terms were not disclosed, but Pfizer paid $1.9 billion for Vicuron in 2005. Durata gains dalbavancin, a long-acting lipoglycopeptide in late-stage trials for treatment of bacterial infections of the skin and skin structure. Pfizer is keeping the antifungal Eraxis. Separately, Pfizer out-licensed ApoA-I Milano, a variant of apolipoprotein A-I that helps remove cholesterol from artery walls, to the Medicines Co. Pfizer gets $10 million up front for the drug and could receive another $410 million in milestones as it moves toward the market.—LJ

BUSINESS ROUNDUP

SÜD-CHEMIE has taken a 25% interest in GTC Technology. Germany-based Süd-Chemie says the alliance with the U.S. firm strengthens its position in catalysts for aromatic compounds such as *p*-xylene, a polyester intermediate.

LIQUIDIA Technologies, a nanotechnology start-up, will receive $3 million in funding from NIST to further develop and scale up its process for making engineered particles. Liquidia's polymer particles are designed to deliver drugs and vaccines.

CELANESE has purchased FACT from the Belgian industrial holding company Ravago Group. FACT, which stands for Future Advanced Composites & Technology, makes long-fiber reinforced thermoplastics, one of the main business lines of Celanese's Ticona unit.

ARIGENE has dropped its bid to acquire the biotech firm Trimeris because it couldn't arrange financing. Arigene, a South Korean medical equipment maker, announced the $81 million takeover in October. A month later, Arigene put up $12 million to be paid to Trimeris in case the deal was terminated.

CLARIENT, an Aliso Viejo, Calif.-based cancer diagnostics company, has acquired Applied Genomics in a stock deal valued at up to $17.6 million. The deal gives Clarient a pipeline of diagnostic tools, including a five-antibody immunohistochemistry test for identifying non-small-cell lung cancer types.

DSM will manufacture MS1819 for Laboratoires Mayoly Spindler, a French drug company, at its Capua, Italy, fermentation facility. MS1819 is a lipase being developed for exocrine pancreatic insufficiency, a digestive disorder characterized by a lack of enzymes.

JUBILANT Organosys will build 10,000-metric-ton-per-year plants for niacinamide (vitamin B-3) and the raw material 3-cyanopyridine. The Indian firm says it's already among the three largest producers of vitamin B-3 worldwide.

GLAXOSMITHKLINE will pay $12 million to apply Seattle Genetics' antibody-drug conjugate (ADC) technology against several antigens selected by GSK. Seattle Genetics says it now has nine ADC licensees and generated more than $35 million during 2009 from ADC collaborations.

GREENPEACE

INTERNATIONAL ACTIVISM A Greenpeace researcher in China's Guangdong province inspects water discharge from a factory.

IN PURSUIT OF CLEAN WATER

Activists in China follow contrasting paths in tackling **INDUSTRIAL CONTAMINATION** of water

JEAN-FRANÇOIS TREMBLAY, C&EN HONG KONG

THE VILLAGES surrounding the town of Shenqiu, in the northeastern part of China's Henan province, don't look any richer, poorer, happier, or sadder than those in other parts of the country. But people living there are cursed with an intractable problem: The contaminated water they have been drinking for the past two decades is making many of them sick and die prematurely.

The quality of drinking water in large swaths of rural China has steadily deteriorated with the country's rapid industrialization. As the number of villages with unsafe water reaches alarming proportions, new initiatives are getting under way to reverse the damage. Over the past two years, two nongovernmental organizations have launched campaigns to improve the quality of water that Chinese rural residents drink. Using different strategies, the two groups offer complementary approaches to solving the problem of polluted drinking water in many parts of China.

In the province of Henan, in central China, the Huai River Protectors are equipping villages with low-cost filtration systems designed to remove harmful industrial contaminants from their water. And in the southern province of Guangdong, the international group Greenpeace has embarked on an ambitious campaign to convince the Chinese government to keep track of hazardous wastes and to more systematically prevent manufacturers from dumping them into rivers and lakes.

"China knows it has a big problem with its water," says Jamie Choi, the Hong Kong-based manager of Greenpeace's campaign against toxic chemicals in China. "It needs help." About a quarter of China's population does not have access to safe drinking water, she says, citing Chinese government statistics.

China is the world's most attractive market for companies in the water treatment business (C&EN, May 11, 2009, page 18). Chinese industry needs large amounts of clean water to feed its power plants, electronics manufacturers, and beverage industries. And major Chinese cities, particularly in the country's northern region, are increasingly using desalination and recycling to make up for the water shortages they face.

But people in farming communities throughout China are often neglected when it comes to clean water. Villagers have traditionally relied on rivers or shallow wells for drinking water, but pollution is often so bad that both the rivers and the wells dug in their vicinity are unsafe. China's government is gradually installing pipes to distribute treated water, but the pace is slow given the vastness of the country.

Hopes for a solution to China's rural drinking water problems were raised last month when India's Tata Group launched Swach, a low-cost water filter suitable for rural parts of the developing world (C&EN, Dec. 14, 2009, page 9). But the company later explained that Swach is designed to remove bacteria and viruses, not heavy metals and agrochemicals from industrial activity.

It is possible to deliver clean water without addressing the underlying pollution, Greenpeace's Choi acknowledges, but the environmental group has more ambitious goals for China. "We're aiming at policy

TROUBLED WATER

Pollution in Guangdong and Henan provinces threatens rural residents

change. We want China to have a plan for its hazardous chemicals," she says.

Currently, Choi says, China has no official accounting of toxic materials released into the environment. "They cannot say they hope to reduce mercury emissions by 20% because they don't know how much mercury is being released," she says.

THE CHINESE GOVERNMENT is aware that water pollution is a serious problem. Companies that pollute in China are fined or forced to treat their emissions. But, Choi argues, the government is not sophisticated in its tracking of pollution. Even though hundreds of compounds can pollute water in multiple ways, China primarily monitors chemical oxygen demand, an indirect test for measuring the quantity of organic pollutants in water.

Greenpeace is best known for dramatic, high-profile actions aimed at drumming up public support for environmental causes. In China, however, the group has adopted a low-key approach. "As in other parts of the world, in China we do research, write reports, and lobby the governments," Choi says. "But it would not be effective in China to hang large banners from the sides of buildings."

JEAN-FRANÇOIS TREMBLAY/C&EN

DO IT YOURSELF Huo Daishan (center) helps build the first slow-sand water filtration system in Henan in the summer of 2008. Jin is on his right, standing on a small concrete vat.

The group's water campaign in China focuses on the Pearl River Delta, in the southern province of Guangdong. Encompassing Hong Kong and Macau, the delta is one of the world's most dynamic industrial zones. Greenpeace reckons that it accounts for 10% of China's gross domestic product and that the Pearl River itself is the source of drinking water for 47 million people. Guangdong, Choi says, is "more aware than elsewhere of the negative consequences of development and therefore more ready to try out another model."

In October, Greenpeace issued "Poisoning the Pearl," a report that describes the toxic substances found in water samples the group took from sites next to some of the large manufacturing facilities operating in the delta. Water analysis was performed at Greenpeace Research Laboratories at the University of Exeter, in England.

The lab found copper, manganese, zinc, beryllium, bisphenol A, phthalates, and chlorinated volatile organic compounds, often at high concentrations. For example, it found that beryllium in one sample exceeded the legal maximum by 25 times. Exposure to beryllium can lead to a debilitating lung disease.

Greenpeace collected the samples because "no one does it," Choi says. "In terms of enforcement, they need help," she says of government officials in Guangdong province. "It's a huge challenge for China to identify who the polluters are." The samples are also a way for Greenpeace to stress how little China knows about what manufacturing facilities are releasing into its rivers and lakes.

If China adopted a policy similar to the U.S. Environmental Protection Agency's Toxics Release Inventory program, the impact would be profound, Choi believes. "If Chinese citizens knew what the factories in their backyard produce and how, it would have a huge effect on pollution in China," she says. Instead, large quantities of chemicals are unaccounted for. "People live next door to those factories; they grow their vegetables there," she says. "It's really dangerous."

Over the longer term, Choi says, China will have to switch to more environmentally friendly production methods. For this purpose, Greenpeace is lobbying the Chinese Ministry of Health, the State Environmental Protection Agency, provincial and municipal environmental agencies, local courts, and other officials, she says. It will be several years before the campaign shows results, she expects.

In Henan province, environmental and social activist Huo Daishan is tired of waiting. He believes it would take so long to fix industrial contamination in his area that it is better to devise new ways to deliver safe drinking water—and fix the pollution later.

Huo, founder of the Huai River Protectors, lives in a part of China where water pollution has had catastrophic consequences. The hamlets surrounding his town, Shenqiu, are notorious "cancer villages"—places where the incidence of cancers is abnormally high (C&EN, Oct. 29, 2007, page 18). Various initiatives to clean the Huai River over the years have ended in failure. And Huai tributaries in the region are in even worse shape.

When he first became concerned with pollution, Huo, a former journalist, focused on documenting environmental damage in the Huai and its tributaries. He took hundreds of photos of the river system and the peasants who became sick from drinking the water, and he pressed local officials to take action. His initiatives bore little fruit, although he claims some success with the Lianhua Group, a producer of monosodium glutamate that, until recently, was one of the Huai's worst polluters, Huo reckons. Over the past two years, Lianhua has done much to clean up its act, he says.

YET REDUCING the emissions of one polluter is not sufficient to make village water safe. So with technical assistance from Jin Shengzhe, a Chinese businessman and philanthropist living in Japan, Huo started in the summer of 2008 to install slow-sand water filtration systems in about a dozen villages around Shenqiu. He has collected enough money from grants and environmental prizes to build 15 more.

Slow-sand filtration is an old but proven method of water treatment used in many locations around the world, including London, Jin tells C&EN. It's well suited to the needs of Chinese villages because of its simplicity and low cost, he says. "Everyone thinks that supplying water is expensive, but they're wrong," he says.

The slow-sand filtration systems being set up in rural Henan consist of three vats through which water flows, one after the other. One is half-filled with gravel and one is half-filled with sand. The third stores water treated in the first two. Most of the installation work is performed by Huo's son, Huo Meijie, who builds the systems on the properties of villagers who agree to share the water with their neighbors.

JEAN-FRANÇOIS TREMBLAY/C&EN

POPULAR MAN Huo Daishan talks with locals in a village where many have died prematurely.

Although they are cheap, the water filtration systems installed by Huo Daishan's group are not free. The concrete vats must be paid for, as must the pump that extracts water from a shallow well to feed into the system. Huo says he finances the endeavor mostly from grants. A few systems were paid for with funding from the World Bank.

C&EN could not determine with certainty that Huo's systems actually make water safe for drinking, but Huo reports that the health of villagers improves soon after they start drinking the water provided. Water that used to be turbid and malodorous becomes clear and tasteless after going through the filtration vats. Moreover, Huo points to tests performed by an independent lab. Huo provided C&EN a copy of the lab report, which concluded that the water meets China's national standards.

But Wu Zucheng, a professor of environmental science and engineering at Zhejiang University, one of China's top schools, is skeptical. One needs to know what is wrong with the water to design an effective filtration system, he says. The lab tests, he points out, did not check for microorganisms and bacteria. The laboratory also did not test for all possible contaminants, a list that can be quite long.

Wu has seen Huo's water purification systems and says they are too primitive to work effectively. "I would not drink the water that comes out of there," he says. During a visit to one of the villages where a system is installed, Wu urged villagers to boil the water coming out. He promises to advise Huo on how to improve the design of the systems.

A World Bank spokeswoman in Beijing says the bank has not independently assessed Huo's water filtration systems but has simply accepted his conclusion that they are "proven effective."

At Greenpeace, Choi expresses much respect for Huo's frontline work. "It's activists like Huo who really enable us to do our work in China," she says. "We have a lot to learn from him." One lesson is that in parts of China, villagers have been waiting so long for clean water that they are willing to take matters into their own hands. ■

Company Of The Year

LUBRIZOL'S RESULTS, unusual for a chemical company in 2009, need to be acknowledged

ALEXANDER H. TULLO, C&EN NORTHEAST NEWS BUREAU

THERE ARE TWO approaches to picking a company of the year. One is to do as *Time* magazine does for its person of the year and select the firm that was in the thick of the action. The other is to emulate the way *Motor Trend* chooses its car of the year and select, as objectively as possible, the best among a range of contenders.

If C&EN had taken the *Time* approach to picking its company of the year, the obvious choice would have been Dow Chemical. Its acquisition of Rohm and Haas was a soap opera that riveted the chemical industry.

Lubrizol headquarters, Wickliffe, Ohio

LUBRIZOL

History will decide whether or not the deal made sense. It certainly can be criticized. Dow's $78-per-share offer represented a handsome premium—25 times Rohm and Haas's prior-year earnings and 25% above its highest stock price over the previous five years. The purchase also came on the eve of the worst banking crisis since the 1930s. Dow Chief Executive Officer Andrew N. Liveris, who sits on Citigroup's board of directors, should have known better.

In making the $18.8 billion offer, Dow was spending promised money. Amid a collapsing economy, Liveris had to foresee the possibility that his deal to raise $9.5 billion by folding Dow's commodity chemical businesses into a joint venture with Petrochemical Industries Co. of Kuwait would fall apart. It did, at the end of 2008.

Facing an ironclad agreement with Rohm and Haas, Dow had to finance the deal with a $13 billion short-term loan meant only as an emergency measure. Dow was forced to sell multiple businesses to raise cash. The company also upended one of the longest dividend histories in the corporate world when it reduced its payout for the first time since before World War I.

Liveris told reporters recently that few would remember any of this in five years. Rohm and Haas, he said, is the linchpin of Dow's transformation from a commodity chemical company to a science-focused specialty materials maker. Furthermore, largely through more than 3,000 layoffs, Dow is well on its way to achieving $1.3 billion in annual cost savings.

Liveris has lofty goals for the combined company. He says he can increase revenues by 10% annually. He also believes that he can increase earnings from the $1.25 per share that he expects for 2009 to $4.50 by 2012 and $10 at some point. If Dow does achieve these goals, then certainly it will be a future company of the year.

But the recession has turned out to be a far bigger event than the actions of any one company. Instead of selecting a company that has been grabbing headlines, better to write about one that has been quietly defying economic circumstances.

C&EN considered several companies of achievement this year, all of them much smaller than Dow. One is Dow Corning, a joint venture between Dow and Corning. Through its Hemlock Semiconductor polycrystalline silicon joint venture, the company is at the epicenter of the boom in photovoltaic power. It earned $367 million through the first nine months of 2009, down 39% versus the previous year but still strong.

Likewise, FMC, which makes specialty inorganic chemicals such as lithium compounds, saw sales and profits decline but managed to maintain its relatively high profit margins through the first three quarters of the year.

The most impressive performance among chemical companies last year was Lubrizol's. Looking at the firm's results, one would hardly know a recession was going on. Its earnings for the first three quarters increased 67%, to $385 million, on sales of $3.4 billion. Executives expect earnings to increase 78% for the full year and hit a company record. James L. Hambrick, Lubrizol's CEO, credits his employees. "It's not an exaggeration for me to tell you that every single person in our company did more with less this year," he told analysts in October.

THE COMPANY has had a particularly strong performance from the business that provides both its name and 70% of its revenues: lubricant additives for transportation and industrial applications. Lubrizol's personal care additives business also fared well during the year. Businesses that are more sensitive to the bad economy—such as thermoplastic polyurethanes and chlorinated polyvinyl chloride resins—faced more challenges.

The company cut costs during the year, notably R&D spending, which declined by 8%, to $153 million, through the first nine months. And it implemented a restructuring early in the year that reduced employment by 170 positions. However, that figure represents just 2.5% of Lubrizol's total employment, mild compared with the bloodletting at other large chemical firms.

Lubrizol even made an acquisition during the depths of the financial crisis, buying Dow's thermoplastic urethane business, which has about $85 million in annual sales. The company says it may use its cash to make more acquisitions costing between $100 million and $500 million.

Overall, stock analysts are positive about Lubrizol's performance, although they worry about the company's ability to sustain its profits. Debt analysts are more enthusiastic. Standard & Poor's put Lubrizol on "credit watch positive" last month. "Given the strengthened financial profile, recent debt reduction, and our expectations for prudent financial policies, we believe the company could sustain its financial profile," credit analyst Liley Mehta told clients. That's the kind of assessment we don't often hear nowadays.

Looking at Lubrizol's results, one would hardly know a recession was going on.

Views expressed on this page are those of the author and not necessarily those of ACS.

FORMALDEHYDE UNDER SCRUTINY

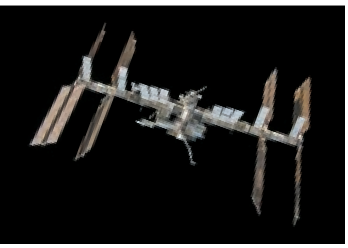
The National Toxicology Program is seeking public comment on whether to list formaldehyde as a "known human carcinogen" in its next Report on Carcinogens, due later this year. Currently, the report lists formaldehyde as "reasonably anticipated to be a human carcinogen." An expert panel recommended the change after a three-day meeting this past November. The panel identified occupational studies that show a link between exposure to formaldehyde and cancer in humans, particularly nose and throat cancer, as well as myeloid leukemia. Formaldehyde is used primarily in the production of industrial resins such as urea, phenol, polyacetal, and melamine. Such resins are found in adhesives and binders in wood products, pulp and paper, plastics, and synthetic fibers. Formaldehyde is ubiquitous in the environment, and a large number of U.S. residents are exposed to it. Although the Report on Carcinogens is not a regulatory document, EPA could develop regulations for substances that are listed in it. EPA is currently evaluating the regulation of formaldehyde emissions from pressed wood products.—BEE

REVEALING INERT PESTICIDE INGREDIENTS

EPA plans to require public disclosure of inert ingredients in pesticides, according to a Dec. 23, 2009, advanced notice of proposed rulemaking. The action comes in response to two petitions filed in 2006, one by the Northwest Coalition for Alternatives to Pesticides and another by a group of state attorneys general. The petitions questioned the safety of more than 350 inert pesticide ingredients and urged EPA to require manufacturers to list potentially hazardous inert ingredients on pesticide labels. Pesticide manufacturers currently disclose inert ingredients to EPA, but they have long fought public disclosure, claiming it would reveal confidential business information. EPA says it is developing the regulation to increase transparency and "assist consumers and users of pesticides in making informed decisions." The agency believes the rule will discourage manufacturers from using potentially hazardous inert ingredients in pesticides. EPA is seeking public comment until Feb. 22 on options for disclosure, including whether to require listing all inert pesticide ingredients or just those that are deemed potentially hazardous.—BEE

HELP URGED FOR SPACE STATION RESEARCH

NASA must do more outreach to attract researchers to the International Space Station, finds a recent report by the Government Accountability Office (GAO-10-9).



NASA

The report comes as ISS is moving from construction to being a full-time national research lab, which it was designated in 2005. The report notes that NASA expects to use up to half of the U.S. share of research resources on internal research, with the rest open to other ISS researchers. Currently, the station is set to be retired in 2015 with no new research funds to be provided after that. Under these circumstances, GAO recommends that in addition to bolstering NASA's outreach to ISS users, the agency should encourage further participation by providing more information about ISS—including research opportunities enabled by microgravity and available hardware—and about launch capabilities to the station after the space shuttles' retirement. If the Administration and Congress decide to extend ISS beyond 2015, the report recommends two additional items: that NASA set up a centralized research management office and that it develop in-house and external scientific and technical expertise to aid ISS users.—SRM

INDUSTRY BACKS FREIGHT RAIL BILL

A Senate committee's approval of legislation that would give shippers more leverage against railroads is being lauded by the chemical industry as an important step toward creating "a more competitive and viable freight rail system." The bill (S. 2889), approved by the Senate Commerce, Science & Transportation Committee, is designed to knock down regulatory barriers that prevent shippers from gaining access to competing railroads and to make it easier for shippers to challenge rates before the Surface Transportation Board (STB), the federal agency that regulates the railroad industry. "We are glad to see the bill enhances the role of STB and encourages it to proactively protect the rights of both the shippers and railroads," says Calvin M. Dooley, president of the American Chemistry Council, a trade group representing more than 130 chemical companies. The Association of American Railroads, a trade group representing freight rail carriers, says it has concerns about provisions in the bill that would require large railroads, such as CSX and Union Pacific, "to open their privately owned and maintained rail networks" and face "vastly expanded government involvement" in their operations.—GH

BP HIT WITH $100 MILLION VERDICT

A federal jury awarded 10 contract workers more than $100 million in damages due to inhalation injuries that they claim they received while working at the BP Texas City, Texas, refinery during March and April of 2007. The lion's share of the award was for punitive damages that amounted to $10 million for each plaintiff, according to the verdict, which was reached in U.S. District Court for the Southern District of Texas. The inhalation injuries resulted from exposure to carbon disulfide. Although the decision is unrelated to a 2005 explosion and fire at the plant that killed 15 workers, the plaintiffs' claims cited a history of negligence at the BP refinery and the company's failure to provide a safe workplace because of poor maintenance. The three-week trial is the first of several, according to attorney Tony Buzbee, who is representing some 110 workers with pending claims against the company. BP said it intends to appeal the verdict.—JJ

WES AGRESTA/ARGONNE NATIONAL LABORATORY

IT'S A GAS Chemist Sabeen F. Ahmad is on a joint Argonne National Laboratory-Nalco research team working on a $2.2 million ARPA-E-funded project to efficiently and economically capture carbon in flue gases from coal-fired power plants.

CLEAN-ENERGY PUSH TAKES OFF

Critics praise ADVANCED RESEARCH PROGRAM for its laudable goals but worry over its implementation

JEFF JOHNSON, C&EN WASHINGTON

"NIMBLE, LEAN, FLAT"—that is Arun Majumdar's vision for the Department of Energy's new Advanced Research Projects Agency-Energy (ARPA-E) that he has led for barely two months.

In a sprintlike 20-minute interview with C&EN, Majumdar bounds from subject to subject, outlining the future for his tiny agency with the huge charge of finding, funding, and guiding development of high-risk transformational technologies that can drive a clean-energy revolution.

Energy Secretary Steven Chu is watching Majumdar and the agency closely. From his first days in office, Chu has stressed his desire to light a fire under DOE-funded research, bypass the agency's stovepipes of program-based research, and bring raw, out-of-the-box energy ideas to the doorstep of commercialization. For a model of transformative research, Chu points to his industry-funded research at Bell Laboratories and elsewhere that led to his Nobel Prize. He envisions ARPA-E as an incubator for the energy-based Industrial Revolution he seeks (*C&EN Online,* March 2, 2009).

Such transformations carry high risk. And creating a fluid environment to encourage freedom to explore ideas while still following government grant policies is rife with contradictions. However, the potential pitfalls have not dampened the excitement for and interest in the new agency by energy-related scientists at DOE and elsewhere: In the first round of ARPA-E grants held last year, some 3,700 applicants chased $151 million in funds, but only 1% were successful (C&EN, Nov. 2, 2009, page 9).

The concept of ARPA-E grew from recommendations in a 2006 National Academies report in part authored by Chu, who at that time headed Lawrence Berkeley National Laboratory (LBNL). Congress made the concept into law in 2007, modeling ARPA-E on the $3.1-billion-per-year Defense Department's Defense Advanced Research Projects Agency (DARPA), a solution-based research management organization that develops raw technologies for military applications. However, Congress didn't fund the agency; instead President Barack Obama did so through an infusion of stimulus funds from the American Recovery & Reinvestment Act of 2009.

Ironically, it was left to Chu to put flesh on ARPA-E's bones. On Sept. 18, 2009, Obama announced the selection of Majumdar—who, like Chu, is another LBNL scientist—to run ARPA-E. Majumdar reports directly to Chu.

The close relationship between Chu, Majumdar, and LBNL is one of many concerns voiced by scientists who see all sorts of possible bias and favoritism in how research topic areas are chosen and how projects are assessed and selected under the new agency. Some also worry that the requirement that grant winners match 20–50% of ARPA-E funds puts companies in the driver's seat because universities and government labs cannot scrape up the money.

Such fears should be expected, these critics note, because of the total power the small agency has over fund allocation. But the critics also note the great potential of the agency to do good and to change the energy world, as well as to reward some garage tinkerer or themselves with a multimillion-dollar grant.

ARPA-E'S FORERUNNER, DARPA, grew out of a DOD research program founded shortly after and in response to the Soviet Union's launch of *Sputnik* in 1957. It now has some 240 staff; about half are program managers and other scientists who work for three to five years at DARPA and then return to academia, business, or from wherever they came, DARPA spokeswoman Johanna Jones says. These program officers are key to keeping the program successful.

DARPA "is a very fluid, very flexible organization," Jones says. "Our last director was here for eight years, and that was a record." She adds that "our primary goal is to save the lives of men and women in uniform. We meet with the guys in the Pentagon. They tell us what keeps them awake at night, and then we ask how we can solve that problem, and our people run and do it. We only have a set amount of time."

DARPA works on "hundreds of projects" at once, Jones says, and the project managers closely monitor them every year or 18 months and decide whether funding should be extended or ended, she says.

Mirroring DARPA, Majumdar explains, "ARPA-E's program managers rotate and serve a maximum of four years. That way, we get the best and the brightest, the all-stars," he says. "That is true for me, too. I will be here for a few years, and then I go. It is a constant shuffle. We are always looking for new ideas, fresh approaches. We have to be nimble, agile, and adaptive to what the conditions are. We are not going to have someone here for 20 years. We need new people: Youth is our future."

The agency now has but three program managers: David Danielson, who holds a Massachusetts Institute of Technology materials science doctorate and was, until joining ARPA-E this summer, employed by a Cambridge, Mass., venture capital firm; Mark Hartney, a chemical engineer with degrees from the University of California, Berkeley, and MIT and a 25-year veteran in technology development, including a stint at DARPA; and Eric J. Toone, a professor of chemistry and biochemistry at Duke University who specializes in physical organic and bioorganic chemistry and studied at the University of Toronto and Harvard University.

DUPONT

SEAWEED DuPont researchers are part of a team that will receive $9 million in funding through an ARPA-E grant to aid development of a technology that uses seaweed as a feedstock for biobased butanol.

"Right now, we have a small staff, seven or eight, but we are interviewing a lot of people on the program side. We want growth, but I want to take our time getting there and get the best people," Majumdar tells C&EN.

According to the law that created ARPA-E, the agency is to have 70–120 program managers, but Majumdar says those numbers will come with a much larger budget. Over the next six months, he hopes to recruit around 12–15 program managers.

"These are deeply technical people who are going to be engaged with each project we fund," Majumdar says of the program officers. Their goal, he notes, "is not to micromanage" projects, but to help investigators overcome technical obstacles by, for example, recommending researchers who may be able to assist on a sticking point or to point out a relevant research paper.

Program officers may be critical in keeping projects moving forward. "All these projects have milestones and they have to be met in a certain time. If you don't meet certain goals, your money is going to be pulled," Majumdar says.

ARPA-E IS NOW buzzing with activity, in stark contrast to its early days. ARPA-E was but a concept and had not received funding until April 2009, when Obama flooded it with $400 million in stimulus money.

With personnel borrowed from other DOE programs, ARPA-E opened for business, and on April 27, 2009, it issued its first call for concept papers—with a short June 2 deadline. The little agency's popularity with the scientific community was overwhelming. It received some 3,700 concept papers, offered by scientists from universities, companies, government labs, and other institutions.

Quickly, the agency began hiring its first program managers and searching for reviewers for the papers. Operations stalled, however, and complaints and rumors began surfacing in the scientific community over the status of projects and difficulties in finding knowledgeable reviewers who didn't also want a grant or who wouldn't profit intellectually or financially from having a chance to see a competitor's ideas.

Eventually, some 500 reviewers were selected, and they and ARPA-E staff began culling the submissions. They examined 334 full proposals and selected 37 winners. Most of this happened without Majumdar at the helm; he wasn't confirmed by the Senate until just a week before the winners were announced on Oct. 26, 2009.

The average grant from the $151 million allocation for this round was $4 million per project; grants ranged from $500,000 for a Lehigh University project to capture carbon dioxide through an electric field swing adsorption technology to $9.15 million for Foro Energy's plan to use a thermal-mechanical technology to drill through basement rocks in a search for geothermal energy.

The agency is now negotiating final agreements and milestones for projects selected in this first round, which it expects to complete this month. But the race is on: Under the terms of the stimulus package, all $400 million is to be deployed by Oct. 1. Also, ARPA-E issued another call for proposals last month, this one for $100 million in three specific areas: biology-based and non-biomass or petroleum, liquid transportation fuels; advanced carbon-capture technologies; and transportation storage batteries.

When asked what the new agency's metrics of success are so far, Majumdar says with a laugh that processing 3,700 applications is clearly one.

"The first round was wide open. We wanted the best ideas no matter the topic," Majumdar says. "It was good because you get to know what people are thinking, but you have huge logistical issues internally. This second round is much more specific and is more typical as we are getting into a much more steady-state operation." But, he adds: "once in a while, though, we might do a more open request. You never know what is out there, and if you are too focused, you might miss what some kid in a garage may be thinking."

HOWEVER, SOME have expressed concerns about how ARPA-E works.

When the first list of 37 winners came out, several scientists told C&EN they were disappointed by the number of large companies—such as DuPont, Archer Daniels Midland, ConocoPhillips, Albemarle, and Babcock & Wilcox—that led or were part of successful consortia.

"I thought this was supposed to be for small start-ups," says one scientist who doesn't want to be named because he may apply for an ARPA-E grant in the future. "These companies don't need the money."

More than 60% of the projects are led by companies, Majumdar acknowledges. But he counters that 43% of the grants went to small businesses, and only 19% went to large companies. "We are not going to limit ourselves," he stresses. "If you have good ideas, we will fund you."

Criticism also was directed at the selection process itself. Between October and December 2009, ARPA-E held five workshops to help guide project calls. Their size was limited to around 80 attendees, and researchers were turned away. Members of the press were not allowed to attend or observe the discussions. To some, the workshops—which helped set selection guidelines—lacked transparency.

"You obviously can't have 300 people taking part in a conversation," acknowledges one researcher and potential ARPA-E grantee, who asked not to be named. "But lots of people were turned away. Although we know ARPA-E is a work in progress, you get the impression it is led by the program directors, Chu, and Majumdar without a lot of other input."

SECRECY RAISES other concerns. In its announcement of first-round selections, DOE provided little information for some of the projects. For Foro Energy, the company winning the largest award, it provided almost nothing—just a sketch of Foro's research goals and its Littleton, Colo., location. The company has no phone listing at Littleton, and its website (foroenergy.com) says: "Foro Energy is a drilling technology company backed by North Bridge Venture Partners and CMEA Capital. Please direct inquiries to Joel Moxley."

In an e-mail response, Moxley said: "I can confirm that we are proud to be a Colorado-based company and were honored to be selected for award negotiations for a DOE ARPA-E grant. Other than that, we are stealth/quiet mode and not talking about what we are doing."

When quizzed, DOE would only say, "Regarding your request to be put in touch with Foro Energy: Our contact at Foro has asked us to politely decline any media requests at this time and has asked that we do not give out their contact information."

Some scientists, concerned about bias and the LBNL connection, say they fear that ARPA-E will become an insiders' club, biased toward technologies and scientists known by the ARPA-E staff and advisers. They point to a recent ARPA-E call for liquid transportation fuels projects, arguing that the call reflects a bias for projects with a synthetic biology approach, similar to work done at the California lab.

Criticisms aside, the first-round grant winners appear eager to start.

"We want to use ARPA-E to get to the prototype stage and then to manufacturing," says grantee Tom Kennedy, chief innovation officer of FloDesign Wind Turbine, an offshoot of FloDesign, a 20-person Wilbraham, Mass., aerospace technology engineering firm. The firm won a grant to pursue new wind-energy design.

Through its aerospace experience and venture capital support, the company developed the concept of a small, highly efficient wind turbine, Kennedy explains. Their wind turbine would be easier to move and install and much quieter and more adaptable than current huge wind turbines with 100-meter blade configurations, Kennedy says.

The company, he says, will use its $8.3 million, 30-month grant to overcome two "valleys of death" for funding: the first comes when a project transitions from basic research to prototype construction and testing, and the second is when it transitions from prototype to a manufacturable product.

In another typical ARPA-E project, Nalco, a water treatment manufacturer and process engineering firm, and Argonne National Laboratory received a $2.3 million grant for a 24-month project to capture CO_2 emissions from coal-fired power plants. The project uses carbonic anhydrase to capture CO_2 from a flue gas stream at almost 100% purity, the company says. If successful, the electrochemical process could significantly reduce the 30%-plus energy loss associated with existing capture technologies.

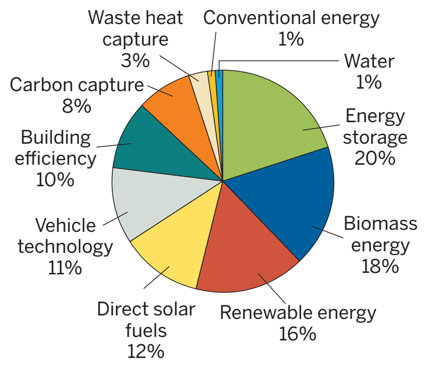
The project is based on a relationship forged over the years between Nalco and Argonne, says Seth W. Snyder, a section leader in Argonne's Energy Systems Division.

"It is really a 50-50 effort," Snyder continues. "We have the research expertise, and the company knows equipment and scale-up. We cannot see a way for us to do it without them, and they can't do it without us."

Nalco is putting up a 20% match to the DOE funds by buying equipment and hiring more personnel for itself and Argonne, says Cathy C. Doucette, Nalco's global technology leader. Their joint goal, she says, is to move the technology from small bench-scale to a "robust bench level" sufficient to demonstrate the economics and ability to build a prototype.

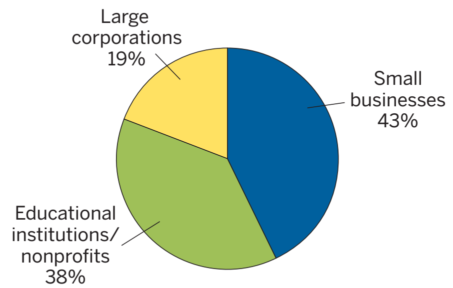
ROUND ONE

$151 million in ARPA-E grants go to 10 research areas ...



Total funding = $151 million

... and more than 60% of projects are led by businesses



Grants awarded for 37 projects

SOURCE: Department of Energy

With 11,000 employees worldwide, Nalco is based in Illinois, just 10 miles from Argonne. Their proximity and familiarity with one another played a big role in laying the project's groundwork, Snyder and Doucette note.

Scientists underscore the importance of partners' history and location. Without such a relationship, they note, matching funding can be hard for university and government labs to obtain, even if they are developing breakthrough technologies. As a result, many worry that ARPA-E projects may be dominated by industries, particularly large companies with deep pockets.

Looking to the future, Majumdar says he wants to see slow growth in funding as ARPA-E shifts from stimulus funds to congressional appropriations.

The verdict is still out on congressional support, but the scientists who spoke to C&EN—including those who voiced criticisms—want Majumdar and ARPA-E to succeed. Success may depend on what happens between now and Oct. 1, when the $400 million stimulus money runs out.■

"We are not going to limit ourselves. If you have good ideas, we will fund you."

SHUTTERSTOCK

WORKING ALONE Problems with collaborative research between industry and academe threaten product innovation.

VALUING R&D

Poor economic models and barriers to research collaboration are **STIFLING U.S. INNOVATION**

DAVID J. HANSON, C&EN WASHINGTON

MUCH IS SAID ABOUT the importance of research, development, and innovation to the U.S. economy. The National Academy of Sciences composes weighty reports on the subject, Congress debates how many tax dollars to devote to science and technology, and corporations tout the value of their research portfolios.

Unfortunately, there is not an obvious or accurate way to put a value on research. At a recent conference sponsored by the Council for Chemical Research (CCR) and the National Science Foundation, economists, federal policymakers, and industry officials examined how R&D is valued. They concluded that current methods are inadequate and that a number of systemic problems hinder research progress, but conference speakers were not able to offer many ideas for solutions.

"We have a disconnect between the values of long-term and short-term research, applied versus basic research, and what industry and universities are expected to do," said Hratch G. Semerjian, president of CCR, after the conference. "We keep saying that we need more R&D investment in this country, but we don't know what the right size of that investment should be."

The conference was a companion to an earlier meeting that discussed intellectual property issues in chemical industry research. It builds on a report done several years ago by CCR on measuring R&D value.

Arden L. Bement Jr., director of NSF, opened the meeting by saying government is making a commitment to developing the science of science policy and that this conference would provide input into shaping that policy (C&EN, May 4, 2009, page 40). "We need evidence-based metrics to describe the impact of the research and development investment," Bement said. "And these metrics can provide something even more important for our future: insights."

The conference covered a number of areas. Three that recurred were the undervaluation of corporate R&D, the increasing problems with R&D collaborations between industry and academia, and the need for better federal innovation planning.

Academic economists have a hard time assigning value to industrial R&D. Bronwyn H. Hall, an economics professor at the University of California, Berkeley, told conference attendees that her attempts to quantify the return on investment for research by the chemical industry showed that the models used for calculating productivity from R&D don't work very well. She said that a variety of factors, including depreciation rates, heterogeneity of the firms doing R&D, the attempt to consider social returns on investment, and the many different types of R&D being performed, contribute to these challenges.

Hall made the point that R&D investment is essentially an investment in people and knowledge and that neither quantifies well. It's not clear how one depreciates knowledge or puts a value on replacing researchers, she pointed out.

More public information could improve the situation. "Studies have found that with better disclosure of research information, you get better capital markets," according to Baruch Lev, a professor of accounting and finance at the New York University Stern School of Business. Lev has studied chemical industry finances and found that smart disclosure of research information can improve a company's capital returns by giving financial analysts, who often undervalue research investments because they lack information, more material to work with. "Disclosure of corporate R&D and innovation activities by high-technology firms positively affects their stock prices," Lev concluded.

As Hall and Lev detailed and other speakers agreed, not having good models for calculating R&D performance and not having enough company information about innovation activity lead to chemical companies' stocks being undervalued. Several studies were also presented that showed this is the case.

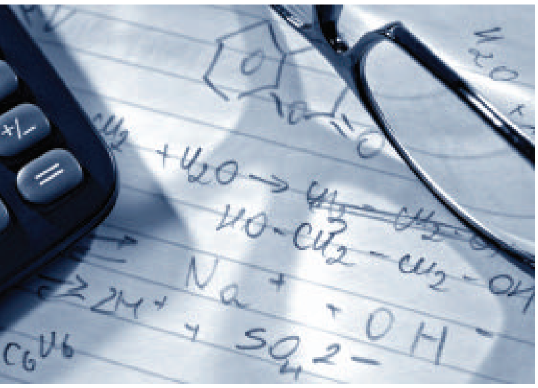
Lev also broached the topic of using accounting practices to require increasing corporate disclosure. Calling current U.S. accounting practices outdated, Lev noted that international accounting standards take a different approach. They consider

"We keep saying that we need more R&D investment in this country, but we don't know what the right size of that investment should be."

R&D as an asset and not as an expense. Making this kind of accounting change would allow investors to see research as providing future benefits and might also improve corporate stock values, Lev said.

One place in which at least some information about company research can be found is in the scientific literature. Publication of research results by industrial scientists, however, is not common. Fionna E. Murray, who teaches entrepreneurship and innovation at the Massachusetts Institute of Technology Sloan School of Management, pointed out wide disparities between the number of chemical research articles published by academic chemists and that by chemists employed by industry. For example, in 2005, out of 19,521 U.S. chemistry research papers published, only 2,743 had at least one industry author, Murray said.

Murray thinks one result of the chemical industry's tendency to not publish is that industry research is becoming decoupled from chemical research being done at universities. The result is that university chemistry departments are becoming less likely to collaborate with industry. Murray said one reason for this trend may be that industry finds that academics don't stay focused solely on the industry problems, and thus the university research becomes less relevant to industry over time. Additional reasons, she said, may be that federal grant rules do not mix well with industrial research and that academic training does not effectively translate to working in industry.



DREAMSTIME

NUMBER CRUNCHING Calculating a corporate value for industrial R&D has proven to be difficult for economists.

The problem, however, is not one-sided. Industry representatives at the conference noted that universities have also changed, making collaborations less attractive. Many top-tier research universities aggressively pursue patents for the discoveries they make and do not want to share profits with companies, they said. Many academic chemists do not want to forego publication of their research, as some industry collaborations require. This adds tension to the industry-university relationship, conference participants claimed. For these reasons, many U.S. companies, it seems, have chosen to collaborate with researchers in other countries, where the concerns of patents and publications are not as prevalent.

CONCERN ABOUT the health of industrial R&D was on the minds of other speakers. Robert J. Cava, chairman of the department of chemistry at Princeton University, noted that government, universities, and industry all must work cooperatively for successful innovation. "I'm worried that the industrial leg is not healthy," Cava said, contending that the people looking for the big-picture, long-term solutions to problems are not working in industry.

Although most of the struggle to understand how to value research and innovation focused on industry and academe, the federal government has an important role as well, namely in supporting the national laboratories and in establishing standards and policies.

National labs and other federal science facilities provide stability and continuity for research that companies cannot, according to Cava. They provide equipment and an infrastructure for science that is too expensive for companies and universities. And publicly available data from these labs can be used for corporate innovation.

Establishing such an infrastructure that supports research is an important government function. John T. Scott, economics professor at Dartmouth College, argued that public spending on what he terms "infrastructure technology" has a large societal benefit. The scope of this public infrastructure technology includes everything from science education and pollution prevention to the development of chemical standards at the National Institute of Standards & Technology.

"Private R&D spending increases with public spending on infrastructure technology," Scott said. This is because these fundamental technologies remove barriers to innovation and give privately funded research higher value. "If you have public policies that increase the value of commercialization of research, the result will be shifting the value of that research higher."

Unfortunately, U.S. policies on research and innovation fall short of that ideal. NIST Senior Economist Gregory C. Tassey told conference attendees that the current policy ignores the innovation process that comes between building the fundamental science base and the commercialization of products, leaving it up to industry to pay for innovation on its own. Tassey thinks the federal role in funding research needs to be restructured because it is not providing the most public good for the huge amount of investment that is being made. "We need to look for specific barriers to innovation and match those with our policy responses," he said.

John H. Marburger III, past science adviser to the President and currently interim vice president for research at the State University of New York, Stony Brook, said at the conference that no one really does strategic planning for research within the government. "Science funding is distributed to dozens of agencies, and any planning is fragmented within the agencies. The result is a 'stovepipe' collection of activities that becomes the President's budget and is presented to Congress, where it is messed with again," he said.

The system that takes basic research and moves it to product innovation is complex, and Marburger does not think the U.S. government takes that complexity into account. "We really need to change this system," he saidw. "We have a very awkward form of government to work through."

Julia I. Lane, who manages the Science of Science & Innovation Policy program at NSF, said one of the conclusions to be drawn from this conference is that more collaboration is needed among all the parties in chemical science for research investments to be optimized. "Although fundamental research is intrinsically risky and long-term, it seems essential to finds ways to accelerate the discovery-to-innovation process for research that is destined to have economic impact," she said. "It is clear, however, that the information needed to accomplish this is not as good as it should be."

Lane, an economist, said the workshop addressed the challenging social science question of how to go about assessing what an optimal investment in chemical research might be. "It is important to get social scientists together with physical scientists so they can get a better understanding of research and innovation. I see activities like this as critical to creating a sound empirical foundation for U.S. science policy," she said. ■

PRIZES FOR INNOVATION

Policymakers look to **FEDERALLY FUNDED** inducement prizes to help solve societal challenges

PRIZES DESIGNED to attain a scientific or technical goal are the policy du jour for promoting innovation and encouraging high-risk research—two areas that the Obama Administration sees as key to maintaining U.S. leadership in technological advancement. The rise in popularity of using prizes to drive innovation was evident last month at a seminar hosted by the nonprofit economic think tank Resources for the Future (RFF).

At the White House Office of Science & Technology Policy, "we see inducement prizes as an important tool for innovation. Not necessarily the only tool, but an underutilized one," Hillary Chen, policy analyst at OSTP, noted during the seminar. Prizes are one way to help focus innovation in areas that are deemed high priority for the government, Chen said.

OSTP is considering the use of prizes to accelerate the development of new technologies, such as those for reducing energy demand. But it is also looking at prizes "outside the technological innovation space," Chen stressed. For example, OSTP is exploring the use of prizes to reduce childhood obesity and improve graduation rates, she said.

In the current economic environment, prizes are particularly appealing because "you only pay for results," Chen noted. "If someone crosses the finish line and comes up with what you want, then you pay. But if they don't, then you are not in a position of paying for it."

Ned T. Stetson, technology development manager of hydrogen storage at the Department of Energy, agreed. He emphasized that DOE has a limited budget to fund research. "By running a prize, we are able to attract a much larger pool of researchers," Stetson said. In addition, prizes build new relationships, encourage teamwork, and improve the workplace, he added.

DOE already has such a prize in place. Under the Energy Independence & Security Act of 2007, Congress authorized DOE to award cash prizes for advances in hydrogen fuel development. This past summer, DOE launched the so-called H-prize competition, offering a $1 million award for the development of hydrogen storage materials for light-duty vehicles.

Interest in prizes for stimulating innovation increased after the success of the $10 million Ansari X Prize, awarded to aerospace designer Elbert (Burt) Rutan and financier Paul G. Allen in 2004 by the nonprofit X Prize Foundation, noted Timothy J. Brennan, a senior fellow at RFF. In that competition, teams were challenged to build and launch a three-person spacecraft 100 km above Earth's surface twice within two weeks.

NATIONAL HUMAN GENOME RESEARCH INSTITUTE

SPEED IT UP The $10 million Archon X Prize for Genomics could lead to faster DNA sequencing and a more personalized approach to medicine.

In 2006, the X Prize Foundation launched the $10 million Archon X Prize for Genomics. That prize will be awarded to the first team that can sequence 100 human genomes in 10 days.

The X Prize competitions and others like them prompted Congress to get involved. Several bills passed over the past few years authorize various federal agencies to sponsor such prizes, including the bill that created DOE's H-prize.

Another bill, the National Aeronautics & Space Administration Authorization Act of 2005, paved the way for NASA's Centennial Challenges, also known as prizes for the "citizen inventor." As a result of the challenges, NASA has awarded $350,000 in prize money for improved gloves for astronaut suits, as well as cash prizes for other advances.

In 2007, the Defense Advanced Research Projects Agency launched its Urban Challenge, offering a $2 million grand prize for the best autonomous vehicle capable of driving in traffic and performing complex maneuvers without a human driver or remote control. The Urban Challenge was prompted by a congressional order that requires one-third of ground vehicles in the military to be autonomous by 2015, said Michele Gittleman, project manager of Carnegie Mellon University's Tartan Racing team, which won the competition.

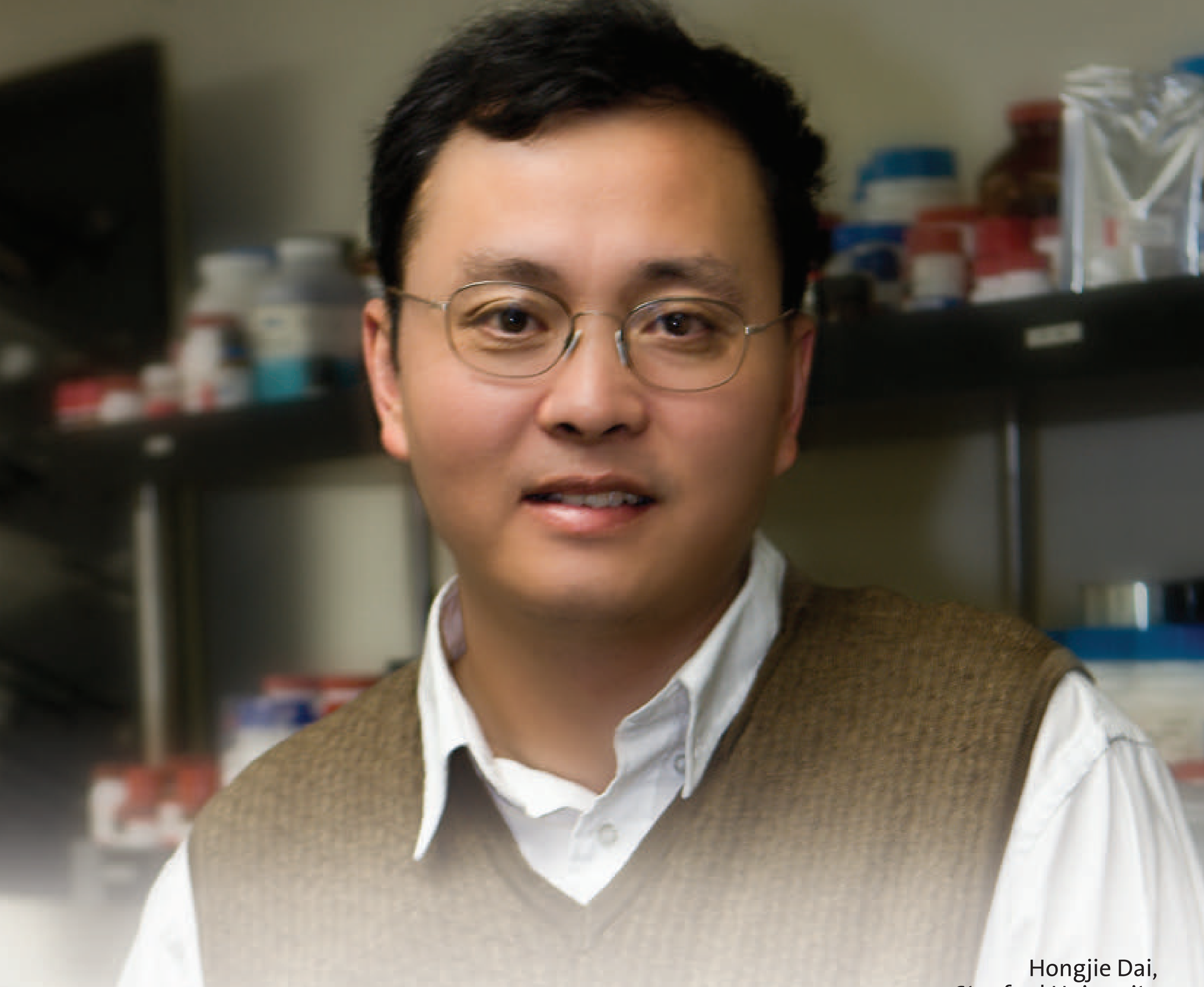
A handful of bills introduced last year in Congress further encourage federal agencies to sponsor prizes that spur innovation. For instance, policymakers proposed prizes for self-powered farms, nanotechnology, cybersecurity, and automotive energy efficiency.

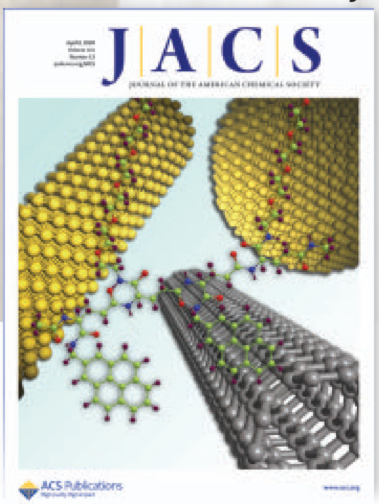
It is unclear, however, whether federal agencies need authorization from Congress to sponsor a prize. "There is ambiguity over what federal agencies can and can't do under current law," Chen noted. "OSTP hopes to clarify what is permissible."

OSTP is also wrestling with how to broaden the spectrum of issues that prizes address so that they benefit society as a whole. The problem is a logistical one, Chen said, adding that each federal agency requests proposals differently.

SOME PEOPLE question whether prizes are needed because there are many other tools for encouraging innovation, including patents, research grants, and investment tax credits. Participants at the seminar agreed that prizes should not replace more traditional sources of funding, but they stressed that there is a place for the awards.

One of the hidden benefits of prizes is that they stimulate the public's interest in science and technology, Gittleman said. "Competitions take something that is behind the lab doors or based in a top secret location and make it public," she noted. "When you can influence and inspire the public about a cause, you gain a lot that goes beyond the actual problem that you are trying to solve."—BRITT ERICKSON

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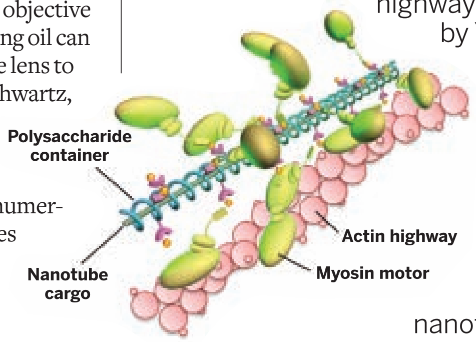
COLLOIDAL LENSES TURN UP THE HEAT

Some biological systems are too hot for single-molecule-imaging studies: At temperatures higher than 50 °C, heat conduction from the sample to the immersion objective through a refractive-index-matching oil can cause the high-numerical-aperture lens to fail. Stephen R. Quake, Jerrod J. Schwartz, and Stavros Stavrakis of Stanford University now show that spherical colloidal particles can be used in combination with low-numerical-aperture air objectives as lenses for high-temperature single-molecule imaging (*Nat. Nanotechnol.*, DOI: 10.1038/nnano.2009.452). Quake and colleagues attached 2-µm TiO_2 colloids to a glass surface via fluorescently labeled molecules. The colloids act as lenses for the molecules they are attached to. This setup allows the researchers to heat samples without also heating the lens. They used the method to study individual thermophilic DNA polymerase enzymes operating at temperatures as high as 70 °C. Such colloidal lenses could make it possible to use high-temperature polymerase enzymes in single-molecule DNA sequencing-by-synthesis technologies, the researchers suggest.—CHA

BIOCONTAINER TRANSPORT

When molecular cargo needs to be shipped to precise locations around a cell, biology often uses molecular motors that walk along molecular tracks with their load in tow. Scientists have been aiming to hijack these cellular highways to deliver drugs and other goods. A team led by Youichi Tsuchiya of Japan's RIKEN and Seiji Shinkai of the Institute of Systems, Information Technologies & Nanotechnologies, in Fukuoka, Japan, has now designed a molecular container that can encapsulate long, tubular cargo (*Angew. Chem. Int. Ed.*, DOI: 10.1002/anie.200904909). The researchers employed a triple-stranded helical sugar called schizophyllan as the container and showed that the polysaccharide can hold a carbon nanotube. Schizophyllan is a convenient container material because it falls apart in dimethyl sulfoxide solvent and reforms in water with the load encapsulated. The team observed that the nanotube-laden container is transported by the motor protein myosin at a speed of 95 nm per second along actin protein highways in cells. Because actin filaments connect to a cell's nucleus, the researchers believe the myosin motors and sugar containers could be commandeered to deliver gene therapies directly to their target.—SE



ANGEW. CHEM. INT. ED.

BETTER VIEW OF SOLID-STATE REACTIONS

Light-driven solid-state organic reactions, while potentially useful for environmentally clean industrial processes, are difficult to probe spectroscopically in fine powders or in single crystals because of high optical densities and light scattering. An international team that includes Malcolm D. E. Forbes of the University of North Carolina, Chapel Hill; Miguel A. Garcia-Garibay of the University of California, Los Angeles; and Valery F. Tarasov of the Semenov Institute of Chemical Physics, in Moscow, has turned to nanocrystals suspended in water as a system that maintains the properties of bulk solids but enables examination by solution techniques (*J. Am. Chem. Soc.*, DOI: 10.1021/ja909521u). The researchers studied the UV-induced conversion of dicumyl ketone to dicumene as a model system for synthesizing molecules with adjacent quaternary carbons. Laser flash photolysis of the ketone produced a nanocrystalline radical-pair triplet state, which the group observed transforming into dicumene by using time-resolved electron paramagnetic resonance spectroscopy. The work sets the stage for new depth of understanding and manipulation of organic solid-state reactions, the researchers say.—EKW

TWO-FACED CATALYST

Tandem reactions taking place at the interface between organic and aqueous layers in a biphasic solvent system can now be catalyzed by different parts of the same nanoparticle, thanks to a new design by Daniel E. Resasco and coworkers of the University of Oklahoma (*Science* **2010**, *327*, 68). The team started by creating MgO-based nanoparticles, which can serve as a basic catalyst. The researchers then grew carbon nanotubes on the MgO surface and adsorbed palladium onto the nanotubes. The MgO surface prefers to be in water, but the nanotubes prefer an organic solvent, thus the nanoparticles end up residing in and stabilizing the emulsion layer of a water/emulsion/decalin solvent system. Resasco and coworkers used the recyclable nanoparticles to develop a tandem reaction that is useful in biofuel production, where the reaction mixture typically has a complex composition. In the first step, MgO catalyzes coupling of 5-methylfurfural and acetone in the aqueous phase. The product slips into the organic phase where a subsequent Pd-catalyzed hydrogenation takes place.—SR

FLU-FIGHTING PROTEINS

If you manage to escape swine flu, thank your interferon-inducible transmembrane (IFITM) proteins. Harvard Medical School's Stephen J. Elledge and Abraham L. Brass and colleagues have discovered that these proteins, which were previously associated with functions including immune cell signaling and bone mineralization, also serve as the body's first line of defense against the H1N1 virus (*Cell* **2009,** *139*, 1243). In experiments with cultured human and mouse cells, IFITM proteins prevented or slowed most virus particles from infecting cells. The proteins are activated by interferon, a protein alarm signal that cells emit when they're invaded by a virus. But the interferon response makes people feel ill when their bodies are fighting the flu. "If we can figure out ways to increase levels of these proteins without interferon," Elledge says, "we can potentially increase natural resistance to some viruses without all the side effects of the interferons." The researchers found that IFITM proteins also protect cells from West Nile virus and dengue virus.—SLR

NEWSCOM

COUNTERFEIT CATCH Counterfeit drugs and creams seized in Belgium.

FAKE PHARMACEUTICALS

Those fighting against counterfeit medicines face **INCREASINGLY SOPHISTICATED** adversaries

SARAH EVERTS, C&EN BERLIN

OF THE CHEMICALS he uncovered in various counterfeit malaria pills, Facundo M. Fernandez did not expect to find sildenafil, the active ingredient in the drug Viagra. He also didn't expect to find the antibiotic erythromycin; one of the building blocks for making the street drug ecstasy; or metamizole, a powerful analgesic that is banned in the U.S. because it is suspected of causing serious bone marrow disorders. Yet the Georgia Institute of Technology chemist, who provides scientific support to international anticounterfeiting operations, has recently found all these chemicals and more in counterfeit malaria pills. "It's shocking," he says. "Sick children take these drugs. It's terrible that they don't receive the correct treatment. But worse, the chemicals in these counterfeits could make them sicker."

READ MORE ABOUT FAKE DRUGS AT **CENBLOG.ORG**

Putting false active ingredients in fake drugs is just one trend in medicine counterfeiting. Bogus pills used to consist primarily of blanks because counterfeiters focused mostly on making the pills look like the originals. But these days, counterfeiters are increasingly adding all sorts of active ingredients to phony tablets. They slip mild pain relievers such as acetaminophen into pills just to make patients feel like they might be getting better, as was the case in fake Tamiflu seized from U.K. pharmacies in 2007. Sometimes, they add small amounts of the correct active ingredient to dupe testers who may not have equipment to accurately quantitate ingredient levels. More worrisome, some counterfeiters substitute life-threatening chemicals for the real McCoy, such as the antifreeze component diethylene glycol to replace glycerine. The toxic substitute ended up in cough medicines that killed hundreds in Nigeria, Panama, and Bangladesh in recent years.

While international police, pharmaceutical companies, customs officials, scientists, and health and regulatory agencies collaborate more closely to track down fake medicines and those who profit from them, counterfeiters are developing more sophisticated knockoffs and putting them in packaging that possesses anticounterfeiting security features, such as holograms. Science and technology are playing an important role in the anticounterfeiting fight—from the analytical techniques used to quantify fakes to the tracking strategies used to catch perpetrators—but the battle against fake drugs is, by all accounts, far from being won.

Fake pharmaceuticals are incredibly lucrative. In 2010, an estimated $75 billion will find its way into the pockets of those making or distributing counterfeit medicines, an oft-quoted statistic from the Center for Medicines in the Public Interest that many say is probably an underestimation. "Counterfeiters can make more money than hard-drug traffickers, and they have less of a chance to go to prison," says Aline Plançon, an Interpol policewoman who leads an anticounterfeiting task force associated with the World Health Organization (WHO) initiative called IMPACT (International Medical Products Anti-Counterfeiting Taskforce). For example, the profit margin from counterfeit Viagra is some 10 times higher than for the street drug heroin, notes David Shore, associate director of global security for Europe at Pfizer, the company that produces Viagra. The attractive revenues don't come with heavy enough consequences, Plançon adds.

IN GENERAL, hard-drug traffickers are charged under specific hard-drug laws, whereas pharmaceutical counterfeiters typically face a variety of trademark, fraud, or money-laundering legislation, says Thomas T. Kubic, a former Federal Bureau of Investigation agent who now heads the Washington, D.C.-based Pharmaceutical Security Institute, which tracks medicine counterfeiting. "Instead of punching out ecstasy tablets, counterfeiters can reload pill-producing machinery and make Lipitor," Kubic says. Indeed, those working on the ground are finding an increasing crossover between hard-drug and pharmaceutical trafficking. For example, at a recent seizure in Istanbul, investigators nabbed 700,000 fake Viagra pills alongside 51 kg of heroin, Shore says.

High profits with comparatively low risks may be a major motivation, but many other factors also enable counterfeiting. Globalization of manufacturing has created more steps between drug production and patient consumption. Counterfeiters have capitalized on "fragmented" supply chains to penetrate markets "with counterfeits that look identical to the original," says James Thomson, chair of the European Alliance for Fake Medicines. The rise of Internet pharmacies has also permitted anonymous individuals to sell medicines directly to consumers; WHO estimates that half of all drugs sold on the Internet are fakes.

A precise count of just how many fakes currently sit in the world's medicine cabinets does not exist. The best "guesstimate" is that 1% of drugs in the developed world, including the U.S. and Europe, are counterfeit, says Paul Newton, a doctor at the University of Oxford's Center for Tropical Medicine, in Laos. In developing nations, between 10 and 50% of drugs are thought to be fake. "But we really have no idea of the full extent of the problem."

Instead, isolated snapshot statistics provide a sobering, if incomplete, picture. In 2008, the European Union launched a two-month operation called Medi-fake, which tracked and seized more than 34 million illegal pills. That same year, the pharmaceutical company GlaxoSmithKline reported 289 counterfeit cases of its drugs globally, with the fakes valued at about $11 million. These figures may seem high, but they are actually the company's lowest in five years.

OTHER COMPANIES are in the same boat. Pfizer's Shore notes that in the first nine months of 2009, 8.5 million fake Pfizer pills were seized. He adds that counterfeiters have copied 14 of the company's medicines, which have subsequently infiltrated the legitimate supply chain of at least 36 countries, including the U.S., Canada, and the U.K. Marcy Forman, who leads the U.S. Immigration & Customs Enforcement team responsible for counterfeits, tells C&EN that seizures of suspected fake drugs at the U.S. border occur at least weekly. When U.S. officials caught the fake-drug distributor Kevin Xu in 2007, they found that U.S. citizens had bought $232,568 of his counterfeits over the Internet.

Counterfeiters try to squeeze into European and North American markets, but they have a smoother ride into the markets of many developing nations, which have fewer resources to fight the problem.

One of the few programs that aims to acquire accurate statistics of drug counterfeiting, at least in developing nations, is a Bill & Melinda Gates Foundation-funded project called the ACT consortium. Newton and Fernandez are part of the group, which is currently tracking the malaria drug counterfeiting problem across the African continent.

On an international level, Interpol teamed up with WHO in 2006 to create IMPACT. The task force, led by Plançon, has only a handful of staff who coordinate intelligence received by pharmaceutical companies, local police, national customs officials, and regulatory agencies around the world. Because counterfeiting rings involve nodes in multiple continents, breaking up these rings requires getting all the anticounterfeiting players "ready on time and at the same time" to haul in players simultaneously, Plançon says. This past fall, the team completed an operation called Mamba II that raided 270 buildings in Kenya, Tanzania, and Uganda. They've also brought down counterfeiters in Southeast Asia.

In addition to local, national, and international law enforcement, pharmaceutical companies hire former police officers to investigate counterfeiting cases. Pfizer, for example, has former Scotland Yard and FBI agents, and even a former Turkish general, as counterfeit investigators. "When we have built up a case, then we pass the information on to local authorities to follow up on," Shore says.

The first step to tracking down counterfeiters is figuring out whether a pill is a real or fake. In North America and Europe, myriad labs at regulatory agencies, border control, academia, and pharmaceutical companies use a battery of analytical tools to check suspected pills for authenticity. Wet chemistry, thin-layer chromatography, X-ray fluorescence, high-performance liquid chromatography, and mass spectrometry are all commonly used to find fakes. But the situation is radically different in developing countries. For example, in the entire continent of Africa, only two labs, one in Kenya and one in South Africa, are equipped to check for counterfeits at WHO standards. International labs, such as Fernandez', provide additional scientific support.

NOT QUITE GMP A counterfeit lab in China.

When Michael Green, a chemist at the U.S. Centers for Disease Control & Prevention, travels to Africa to check for fake malaria pills, he opts for basic wet chemistry color tests to verify medicine authenticity. He uses solvents he brings from the U.S., because "you can't count on the fact that solvents we use regularly at home will be available," he says. Green has developed simple color tests that can assess whether specific active ingredients can be found in artesunate malaria tablets and Tamiflu influenza medication.

GIVING PILLS a basic physical exam can also highlight fakes. For example, the weight of pills made in current Good Manufacturing Practices-certified labs won't vary by more than about 1%, whereas fakes can sometimes fluctuate by as much as 10% or even 50%. Calcite (calcium carbonate) is also often used instead of starch as an excipient—the bulk material in tablets. If a pill that normally uses starch as the excipient fizzes when dropped in vinegar—a common reaction with calcite—then "you can be pretty sure it's a fake," Green says. Counterfeiters also use talc, dolomite, anhydrite, and gypsum as excipients, says Dallas Mildenhall, a forensic scientist at GNS Science, a government research organization in New Zealand. Some of these materials do not dissolve in water, which every pill should because the contents must be absorbed by the body. If a pill

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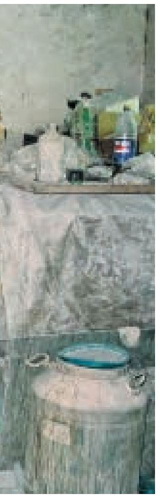


DAVID SHORE

doesn't dissolve in water at body temperature, then it is likely bogus.

Handheld analytical devices based on Raman and near-infrared spectroscopy are ideal for field situations because they are noninvasive: Pill pouches don't even need to be opened to be assessed for authenticity. These tools are not without challenges, however. Identifying chemical components in samples requires comparing the acquired spectra with reference spectra from a database. However, reference spectra of the same drug from different, legitimate manufacturers may vary. One solution researchers are pursuing is to use sophisticated statistical algorithms for comparing spectra.

If a comprehensive ingredient list of a tablet is required, then the tool of choice is mass spectrometry, Fernandez says. Checking pill authenticity of a large batch of pills using mass spec would take hours, and sometimes days, because of the extensive sample prep required—grinding up pills, for example. Fernandez has spearheaded the use of new mass spectrometry techniques that can take mass spectra directly from the surface of a pill. That strategy has sped up analysis by a factor of 60, Fernandez says.

As counterfeiters put increasingly good fakes on the market, some companies are investigating the possibility of putting special chemical tags in the coating of pills that could distinguish the originals. The U.S. Food & Drug Administration has given a preliminary go-ahead to try out this strategy, but European regulators have kiboshed the idea of allowing "anything in tablets unless it needs to be," Pfizer's Shore says.

Aside from exploring the idea of adding security features to a pill, companies around the world have primarily considered adding authenticity features to pill boxes and packaging. Yet any new security features for packaging last only about 18 months before counterfeiters can produce mimics, Shore says. Holograms were one of the first security features pharmaceutical companies added to packaging. But counterfeiters have been able to hire reputable hologram-making companies who don't even realize they are supplying to counterfeiters, Shore notes. He says drug counterfeiters have purchased from a company that also supplied holograms for Euro bank notes. In fact, counterfeiters' ability to add holograms to packaging is so common that "one pharmaceutical company reported a counterfeit product that had a hologram on the packaging, but in their genuine product, they had never actually put one," Kubic says.

ANOTHER SECURITY feature that has come and gone are so-called color-shift logos, which change color as the label twists in the light, Shore says. Only three companies in the world could make the ink for these logos, he says. "Then we found a pack in Hong Kong earlier this year that was such good quality it was almost impossible for the laboratory to tell whether it was a real product or not." Pfizer has stopped using this technology, Shore says. He did not divulge what the company is now using as security feature, but he says that Pfizer maintains a queue of new technologies to replace whatever counterfeiters can adeptly mimic.

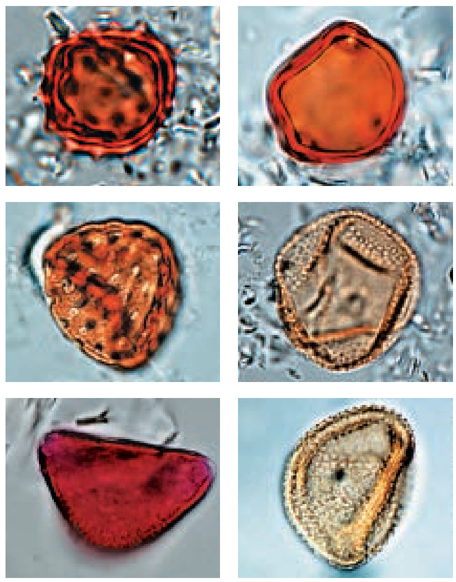
Those wanting to prevent counterfeiting are trying out bar codes or RFID tags on packaging so that pharmacists can check the pedigree of a package before dispensing the drug. If the package has been dispensed elsewhere, then it's a likely sign that a counterfeiter has reused security tags for fakes. Yet as much as holograms, color-shift logos, bar codes, or RFIDs might be appropriate security measures in industrialized societies, "in tropical Asia, Africa, and South America, it's going to be very difficult for them to be used," because they require sophisticated detection technology, Newton says.

Despite the challenges of identifying counterfeits, finding the counterfeiters can be even more difficult. Those involved are increasingly using forensic science to track down perpetrators. One strategy is to take a closer look at the isotopes of elements that form the pill's excipient. These isotopes can give geographical clues about where the pill was manufactured. For example, isotope analysis of a calcite excipient found in a counterfeit malaria drug called artesunate helped GNS Science's Mildenhall figure out that the fake pills were probably made at the border between China and Vietnam. In particular, the unusual isotope ratios of calcium, hydrogen, and oxygen suggested that the calcite had not come from the typical ocean source but instead from a hydrothermal mine. Because there is only one hydrothermal mine in the world—in southern China—the calcite helped narrow down where the manufacturing was being done.

The calcite data supported other evidence Mildenhall had that pointed to the region. He had also been scrutinizing pollen found in the fakes. Pollen "is found in all pills—real or fake," he says. But the pollen found on the counterfeit malaria drugs also came from plants native to the China-Vietnam border.

Mildenhall's pollen and calcite analyses, in combination with analyses from Fernandez, Green, and Newton, eventually allowed the IMPACT team to orchestrate the arrest of a Xu Qiang, a counterfeit trader in southern China. The team published a rare article about the case (*PLOS,* DOI: 10.1371/journal.pmed.0050032). Details of many other cases in the fight against counterfeits have not been released.

Even though "we are seeing some successes, fighting counterfeits has a long road ahead," Thomson says. "The fact is, these people can make fakes look perfect and they can get them into the distribution system. Is it possible to stop medicines counterfeiting altogether? I doubt very much whether it is. All we can do is to try our best to secure the supply chain." ■



DALLAS MILDENHALL/GNS SCIENCE

TINY EVIDENCE The type of pollen found in counterfeit and genuine drugs can be used to identify where the drugs were manufactured. Each pollen grain is about 20 μm wide.

2010 ACS NATIONAL AWARD WINNERS

Recipients are **HONORED FOR CONTRIBUTIONS** of major significance to chemistry

FOLLOWING IS THE FIRST set of vignettes of recipients of awards administered by the American Chemical Society for 2010. C&EN will publish the vignettes of the remaining recipients in January and February issues. A profile of Richard N. Zare, the 2010 Priestley Medalist, is scheduled to appear in the March 22 issue of C&EN along with his award address.

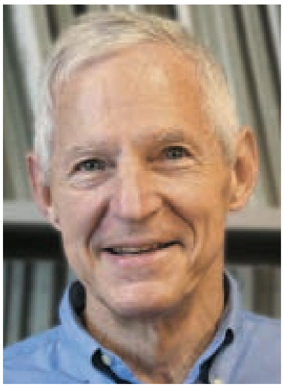
Most of the award recipients will be honored at an awards ceremony that will be held on Tuesday, March 23, in conjunction with the 239th ACS national meeting in San Francisco. However, the Arthur C. Cope Scholar awardees will be honored at the 240th ACS national meeting in Boston, Aug. 22–26.

JAMES FLACK NORRIS AWARD IN PHYSICAL ORGANIC CHEMISTRY

Sponsored by the ACS Northeastern Section

The hallmark of **John E. Baldwin's** career in physical organic chemistry is his "willingness to apply complex mathematical methodologies to challenging kinetic problems and to utilize site-specific isotopic labeling to extract key mechanistic details," says colleague Phyllis A. Leber, a chemistry professor at Franklin & Marshall College.

A representative example, she says, is a 2005 study of 1-^{13}C-2,2,3,3-d_4-cyclopropane, which showed that the cyclopropane rearrangement to propene takes place by way of both a trimethylene diradical (as expected) and a 1-propylidene singlet carbene reactive intermediate in a 9:1 ratio.



SALLY ANN PRASCH

Baldwin

Baldwin, who is Distinguished Professor of Chemistry and the William Rand Kenan Jr. Professor of Science at Syracuse University, would deserve the Norris Award "based solely on the sheer volume of his publications, which number 236 to date, including one book and 10 review articles," Leber says. She notes that 40% of his publications have appeared in the *Journal of the American Chemical Society.*

In addition to his outstanding research and teaching, "John has the perspective of a person with national stature who knows how world-class chemists and departments operate. In his gentle and collegial manner, John continues to be an intellectual leader on campus and around the world," Syracuse Graduate School Dean Ben Ware says. "The impact of his career on our chemistry department will continue for decades."

Baldwin, 72, tells C&EN that news of his selection came as a humbling surprise. "I was stunned when I got the call from the ACS president," he says. "I've gained enormously from interactions with other physical organic chemists and feel that I'm part of a shared enterprise even as I'm delighted to see my name added to the list of the prior awardees, real giants in the field. They have provided invaluable leadership and inspiration."

After earning a B.A. degree at Dartmouth College in 1959, Baldwin began doctoral studies in chemistry and physics at California Institute of Technology under the tutelage of John D. Roberts. Baldwin completed his Ph.D. in just three years and accepted a faculty position at the University of Illinois, Urbana-Champaign, which he held from 1962 to 1968. He then spent 16 years at the University of Oregon, five of which he was dean of the College of Arts & Sciences.

Since coming to Syracuse in 1984, Baldwin's research has been continuously supported by the National Science Foundation. "NSF funding allowed me to follow my basic research priorities for all of these years, for which I am extremely fortunate and thankful," Baldwin says. "Significant advances in chemistry over the past 25 years have enabled us to conceptualize and execute experiments pertinent to reaction mechanisms that would have been unimaginable earlier."

Other honors and awards garnered by Baldwin include a Daniel Webster National Fellowship, the Charles Lathrop Parsons Scholar Fellowship, an Alfred P. Sloan Fellowship, a Guggenheim Foundation Fellowship, and a Senior U.S. Scientist Award from the Alexander von Humboldt Foundation.

Baldwin will present the award address before the Division of Organic Chemistry.—GLENN HESS

FRANK H. FIELD & JOE L. FRANKLIN AWARD FOR OUTSTANDING ACHIEVEMENT IN MASS SPECTROMETRY

Sponsored by Waters Corp.

For nearly 40 years, **Catherine E. Costello** has advanced the application of mass spectrometry to biomolecules, especially carbohydrates and glycoproteins. Costello, 66, is a professor of chemistry, biochemistry, and biophysics at the Boston University School of Medicine and founding director of both the school's mass spectrometry resource and its cardiovascular proteomics center.

"Early on, the scientific world pooh-poohed MS for structural characterization because most published mass spectra were of hydrocarbons. Even when MS was acknowledged as useful for other compound types, most thought that carbohydrate behavior was even less promising than that of hydrocarbons," says Fred W. McLafferty, an emeritus professor at Cornell University. "More than anyone else, Cathy has shown us 'lack of faith' people that MS can really characterize terrible molecules such as sugars, carbohydrates, and glycoconjugates, and she has now convinced key researchers studying such critical biomolecules that MS is a first-choice resource." In a paper that has been cited more than 850 times, Costello described the nomenclature for dissociation of glycans from glycoconjugates.

Costello has shown "prescient vision in collaborating with biomedical scientists on problems with high impact on human health," says Peter B. O'Connor, a former colleague at Boston University who is now at the University of Warwick in Conventry, England. For example, she collaborated with D. Branch Moody at Harvard University in work that showed that isoprenoid glycolipids are involved with the immune system's response to *Mycobacterium tuberculosis* infection. They also identified a previously unknown family of *M. tuberculosis* lipopeptides that activate T cells.

Working with Carlos B. Hirschberg at Boston University, she used mass spectrometry to determine the fine structure of N-glycans of the worm *Caenorhabditis elegans* and how N-glycans are specific to different developmental stages of that model organism.

COURTESY OF CATHERINE COSTELLO

Costello

In addition, Costello was one of the first to recognize the value of the MALDI (matrix-assisted laser desorption ionization) technique. She helped bring MALDI to a wider audience by encouraging Marvin Vestal that his company Vestec should start manufacturing a MALDI time-of-flight mass spectrometer, which became the first commercial instrument of its kind.

Costello received a bachelor's degree in chemistry from Emmanuel College in Boston in 1964. In 1970, she received a Ph.D. in organic chemistry from Georgetown University, where she worked with Charles F. Hammer on NMR and organic reaction mechanisms. She was a postdoctoral associate with Klaus Biemann at Massachusetts Institute of Technology from 1970 to 1973, and there she made the switch to MS. She continued as the associate director of MIT's mass spectrometry resource until 1994, when she became the founding director of the mass spectrometry resource at Boston University.

She has served in many scientific societies, including as a councilor of ACS, as president of the American Society for Mass Spectrometry, and as senior vice president and currently president-elect of the Human Proteome Organization (HUPO). She received the 2004 Henry A. Hill Award from the ACS Northeastern Section, the 2008 Discovery Award in Proteomics Sciences from HUPO, and the 2009 Thomson Medal from the International Mass Spectrometry Foundation.

Costello will present the award address before the Division of Analytical Chemistry at the fall ACS national meeting in Boston.—CELIA ARNAUD

ERNEST GUENTHER AWARD IN THE CHEMISTRY OF NATURAL PRODUCTS

Sponsored by Givaudan

For **Michael T. Crimmins,** inspiration comes from many places. The ocean, the source of many of the natural products he's synthesized, is one. His experiences as a student are another.

Crimmins, 56, the Mary Ann Smith Professor of Chemistry at the University of North Carolina, Chapel Hill, is being honored for his sustained record of achievements in the synthesis of architecturally complex natural products. His "scholarship, integrity, and attention to detail, as well as his unwavering commitment to solving some of the most difficult problems in synthesis set him apart," says James D. White, Distinguished Professor of Chemistry Emeritus at Oregon State University. "He is the very model that every student in pursuit of a career in synthetic organic chemistry should aspire to."

LARS SAHL

Crimmins

Crimmins earned a B.A. in chemistry with honors at Hendrix College in Arkansas. From there, he moved to Duke University, where he received his Ph.D. in 1980 under the guidance of Steven W. Baldwin. "We worked very closely together. He was a great mentor to me," Crimmins says. In Baldwin's group, he used photochemical processes to make molecules, a theme he expanded upon in his independent career.

In particular, Crimmins has perfected intramolecular light-promoted ring-forming reactions between an α, β-unsaturated ketone and an olefin on the same molecule. In the reaction, preexisting chiral centers on a tether between the reacting moieties control the stereochemical outcome.

The biggest showcase for those innovations is Crimmins' 1999 synthesis of ginkgolide B, a densely functionalized natural product from the ginkgo tree, says Amos B. Smith III, the Rhodes-Thompson Professor of Chemistry at the University of Pennsylvania. "It is truly a landmark achievement and is, I believe, deserving of recognition of the Ernest Guenther Award in and of itself," Smith says. "This synthesis has become a standard of strategic planning now included in most, if not all, graduate synthesis courses."

The influence for the next major theme of Crimmins' work came from his NIH-NCI postdoctoral fellowship at California Institute of Technology with David A. Evans, a pioneer in aldol chemistry. As with photochemistry, the Crimmins team elaborated on those aldol foundations. They've found ways to combine a modified aldol reaction developed in their labs with olefin metathesis. That pairing works wonders for building rings, even tough-to-make medium-sized rings, and controlling the stereochemistry on them.

"In a moment of insanity," Crimmins jokes, his team decided to use the aldol-metathesis approach to make their most daunting natural product target yet: brevetoxin A, a marine neurotoxin loaded with medium-sized rings. They succeeded and published their synthesis in 2008.

At UNC, where he's been ever since he began his independent career in 1981, Crimmins, the senior associate dean for natural sciences, has also explored new ways of harnessing pyrone and cyclobutane rings for chemical synthesis. On top of his research achievements, Crimmins has won university-wide awards for teaching and is "an outstanding mentor, marvelous departmental citizen, and superb colleague," says UNC colleague Maurice Brookhart, the William R. Kenan Jr. Professor of Chemistry.

Crimmins will present the award address before the Division of Organic Chemistry.—CARMEN DRAHL

ACS AWARD FOR AFFORDABLE GREEN CHEMISTRY

Sponsored by Dow Chemical

With all the talk about wind and solar becoming economically viable sources of clean power, it's easy to overlook that crude oil will continue to play the predominant role in energizing our planet for many more decades. **Vincent J. D'Amico, Emanuel (Emiel) H. van Broekhoven,** and **Juha J. Jakkula** have invented an environmentally friendly process for producing gasoline alkylate, a key component in formulating gasoline with high octane and low emissions.

Up to now, the production of alkylate has required the use of billions of gallons of liquid catalysts based on either hydrofluoric or sulfuric acid. There are numerous downsides to these methods. HF is extremely toxic and can form aerosol clouds when it leaks. H_2SO_4-based catalysts, meanwhile, are highly corrosive, and once used, they must be transported for regeneration. Research scientists in the refining field have long searched for a better way to make alkylates.

The new process developed by the awardees makes use of a novel solid acid zeolite catalyst that does not generate waste products or heavy polymer by-products. The technology has been proven at a 10-barrel-per-day demonstration plant owned by Neste Oil in Porvoo, Finland.

The cost of implementing the technology is about equivalent to that of building a facility that uses hydrofluoric acid catalysts and is 10 to 15% lower than the cost of one that uses sulfuric acid catalysts. The process was developed under the umbrella of AlkyClean, a joint venture of Albemarle, Lummus Technology, and Neste Oil, the three firms in which the trio are or were senior scientists. Jakkula recently retired.

D'Amico, 56, is now manager of refining technology at Lummus. The holder of a masters degree in chemical engineering from Princeton University that he earned in 1976, he joined Lummus in 1980 after working for four years as a staff engineer at Union Carbide's Linde division. During nearly three decades at Lummus, D'Amico has focused mostly on "clean fuels" themes. He joined the AlkyClean team in 1999 where he served as team project manager. He currently supports the commercialization of the process.

Van Broekhoven, 53, is head of application research for alternative fuel technologies at Albemarle Catalysts. He obtained a Ph.D. in heterogeneous catalysis from Leiden University in 1985. That year, he joined the AkzoNobel petroleum-refining catalysts business that was acquired by Albemarle in 2004 (C&EN, April 26, 2004, page 7). At Akzo, he developed catalysts for fluid catalytic cracking, naphtha reforming, isomerization, and other chemical processes and obtained patents for DeSOx additives. He started conducting research on the AlkyClean process in 1994 and, together with his team, developed the catalyst and process concept that were used to build the first pilot plant in 1995.

Jakkula, 66, earned a masters degree in chemical engineering from Helsinki University of Technology in 1969. He joined Neste in 1970 and has been there his whole career, starting out as a process design engineer. He retired in 2008 as Neste Engineering's head of process engineering. He became a member of the AlkyClean team in 1999 and there led a group of scientists who worked out how the technology could be demonstrated on a semi-commercial scale at the Neste Porvoo refinery.

Industry response to AlkyClean has been positive, the awardees tell C&EN. Potential customers recognize it as the leading green technology in the alkylation field. A number of refiners have expressed interest, and the awardees expect that AlkyClean will be installed on a large scale in the near future.

The award address will be presented before the Division of Petroleum Chemistry.—JEAN-FRANÇOIS TREMBLAY

D'Amico

Van Broekhoven

Jakkula

ACS AWARD IN INORGANIC CHEMISTRY

Sponsored by Aldrich Chemical

Donald J. Darensbourg, professor of chemistry at Texas A&M University, grew up wanting to be an architect or engineer. After all, during high school, he worked with his father, who was a builder, so the two career paths made sense. But thanks to a fascinating general chemistry course and a less than captivating mechanical drafting class, Darensbourg changed his mind. And the rest, as they say, is history.

Working in the area of inorganic chemistry, Darensbourg, 68, has spent much of his career studying the mechanisms of organometallic reactions, including carbon dioxide insertion into hydrogen-, carbon-, and oxygen-metal bonds. He is being honored for these studies and their specific applications to polycarbonate formation.

"It's truly humbling and very gratifying to have your work validated by your peers with such an award," Darensbourg says. "I certainly realize that inorganic chemistry is a diverse field that has attracted many talented scientists, so I consider myself very lucky to be acknowledged by this award."

Research in Darensbourg's lab in recent years has focused on copolymerizing CO_2 with epoxides to produce polycarbonates. These industrially important thermoplastics with wide-ranging properties and uses are currently made via a process that involves interfacial polycondensation of phosgene and diols. To improve this process and make it more environmentally friendly, Darensbourg's group is doing detailed mechanistic studies of metal-catalyzed CO_2/epoxide-coupling reactions using in situ infrared spectroscopy methods.

Research in this area has also led to the synthesis of biodegradable polymers for use in medical devices. Specifically, the group has shown that copolymers made from CO_2 and oxetanes with polyesters afford biodegradable thermoplastic elastomers that can be used for surgical sutures, drug-delivery devices, or dental implants.

"CO_2 chemistry has been a continuous theme over most of Don's career, leading to exciting applications that now attract a host of international research teams," says Malcolm H. Chisholm, a chemistry professor at Ohio State University. "He spearheaded this area in its genesis and he continues to be the long-term leader."

Because of Darensbourg's work on CO_2/epoxide copolymerization, "countless scientists have been attracted to the field, including myself," adds Geoffrey W. Coates, a chemistry professor at Cornell University.

These accolades aside, Darensbourg says: "I've always thought it was reward enough to have such a wonderful career—teaching and mentoring bright graduate and undergraduate students, as well as doing research that I am passionate about. You can't ask for much more than to be excited about going to work every day."

COURTESY OF DONALD DARENSBOURG

Darensbourg

Darensbourg earned a B.S. in chemistry from California State University, Los Angeles, in 1964, and a Ph.D. in inorganic chemistry from the University of Illinois in 1968. After graduate school, he did a 10-month stint at the Texaco Research Center in Beacon, N.Y., before joining the faculty of the State University of New York, Buffalo. In 1973, he moved to Tulane University, where he rose through the ranks to become a full professor. He assumed his current position at Texas A&M in 1982.

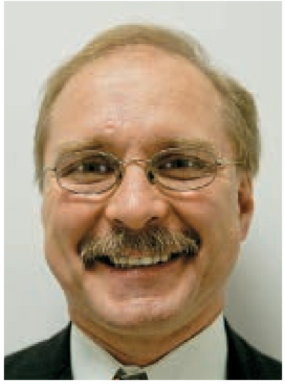
Darensbourg has some 330 journal articles to his credit and has graduated 48 Ph.D. chemistry students. He has been honored with distinguished teaching and research awards.

Darensbourg will present the award address before the Division of Inorganic Chemistry.—SUSAN MORRISSEY

ACS AWARD FOR COMPUTERS IN CHEMICAL & PHARMACEUTICAL RESEARCH

Sponsored by Schrödinger

It was a secondhand microscope that pushed **Kenneth M. Merz Jr.** into a career in science. The state-of-the-art instrument, brought home from work by his materials scientist father, gave the young Merz his first look at the denizens of local Pennsylvania pond scum.



JUDY PARKER

Merz

Now a professor of chemistry and codirector of the Quantum Theory Project at the University of Florida, Merz has made a career out of exploring the inner workings of biological systems. His "microscope" of choice these days, however, is quantum mechanics.

Merz, 50, was one of the first people to tackle complex chemical problems in biology with quantum mechanical methods, according to Irwin D. Kuntz, a physical chemist and an emeritus professor of pharmaceutical chemistry at the University of California, San Francisco. Physical chemists have long believed that molecular recognition and molecular interaction problems should ideally be attacked by quantum mechanics, he says. But for many years, such problems remained too computationally intensive to be tackled with anything but approximate approaches based on molecular mechanics. Merz, taking advantage of the exponential advances in computer processing power that took place in the early 1990s, devised a way to break large biological systems into smaller parts that could be more easily addressed by quantum mechanics.

"Building on these insights, the Merz group has made a series of critical advances that have allowed quantum-mechanical-level treatments of many of the most interesting issues in computational biology," Kuntz adds. As examples, he points to Merz's efforts to use quantum mechanics to look at how proteins interface with the solvent that surrounds them and to model protein-drug interactions.

Thanks to Merz's experience working in both academia and at pharmaceutical services provider Pharmacopeia (now a part of Ligand), "he has a clear idea of how his pioneering work in quantum mechanics can be applied to real-world problems of relevance to the pharmaceutical industry," according to a collaborator at a major drug firm.

More recently, Merz has developed quantum mechanical methods to refine structures obtained by X-ray crystallography and nuclear magnetic resonance spectroscopy. He also introduced a quantum-mechanical algorithm for computing the NMR chemical shifts of entire proteins. The latter method "will play a major role in the area of structural biology," Kuntz predicts.

Merz received a B.S. degree in chemistry from Washington College in 1981 and a Ph.D. in organic chemistry from the University of Texas, Austin, in 1985. After postdoctoral fellowships at Cornell University and the University of California, San Francisco, Merz took a faculty position at Pennsylvania State University in 1989. While still teaching at Penn State, Merz led a computational group at Pharmacopeia from 1998 to 2001. In 2005, he moved to the University of Florida.

Merz has been a fellow of the American Association for the Advancement of Science since 1999. He won a coveted Guggenheim fellowship in 1996.

Merz will present the award address before the Division of Computers in Chemistry.—AMANDA YARNELL

NATIONAL FRESENIUS AWARD

Sponsored by Phi Lambda Upsilon, the National Honorary Chemical Society

Colleagues are heaping praise on **Daniel J. Mindiola,** associate professor of chemistry at Indiana University, Bloomington. His accomplishments include the development of highly reactive, low-coordinate complexes containing metal-ligand multiple bonds induced by α-hydrogen abstraction, including those of the type M=CHR and M≡CR that readily open the C–N bond in N-heterocycles.

Mindiola discovered a route to low-coordinate multiple-bond chemistry that enables the routine use of the inexpensive and versatile metals titanium, vanadium, and niobium in group-transfer chemistry. He is now expanding the series to more ionic elements such as scandium. Multiple bonds of these metals were formerly rare, says James P. Reilly, chemistry department chair at IU. Mindiola's work "exposed these types of compounds for broad study by other researchers," he adds.

Key applications of the metal complexes are facile cleavage and rearrangement of heterocyclic C–N bonds and activation and functionalization of hydrocarbons. The former could be used in the petrochemical industry to remove nitrogen from carbon-based fuel products and thereby reduce NO_x emissions when the fuels are burned. Mindiola's work could lead to cleaner and cheaper petroleum-based fuels, Reilly says.

The Ti=CHR moiety particularly impresses Massachusetts Institute of Technology chemistry professor Christopher C. Cummins, who was Mindiola's Ph.D. adviser. "The high and unprecedented reactivity of this species has provoked in-depth analysis by theorists," he says.

The journey leading to this year's award began in 1989, when Mindiola and his mother left the turmoil of his native Venezuela and came to the U.S. (C&EN, Oct. 17, 2005, page 35). After a lackluster high school experience, he was inspired by Kim R. Dunbar, a chemistry professor at Michigan State University, to study inorganic chemistry. Helped partly by a scholarship from the ACS Scholars Program, he received a B.S. in chemistry with honors in 1996. In 2000, he received a Ph.D. in chemistry from MIT. After a postdoctoral stint at the University of Chicago, he joined IU as an assistant professor in 2002. He gained tenure in 2007.

Mindiola "is the best young scientist I've encountered in my 25 years at the University of Chicago, both in terms of demonstrated accomplishment and the certainty for continued scientific excellence," says chemistry professor Gregory L. Hillhouse, who was Mindiola's postdoctoral supervisor. In Hillhouse's lab, Mindiola prepared the first series of compounds with ligands multiply bonded to nickel.

A citizen of Venezuela and the U.S., Mindiola, 35, is an ardent promoter of diversity in the sciences through mentoring minority students. He also advises the IU student chapter of the National Organization for the Professional Advancement of Black Chemists & Chemical Engineers, which he founded in 2007. He has also served on ACS's Minority Affairs Committee and Fellowship Selection Committee.

COURTESY OF DANIEL MINDIOLA

Mindiola

Among Mindiola's honors are the Friedrich Wilhelm Bessel Research Award from the Alexander von Humboldt Foundation, the Camille & Henry Dreyfus New Faculty Award, the Indiana University Outstanding Junior Faculty Award, the Alfred P. Sloan Research Fellowship, the Camille & Henry Dreyfus Teacher-Scholar Award, and the NSF Presidential Early Career Award for Scientists & Engineers.

Mindiola will present the award address before the Division of Inorganic Chemistry.—MAUREEN ROUHI

HERBERT C. BROWN AWARD FOR CREATIVE RESEARCH IN SYNTHETIC METHODS

Sponsored by the Purdue Borane Research Fund and the Herbert C. Brown Award Endowment

In the 40 years since he earned his doctoral degree, **Larry E. Overman** has racked up an impressive number of accolades. But winning the award named for Nobel Laureate Herbert C. Brown is of particular significance. "He was someone that I vastly admired for his contributions to chemistry," Overman says. In fact, he points out, one of his earliest projects as an assistant professor used a mercury reagent developed by Brown.

Like Brown, Overman has established his reputation as a scientist through the development of new synthetic methods. He boasts more than 340 publications, including the total synthesis of more than 80 complex natural products. "I think the thing that is characteristic of what we've done is to explore new methods of synthesis and use these methods to tackle very complex structures," Overman explains. "As soon as we've developed a new method, we want to see how it performs with complex structures. That's the only way you learn what the method's limitations are."

Overman began his study of chemistry at Earlham College in Richmond, Ind. He earned a doctoral degree from the University of Wisconsin in 1969, working with Howard W. Whitlock Jr. A postdoctoral fellowship with Columbia University's Ronald Breslow followed. In 1971, Overman joined the faculty at the University of California, Irvine, where, at age 66, he now holds the title Distinguished Professor of Chemistry.

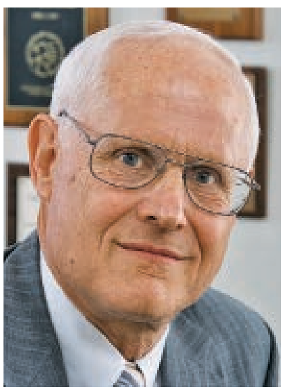
Highlights among the many advances in synthetic methodology to come out of Overman's lab include the asymmetric Heck reaction, the intramolecular Heck reaction for constructing complex ring systems, and the tethered Biginelli reaction. Overman also holds a coveted distinction among synthetic chemists—he has his own named reaction, the Overman rearrangement.

"Larry Overman's premier contributions to synthetic organic chemistry represent a remarkable and productive union of synthetic methodology, mechanistic insights, and total synthesis of complex natural products," says Scott D. Rychnovsky, Overman's colleague at UC Irvine. "The creativity evident in the work, his ability to develop reactions and apply them to the construction of complex molecules, and the broad impact of his work on the field of synthesis are truly impressive."

"Over the years his selection of problems has been inspiring, usually reflecting creative insight into areas of opportunity that served to define future directions of the field and precipitate interest from others," adds Stanford University's Paul A. Wender. "Great syntheses arise from an understanding of structure and mechanism, and Overman has demonstrated a mastery of these elements in his efforts."

In addition to his research skills, Overman's colleagues note that his creativity and ability to inspire also extend to his skills as a mentor—a role that he particularly relishes. "The greatest joy is the opportunity to work with young people at a very important time in their lives," he says. Even so, Overman doesn't have any special advice to offer. "How students really learn is by observing how science is conducted in your lab," he notes. "That's a hundred times more important than anything you might say."

Overman will present the award address before the Division of Organic chemistry.—BETHANY HALFORD



COURTESY OF LARRY OVERMAN

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QUALITY JOBS, QUALITY CHEMISTS

POSITIONS OPEN

ACADEMIC POSITIONS

Director of Chemistry, Therapeutics for Rare and Neglected Diseases (TRND) Program

National Human Genome Research Institute

The National Institutes of Health (NIH) is seeking a senior scientist to serve as the Director of Chemistry for the Therapeutics for Rare and Neglected Diseases (TRND) Program, a new effort administered by the National Human Genome Research Institute (NHGRI) and the NIH Office of Rare Diseases Research (ORDR). The goal of this Program is to discover and develop small molecules that are suitable for testing in humans and promising for treating individuals with rare and neglected diseases.

As an integral part of the TRND executive team, the Director of Chemistry will provide input on the overall strategy for TRND and lead the research operations of all functions of the Chemistry Section. The successful candidate will be a recognized leader with a proven track record in human drug development, with at least 15 years of relevant synthetic and analytical chemistry experience in the pharmaceutical industry. The candidate must have a Ph.D. in synthetic or medicinal chemistry, an excellent publication record and patent portfolio, should show fluency in structural and computational chemistry, and be cognizant of relevant state-of-the-art techniques and the utilization of specialized technical equipment. The candidate will have demonstrated ability to supervise a large group of chemists effectively and a history of providing outstanding mentorship. The candidate is also expected to be well versed in biology, pharmacology, drug metabolism and pharmacokinetics, as well as have a demonstrated history of effective and successful collaborations.

The TRND Program includes ongoing support for the Director of Chemistry and the scientific team that the Director is expected to build. Interested applicants should send their curriculum vitae, a three-page statement of interest in (and vision for) the Chemistry Section of TRND, and three letters of recommendation through our online application system, at http://research.nhgri.nih.gov/apply.

Applications will be reviewed starting January 31, 2010 and will be accepted until the position is filled.

Specific questions regarding the recruitment may be directed to Dr. Carole Bewley, Search Chair, at CaroleB@intra.niddk.nih.gov. Questions may also be directed to Dr. Melissa Ashlock at ashlockma@mail.nih.gov.

DHHS and NIH are Equal Opportunity Employers and encourage applications from women and minorities.

NATIONAL HUMAN GENOME RESEARCH INSTITUTE Division of Intramural Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES | NATIONAL INSTITUTES OF HEALTH | genome.gov/DIR

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Professor of Biochemical Engineering

ETH Zurich invites applications for a professorship in Biochemical Engineering at the Institute of Chemical and Bioengineering Sciences. Candidates should demonstrate an exceptional potential to develop an innovative and collaborative research program at the interface between chemical engineering and biochemistry, biology and medicine. The Zurich area offers extraordinary opportunities, including efficient and rapid access to early clinical trials and an impressive local biomedical industry representing some of the global market leaders. The new professor will be expected to teach undergraduate level courses (German or English) and graduate level courses (English) in chemical and biochemical engineering.
Requirements include an internationally recognized research program and excellence in teaching.

Please submit your application together with a curriculum vitae, a list of publications and projects as well as a research plan to the **President of ETH Zurich, Prof. Dr. Ralph Eichler, ETH Zurich, Raemistrasse 101, 8092 Zurich, Switzerland (or via e-mail to faculty-recruiting@sl.ethz.ch), no later than March 31, 2010.** With a view toward increasing the number of female professors, ETH Zurich specifically encourages qualified female candidates to apply.

TEXAS A&M ENGINEERING

ENDOWED CHAIR IN MATERIALS SCIENCE AND ENGINEERING
THE DWIGHT LOOK COLLEGE OF ENGINEERING
TEXAS A&M UNIVERSITY

The Dwight Look College of Engineering at Texas A&M University invites nominations and applications for an endowed chair professor position in the area of materials science and engineering. Exceptional candidates in any branch of materials with an international reputation of excellence are encouraged to apply.

■ **REQUIREMENTS:** Preference will be given to applicants whose research is broadly focused in the areas of energy harvesting, energy conversion, sensors, biomaterials, multifunctional and nano-engineered materials, or advanced structural materials, although applicants in other fields with extraordinary national and international stature will also be considered. It is expected that the successful candidate will lead Texas A&M's interdisciplinary Materials Science and Engineering Program. Researchers in academia as well as those in government and industry research laboratories are encouraged to submit nominations or applications.

■ **ABOUT OUR PROGRAM:** Texas A&M's Dwight Look College of Engineering is one of the largest engineering colleges in the nation, with more than 10,000 students and 12 departments. *U.S. News & World Report* ranks the Texas A&M Engineering graduate program eighth and the undergraduate program ninth among public schools. The college is also third amongst all U.S. universities in engineering research expenditures, at more than $200 million. Texas A&M University has made materials science and engineering a strategic focus and is committing significant resources toward enhanced infrastructure and faculty hires. The Material Science and Engineering Program is five years old, and has already grown to more than 20 faculty and 60 M.S. and Ph.D. students. More information is available online **(http://msen.tamu.edu)**.

■ **HOW TO APPLY:** Nominations should include the person's name and a short description of his/her qualifications. Applicants should submit a complete resume, a brief research, leadership and teaching statement, including their vision for the area and future plans, and a list of three references to:

Dr. Dimitris Lagoudas, Search Committee Chair
Department Head of Aerospace Engineering
Texas A&M University
3141 TAMU
College Station, TX 77843-3141
e-mail: msenchair@tamu.edu

The initial screening of applicants will begin on **February 1, 2010.** However, the position will remain open until filled. A Fall 2010 start date is anticipated.

http://msen.tamu.edu

Texas A&M University is an Affirmative Action/Equal Opportunity Employer. The University is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities, and covered veterans. Employer paid advertisement.

TEXAS A&M UNIVERSITY

The Institut national de la recherche scientifique, a university institution dedicated to research and postgraduate studies, seeks to fill a tenure track position in ***Nanobiotechnology,*** *associated with a Tier 2 Canada Research Chair, at its Énergie Matériaux Télécommunications Centre (for information on the Canada Research Chairs program, visit: www.chairs.gc.ca). A Tier 2 Chair is intended for exceptional emerging researchers who have the potential to become leaders in their field. This position is incorporated within an environment where about forty professors-researchers undertake leading-edge research and teaching in diverse fields of energy, materials and telecommunications.*

One of our main axes of strategic development is in the field of nanobiophotonics, broadly defined as the synthesis, processing and imaging/characterization of nanosystems relevant to biology, including, but not limited to applications in health and the environment. Research topics of interest for this position may include the use of nanomaterials and processes in the broad areas of infections and cancer, both diagnosis and therapy, gene therapy, tissue repair/regeneration/engineering, the modification and characterization of biocompatible materials, advanced imaging of molecular systems from simple biomolecules to viruses to living cells (including animal studies in vivo).

The Institute is located in Varennes, on the South Shore of Montreal. More information is available on the web site: www.emt.inrs.ca.

PROFESSOR-RESEARCHER NANOBIOTECHNOLOGY

(Tenure Track – Tier 2 Canada Research Chair)

The candidate should have:

- A PhD degree in a relevant discipline (Physics, Chemistry, Material science or Engineering).
- An excellent record of research accomplishments. She/he is expected to have demonstrated the potential to achieve international recognition in the next five to ten years.
- The ability to work in a multidisciplinary team and within research networks.
- Entrepreneurial skills and potential to attract significant external funding.

The language of our work environment is French. Candidates whose native language is not French are encouraged to apply. The Centre will provide them with all the resources necessary to facilitate their learning of the French language.

Salary and benefits are in accordance with the current collective agreement at INRS.

Interested candidates should submit a full curriculum vitæ by e-mail and registered mail, a statement of research interests (max. 3 pages), a statement of teaching philosophy, 3 representative publications, and the names and contact addresses of at least three referees before **January 31, 2010**, indicating competition **DS 09-06** to:

Dr. Jean Claude Kieffer, Director
Centre Énergie Matériaux Télécommunications
1650, Lionel-Boulet Blvd.
Varennes (Québec) J3K 1S2, Canada
kieffer@emt.inrs.ca

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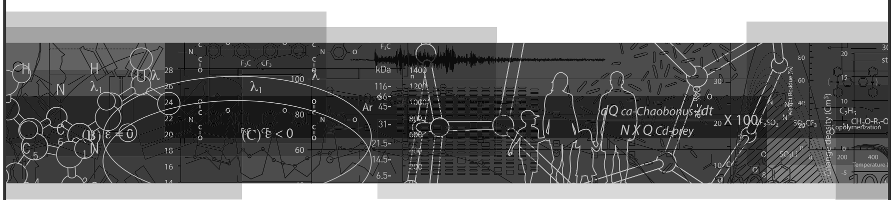
WWW.INRS.CA



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ACADEMIC POSITIONS

ASSISTANT PROFESSOR IN CHEMICAL BIOLOGY
DEPARTMENT OF CHEMISTRY
UNIVERSITY OF MASSACHUSETTS AMHERST

Applications are invited for a tenure-track faculty position at the Assistant Professor level, to begin in September 2010 or thereafter. This appointment in the Chemistry Department is in collaboration with the Institute for Cellular Engineering, a multi-disciplinary research and training program focused on developing novel technologies and approaches for understanding and controlling cellular function. Candidates from all areas of Biological Chemistry will be considered. Those utilizing natural or synthetic compounds to manipulate biological processes or using directed evolution or computational design are particularly encouraged to apply. Candidates should have a Ph.D. in chemistry or a related field. Salary will be commensurate with qualifications and experience. Candidates should electronically submit a cover letter, a curriculum vitae, statement of research and teaching plan as a single PDF file (less than 15MB), and arrange to have three letters of recommendation sent electronically to **facultysearch@chem.umass.edu.** Paper applications may be submitted to **ICE Faculty Search Chair, Department of Chemistry, 713J LGRT, University of Massachusetts, Amherst, MA 01003-9336 USA.** Evaluation of applicants will begin on January 11, 2010, and continue until the position is filled. The university provides an intellectual environment committed to providing academic excellence and diversity including mentoring programs for faculty. The college and the department are committed to increasing the diversity of the faculty, student body and the curriculum. The University of Massachusetts is an Affirmative Action/Equal Opportunity Employer. Women and members of minority groups are encouraged to apply.

FACULTY POSITIONS
UNIVERSITY OF CALIFORNIA, RIVERSIDE
BOURNS COLLEGE OF ENGINEERING

The Bourns College of Engineering at the University of California, Riverside, invites applications for tenure-track faculty positions at the Assistant Professor rank, or tenured senior-level positions for exceptional candidates, in the area of materials and energy. Applications are especially encouraged from individuals with research interest in biomaterials, materials for clean energy conversion and storage, and 3-D electronics. The successful candidate will be affiliated with the Materials Science and Engineering program which integrates across all five departments in the college, and will join any of these departments, but preference will be given to Bioengineering, Chemical and Environmental Engineering, or Mechanical Engineering. Individuals with vigorous research programs and demonstrated productivity are strongly encouraged to apply for the senior rank. Details and application materials can be found at **www.engr.ucr.edu/facultysearch.** The search committee will review applications beginning on 2/1/2010, and will continue to receive applications until the positions are filled. EEO/AA Employer.

POSTDOCTORAL FELLOW AT RICE

Applications for a Dreyfus Environmental Chemistry Postdoctoral Fellow in the Department of Civil and Environmental Engineering at **Rice University** are sought. The Fellow will work under the guidance of Professors Rob Griffin and Daniel Cohan on a laboratory, field, and/or computational project related to heterogeneous reactions on organic particle surfaces in the atmosphere. The Fellow will join a group actively involved in atmospheric chemical research; significant educational and mentoring opportunities will be made available to the Fellow. A Ph.D. in chemistry, chemical engineering, atmospheric science, or other related field is required, with a preference for those not previously engaged in environmental chemistry research. Applications should include a cover letter describing research interests, a CV including list of publications, and contact information for three references, and should be submitted electronically to **rob.griffin@rice.edu.** Applications will be reviewed until the position is filled. Rice University, located in **Houston, TX,** is an Equal Opportunity/Affirmative Employer.

THE CHEMISTRY DEPARTMENT at **Idaho State University** (ISU) has immediate openings for **two postdoctoral research associates.** One is in the nano materials and device group to conduct supercritical fluid experiments. The other is a joint appointment with the **Idaho Accelerator Center** in radiochemistry, nuclear chemistry, or separations chemistry to support ISU's research effort in medical isotopes. Additional information on both positions is available on the web at **http://www.isu.edu/departments/chem/search/.**

ACADEMIC POSITIONS

RESEARCH ASSISTANT PROFESSOR. As part of the **Ohio Research Scholars Program, Prof. F. N. Castellano at Bowling Green State University (BGSU)** invites applications from outstanding individuals for an appointment as Research Assistant Professor. Successful candidates will have research interests in energy-related fields that are strongly aligned with those of the Castellano research group **(http://www.bgsu.edu/departments/chem/faculty/castell/Castellano_Group/Home.html).** A Ph.D. degree in Chemistry or related disciplines and a minimum of 1 year of postdoctoral experience are required. Applicants should submit (PDF) their CV, list of publications, brief statement of research interests, and provide the names and contact information for 3 references electronically to **researchscholar@bgsu.edu.** Applications received by 1/15/2010 will receive full consideration. *BGSU, located in Bowling Green, Ohio, is an AA/EO Employer and supports diversity in the workplace.*

ASSISTANT RESEARCH PROFESSOR—SYNTHETIC DRUG DISCOVERY. The Department of Chemistry and Biochemistry at Auburn University invites applications for a non-tenure-track faculty position to assist in a research program in drug discovery based on the synthesis of complex nucleosides. A Ph.D. in organic chemistry with a minimum of 5 years' postdoctoral research experience in synthetic nucleoside chemistry is required. The candidate selected for this position is anticipated to begin February 2010 and excellent communication skills are required. Applicants must meet eligibility requirements to work in the United States by the date the appointment begins and continue working legally for the proposed term of employment. **Minorities and Women are encouraged to apply.** Applicants should submit a curriculum vitae that includes the names and addresses (including e-mail) of three references to **Dr. S.W. Schneller, Sciences Center, 315 Roosevelt Concourse, Auburn University, Auburn, AL 36849.** Review of applications will begin January 15, 2010, and continue until the position is filled. Auburn University is an Affirmative Action/Equal Opportunity Employer.

ACADEMIC POSITIONS

MEDICINAL CHEMIST
POSITION ANNOUNCEMENT

The University of Tennessee College of Pharmacy has a twelve-month, tenure-track (Assistant, Associate, or Full Professor) position available. Candidates must have a Ph.D. degree in medicinal chemistry or a related area and an externally funded research program. The candidate must have an interest in teaching medicinal chemistry at the Pharm.D. and graduate levels and possess good communication skills. All areas of medicinal chemistry and related disciplines will be considered but preference will be given to candidates with research programs in chemical biology and anti-infective agents. The position offers start-up funds, an attractive research incentive plan, and a competitive salary and benefits package commensurate with experience. The College will be moving into a new building (183,857 GSF) in 2010. Applications are being accepted. Applicants should send a letter, including a summary of future research plans, a Curriculum Vitae, and 3 letters of references to **Isaac Donkor, Ph.D., Professor and Vice Chair, Dept. of Pharmaceutical Sciences, 847 Monroe Avenue, Suite 327, Memphis, TN 38163.** Applications will be accepted until the position is filled. *The University of Tennessee is an EEO/AA/Title VI/Title IX/Sect. 504/ADA/ADAE Employer.*

ASSISTANT PROFESSOR OF PHYSICAL CHEMISTRY

OBERLIN COLLEGE **(http://new.oberlin.edu/chemistry/)** invites applications for one-year appointment beginning July 2010 in Physical Chemistry to teach courses in physical, nonmajors environmental, and introductory chemistry. Applicants should submit a CV, statement of teaching philosophy, graduate and undergraduate transcripts, and arrange to send three letters of recommendation to **Matthew Elrod, Chair, Department of Chemistry and Biochemistry, Oberlin College, 119 Woodland Street, Oberlin, OH 44074** by February 12, 2010. Oberlin College is an Equal Opportunity Employer and welcomes nominations and applications from women and minority groups.

ACADEMIC POSITIONS

CHEMISTRY AND CHEMICAL BIOLOGY TENURE-TRACK ASSISTANT PROFESSOR POSITION IN ANALYTICAL CHEMISTRY

The Department of Chemistry and Chemical Biology solicits applications to fill a tenure-track position at the rank of Assistant Professor in the area of analytical chemistry, effective July 1, 2010. Applications are encouraged in all areas of analytical chemistry, particularly in bioanalytical chemistry. Scientists with research interests that have applications in the biosciences, biointerfaces, environmental science and materials/nanoscience areas are encouraged to apply. Our aim is to enhance interdisciplinary science at McMaster, a university with a long standing history of collaborative research initiatives. Faculty members in this department have been key players in two recently funded Canada Foundation for Innovation infrastructure projects, each valued at ~$20M. The equipment and facilities in the Centre for Microbial Chemical Biology and the Biointerfaces Institute will be available, as befits the research interests and equipment needs of the successful candidate's research program. Applicants should clearly demonstrate potential to develop a prominent, externally funded research program and be committed to excellence in teaching at the graduate and undergraduate levels. Candidates must have a doctoral degree in chemistry or a closely related field, postdoctoral experience, and a promising record of research scholarship and productivity. Application materials must include a cover letter, curriculum vitae, a statement of teaching interests, and detailed descriptions of at least three research projects that exemplify your proposed research program. Please include a listing of the major instrumentation and equipment necessary to pursue each project. Review of applications will begin after February 1, 2010, and will continue until the position is filled. Please send these materials and arrange for three letters of recommendation to be sent to **Dr. Brian E. McCarry, Chair, Department of Chemistry and Chemical Biology, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4M1 CANADA.** All qualified candidates are encouraged to apply; however, Canadian citizens and permanent residents will be given priority. McMaster University is strongly committed to employment equity within its community, and to recruiting a diverse faculty and staff. The university encourages applications from all qualified candidates, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

A POST-DOCTORAL POSITION in medicinal chemistry is available immediately for a highly motivated individual to join a dynamic multidisciplinary research team at **Scripps Florida.** Requirements: Ph.D. with strong background in organic synthesis, especially synthesis of heterocyclic compounds; proven track record of accomplishments (peer-reviewed publications and patents). Experience in medichem, parallel/combinatorial synthesis is a plus. Please send your CV and a list of three references to **hodderp@scripps.edu.**

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Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, DC 20036. Periodicals postage is paid at Washington, DC, and additional mailing offices. **POSTMASTER:** Send address changes to: Chemical & Engineering News, Member & Subscriber Services, P.O. Box 3337, Columbus, OH 43210.

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newscripts

WALKIN' IN A WINTER NANOLAND

He might not have a corncob pipe and a button nose, but a microsnowman recently fabricated by David Cox, a scientist in the Quantum Detection group at the National Physical Laboratory, in the U.K., has something Frosty doesn't: staying power. Made of two tin beads "glued" together with a bit of platinum, this snowman stands about 25 µm high and doesn't fear the sun, permanently smiling with a mouth milled out by a focused ion beam (FIB).

According to Cox, his jolly little creation, which stands atop an atomic force microscope cantilever, was put together for the lab's annual holiday card. But images and video of the **"WORLD'S SMALLEST SNOWMAN"** also went viral over the Web. "It has certainly given me an insight into the power of the Internet," he tells C&EN. "I've had colleagues all over the world asking it if was mine."

Cox typically uses the lab's dual-beam FIB instrument to make or modify objects such as nano-superconducting quantum interference devices (nanoSQUIDs) for studying the nanomagnetism of biological systems. To make the snowman, he used the instrument's piezo manipulation system and a carbon-fiber tip to move the beads into place. He then deposited the platinum glue through ion-beam decomposition of a short burst of $(CH_3)_3(CH_3C_5H_4)Pt$ gas. The snowman's nose, about 1 µm wide, is also a small blob of platinum, deposited in mere seconds.

"I only had a couple of days to plan it and build it, so I decided on the snowman," Cox says. "I could put it together in a couple of hours." But "had I known it would go global," he laments, "I would have made it much smaller—at least an order of magnitude."

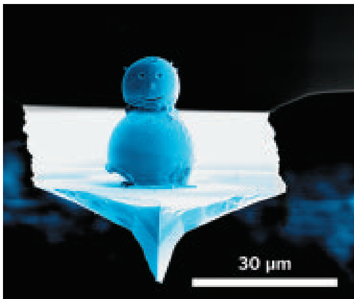
Students at the University of Nevada, Reno, have also recently begun to ponder wintery applications for tiny particles. A new curriculum developed there by mechanical engineer Kam K. Leang and colleagues Jonghwan Suhr and John Cannon aims to integrate nanotechnology into undergraduate design courses. To start with, the scientists will help students practice their downhill form by **BUILDING THEIR OWN SKIS.**

The undergrads will substitute some of the traditional materials in skis—composite layers of polymers, metal, wood, rubber, and fiberglass—with more advanced nanomaterials "to improve performance, reduce weight, increase strength, and improve damping and stability," Leang says.

Within an hour's drive from Reno are a handful of ski areas, says Leang, who has been building skis in his garage since 2004. "So we have a lot of students who are excited about skiing, and this project gives them the opportunity to apply their engineering skills to an exciting example," he adds.

In its inaugural semester, the class produced two sets of prototype skis: The first incorporates tiny metal balls, or particle dampeners, into the ends of the skis to dissipate energy and lessen vibration on the slopes. The second set of skis—although they don't yet incorporate micro- or nanoparticles—have been designed to fold to a convenient size for travel. "We'll focus on incorporating the new materials to enhance performance" in the next class, Leang says.

NATIONAL PHYSICAL LABORATORY



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Microsnowman: Eat your heart out, Frosty.
Hot off the presses: One of Leang's students holds a newly molded ski.

In the future, he tells C&EN, the two-year National Science Foundation-funded project should afford the students time to look into other structures such as aircraft components and wind turbine blades. "The ski example is just one way to excite them to think about the possibilities of engineering with nanomaterials," he says.

In the meantime, some serious testing needs to be done. Leang says he will soon be joining his students on the slopes—all in the name of science—to check their designs.

LAUREN K. WOLF *wrote this week's column. Please send comments and suggestions to newscripts@acs.org.*