JANUARY 11, 2010

C&EN

CHEMICAL & ENGINEERING NEWS

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CHEMICAL & ENGINEERING NEWS

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COVER STORY

WORLD CHEMICAL OUTLOOK

The chemical industry predicts better times in 2010. PAGE 11

QUOTE OF THE WEEK

"This toothless declaration, being spun by the U.S. as a historic success, reflects contempt for the multilateral process, and we expect more from our Nobel Prize-winning President."

KATE HORNER, INTERNATIONAL POLICY ANALYST, FRIENDS OF THE EARTH U.S. PAGE 27

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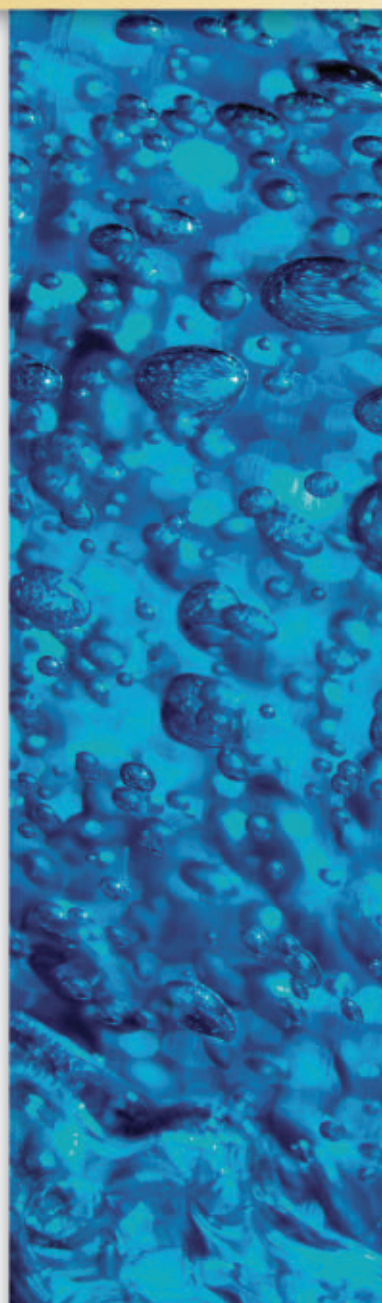

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After Copenhagen

THE UNITED NATIONS-sponsored climate conference held in December in Copenhagen was neither the groundbreaking success proclaimed by President Barack Obama and other world leaders nor the abject failure gleefully denigrated by climate-change skeptics.

C&EN Senior Correspondent Cheryl Hogue attended the entire conference and, with assistance from Senior Correspondent Jeff Johnson here in Washington, reported on it in several News of the Week stories (Dec. 14, 2009, pages 6 and 7; Dec. 21, 2009, pages 6 and 7; and Jan. 4, page 8). Hogue's comprehensive wrapup from the conference appears in this week's issue (see page 27).

As Hogue points out, negotiations in Copenhagen "yielded little. They were stymied not only by shifting geopolitical dynamics but also by procedural maneuvers that stifled consensus and by disruptions from the unprecedented number of people observing the proceedings."

That's a nice way of saying that the conference was a mess. As Hogue suggests, it has now become likely that a UN-sponsored, worldwide agreement to limit greenhouse gas emissions is unattainable. Climate-change skeptics are elated by this development, but they should not be.

Their fundamental position is no longer tenable. No world leader who spoke in Copenhagen suggested that human-induced climate change is the fiction skeptics claim it to be. Copenhagen, in fact, established global climate change caused by human activities as a worldwide challenge, no longer deniable, that even the Chinese recognize they have to at least pay lip service to.

Do not underestimate the importance of lip service. Climate-change skeptics would have you believe that Chinese (and Indian and Brazilian) commitments to curb their contributions to global warming are meaningless. This misses the point entirely. China, India, Brazil, and other rapidly industrializing countries have now acknowledged that they have a responsibility to play a role in protecting the global climate. This is important progress that should not be dismissed.

Nevertheless, consensus doesn't equate with constructive action on climate issues. What is also now clear is that the U.S. should move forward to aggressively tackle climate-change issues outside of the UN-sponsored framework.

For starters, H.R. 2454, the 1,200-page climate-change and energy legislation passed by the House of Representatives in June 2009 that establishes a CO_2 cap-and-trade system, should be put out of its misery in favor of a simple carbon tax. Cap-and-trade is a sop to the coal, petroleum, and other energy-intensive industries; it does nothing but muddle the very simple need to put a price on carbon on which industry can base its capital-spending decisions. A carbon tax accomplishes that goal simply and efficiently.

The Europeans already are coming to recognize the inherent problems of cap-and-trade because they are experiencing them. The European Union and the U.S., together with Japan—already the most energy-efficient developed nation—should jointly enact a significant and escalating carbon tax that would promote real energy efficiencies and cuts in greenhouse gas emissions.

But wait, wouldn't that leave China, India, and other nations free to undercut the carbon-tax-inflated prices of goods from the U.S., the EU, and Japan? Not at all. Nations that adopt the carbon tax regimen should impose a carbon tariff equal to the carbon tax on all manufactured goods from countries that do not participate.

The Chinese, in particular, would protest such an action vociferously. Let them. China is not a developing nation; it is an authoritarian, industrialized, mercantile behemoth that is the world's largest emitter of greenhouse gases. It is time for the world to stop allowing China to pretend otherwise. If China wants to sell its carbon-tax-free products to developing nations in Africa, Asia, and South America, fine.

Many thoughtful economists have put forth mechanisms whereby a carbon tax would be truly revenue neutral, simultaneously discouraging the use of fossil fuels and stimulating development of alternative energy sources while protecting less affluent consumers. It's time to join forces with other developed nations to put one in place.

Thanks for reading.

Editor-in-chief

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

CHEMICAL SAFETY: SODIUM AZIDE HAZARDS

ROBERT SEIBERT'S letter contains an interesting account of an explosion that involved sodium azide (NaN_3) in the late 1940s (C&EN, Nov. 9, 2009, page 8). Following the dreadful accident, Seibert remembers remarking that the explosion must have been caused by wet methanol and warns about the dangers of adding sodium azide to wet methanol.

Because no further details about the contents of the reactor are given, there is nothing I can say about it but to clarify that NaN_3 does not form explosive compounds when dissolved in water. Besides its toxicity, the danger associated with NaN_3 is its ability to form explosive azides when reacted with heavy metals such as lead, copper, zinc, cadmium, or nickel.

Cesar Aliaga
Albany, Calif.

WHY BOYCOTT ISRAEL?

DAVID MENDENHALL defends the academic boycott of Israel (C&EN Sept. 21, 2009, page 3), which was denounced as bigoted in an earlier letter (C&EN, April 27, 2009, page 2). Mendenhall made two arguments against the notion that the boycott is bigoted: It "has widespread support in Britain and other European countries," and the activists he knows who support the boycott "are mostly Jewish."

I don't see how these arguments prove the nonbigoted nature of the boycott. Mendenhall seems to be contending that British and European academics, and Jews in general, are inherently tolerant of Jews and thus any activity they are involved in cannot be anti-Semitic or bigoted. One only wishes this were true. Anti-Semitism exists among a subset of British and European academics, and there are as many self-hating Jews as there are homophobic gay people; that is to say, not a lot, but some.

Mendenhall gives as an example of Israeli academic prejudice Haifa's new private college, the Carmel Academic Center, which closed its accounting academic major one week before classes started, allegedly because too many Arabs were registered. Let's put aside the fact that this is a brand-new college, just opening its doors, and a privately supported for-profit institution as well. Let's also put aside the "official" explanation that the major was canceled due to "financial considerations"; that is, not enough of the accounting students were paying tuition.

Even if one accepts that this brand-new, small private institution canceled a new major with racist intent, is this reason to support an academic boycott against every single academic institution in the country and all of the scientists who work in these institutions?

Regarding academic boycotts, I would say if you abhor the science that a certain researcher is doing, by all means, refuse to collaborate with him or her. If you disagree with the national policies of a certain government, by all means, write letters and encourage your government to withdraw foreign aid. But if you refuse to work with a fellow scientist because you abhor the policies of his or her government, I'm sorry. To me that does smack of bigotry.

Todd P. Silverstein
Salem, Ore.

MENDENHALL ARGUES that scientists should support an academic boycott of Israel. His thinking is warped.

Israel is not an apartheid state. That term has been selected by Palestinian propagandists as the way to delegitimize Israel and its existence. More than 1 million Arabs currently live in Israel, within the pre-1967 borders. But Palestine would be an apartheid state, once established. All Jews living in 1948 in what is now referred to as "Arab East Jerusalem" were forced to leave once the area was taken by Jordan; Palestinians refuse to allow any Jews to live in what they regard as "Palestinian lands."

An academic boycott is totally unwarranted, and 190 signatures, including many students', is not enough to show anything.

Joel Ackerman
Richmond, Calif.

INSULTING GENERALIZATION

I HAVE AN AVERSION to the following sentence, which appeared in an article titled, "DuPont Accuses Scientist of Theft": "Chinese students tend to have stronger allegiances to their alma maters than to the companies they work for" (C&EN, Sept. 28, 2009, page 47). This is a very serious charge to make because it attacks the morality of all Chinese students.

I don't deny that this statement might apply to some Chinese students, but definitely not to all. Plus, the same can be said of some students from other countries, even from the U.S. How could the author come to such a general conclusion or statement without any objective source? Or did this just come from the top of his head? Has he any survey or study to prove it? If there is support for this statement, it should have been provided in the article. If the statement is a personal opinion or impression, please say so clearly and do not imply that it is a generally accepted truth.

James Wang
Berkeley, Calif.

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C&EN news of the week

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FINALLY, PALAU'AMINE

ORGANIC SYNTHESIS: Ring formation anchors landmark conquest of complex marine natural product

WITH THE HELP of a daring cyclization reaction, a team led by Phil S. Baran at Scripps Research Institute has completed the first total synthesis of palau'amine, a marine natural product that has captivated synthetic chemistry groups around the globe (*Angew. Chem. Int. Ed.*, DOI:10.1002/anie.200907112).

Isolated from the sponge *Stylotella agminata* in waters near the Republic of Palau in the Pacific Ocean, palau'amine is a dauntingly complex alkaloid. It has eight contiguous stereogenic centers and a preponderance of reactive nitrogen-containing moieties. It is also highly polar, which can make it nightmarishly difficult to manipulate synthetic intermediates. The challenge of making such a complex structure has intrigued chemists for more than a decade.

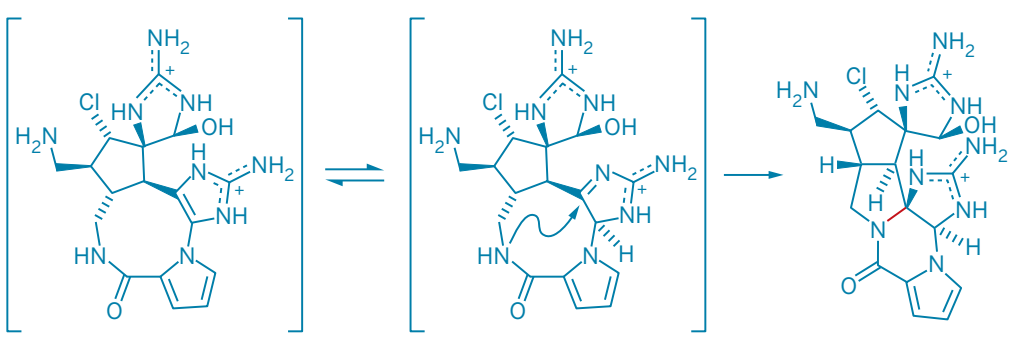
Until now, "palau'amine's unprecedented hexacyclic ring system and its nasty physical properties had undermined total synthesis endeavors in leading laboratories worldwide," says Larry E. Overman, an organic chemist at the University of California, Irvine, who has worked on palau'amine and its relatives in the pyrrole-imidazole alkaloid family.

Palau'amine's biggest chemical challenge is in its highly strained core, which features a peculiar trans junction between two five-membered rings. This feature was one of a few recent revisions to palau'amine's structure proposed by an international team in 2007 (C&EN, March 5, 2007, page 12). That revision was key to finishing the synthesis, but so were a combination of synthetic tenets that are the hallmark of the Baran lab. For instance, en route to palau'amine, the Scripps team harnessed the innate reactivity of nitrogen heterocycles, minimizing the use of protecting groups (C&EN June 4, 2007, page 38).

After several attempts to make the strained core met with failure, Baran, graduate student Ian B. Seiple, postdoctoral researcher Shun Su, and colleagues tried a different cyclization strategy. They reasoned that a hypothetical molecule with a large ring, which they dubbed "macro-palau'amine," might lead to palau'amine via cyclization across the large ring. Their strategy succeeded, but not until they had explored this line of attack for nearly two years.

Overman says the cyclization step "exemplifies the innovative retrosynthetic analysis and mechanistic thinking that underpins the Baran group's remarkable string of total synthesis successes in this area."

The Scripps team didn't make the natural product via proposed biomimetic cyclizations, notes Daniel Romo of Texas A&M University, who also has worked on this alkaloid family. "Together with their elegant, successful strategy, this raises intriguing questions about how palau'amine might really be made in nature," he says.



THE RING'S THE THING

Baran's team cemented palau'amine's core in place with a cyclization across a large ring.

Baran emphasized that the job isn't done. His team is working on an enantioselective version of the synthesis for obtaining gram amounts of material. Although initial reports of palau'amine's promising biological activity have yet to pan out, the structure and others like it are a fertile testing ground for chemical strategies. "The problem with most news stories about a synthesis is that they give the community a false sense of closure," Baran says. Unless chemists can routinely make large quantities of scarce natural products such as palau'amine for further investigations, the need for chemical innovation is far from over, he says. "I don't see this synthesis as an end—I see this as a beginning."—CARMEN DRAHL

NOVARTIS ACTS TO ACQUIRE ALCON

PHARMACEUTICALS: Deal will make Swiss giant a big player in eye care

ALCON

Alcon's Infiniti device uses low-energy ultrasound to remove cataracts.

NOVARTIS INTENDS to complete its acquisition of Alcon. It will do so by first purchasing a 52% stake currently owned by Nestlé. It will then buy what remains of Alcon on the stock market. In total, Novartis will have spent $49.7 billion to take over the ophthalmic products firm.

The Swiss drug giant paid Nestlé $10.4 billion in 2008 for a 25% stake in Alcon. It is now exercising an option under that agreement to purchase Nestlé's remaining stake in Alcon for $28.1 billion, or $180.00 per share. Novartis then plans to spend $11.2 billion for the 23% of the company in publicly owned shares.

Nestlé purchased Alcon, which was based in Fort Worth, Texas, in 1977 for $280 million. It later floated part of it on the stock market. In 2008, Alcon had $6.3 billion in sales divided among surgical products (46%), pharmaceuticals (41%), and consumer products such as eye drops (13%).

The deal is the most recent move by a large pharmaceutical firm to supplement income from traditional prescription drugs by acquiring over-the-counter, generic, or specialty health care businesses. Last month, for example, Sanofi-Aventis announced plans to acquire Chattem, a U.S.-based consumer health care firm, for $1.9 billion (C&EN, Jan. 4, page 11).

"The addition of Alcon will strategically strengthen our health care portfolio and our position in eye care, a sector with dynamic growth due to the increasing patient needs of an aging population," says Novartis CEO Daniel Vasella.

Vasella adds that the acquisition will combine Alcon's research and marketing assets with Novartis' Ciba Vision eye-care business, which specializes in contact lenses. Novartis estimates that the combined business will have annual sales of about $8.5 billion and cover 70% of the global vision-care market.

Eric Le Berrigaud, a stock analyst with Raymond James, in Paris, says Novartis' acquisition can be viewed as part of a significant restructuring of its overall business that would justify the high price it is paying. "This is an expensive deal," he says. "But Novartis is not only looking to offset patent expiry; it is looking to build a new Novartis for the next decade."—RICK MULLIN

RESTRICTING DIOXIN IN DIRT

ENVIRONMENT: EPA proposes to strengthen cleanup guidelines

IN A MOVE THAT could portend more extensive and expensive cleanups, EPA is proposing to tighten its guidelines for remediating dioxins and related chemicals in soils.

EPA proposes what it calls "preliminary remediation goals" of 72 ppt for dioxins, furans, or polychlorinated biphenyls in residential soil and 950 ppt for the chemicals in commercial or industrial land. EPA defines these goals as "national levels protective for cancer and noncancer effects from human exposure by ingestion and dermal contact with surface soils."

The proposed levels would be significantly lower than EPA's current preliminary remediation goals, set in 1998. Those are 1,000 ppt for residential soil and a range of 5,000–20,000 ppt for commercial or industrial soil.

CHERYL HOGUE/C&EN

Signs like this one posted by the state of Michigan warn about dioxin in fish from waterways downstream of Dow's headquarters in Midland.

Once finalized, EPA will ask its regional offices, states, and tribes to use the new goals, which are not legally binding, as starting points as they craft cleanup plans for contaminated sites.

The proposed goals, which the agency released on Dec. 31, 2009, take into consideration the potential for absorption of dioxins through skin in contact with contaminated soil, EPA says.

Environmental groups praised EPA's move, saying it will lead to better protection of the public and the environment. But some in industry disagree.

"Soils aren't really a primary route of exposure" for dioxins, says Mary Draves, a spokeswoman for Dow Chemical. She tells C&EN that current remediation goals are already protective of health.

Dow is facing cleanup of dioxins in two rivers downstream of its Midland, Mich., plant as well as Saginaw Bay in Lake Huron (C&EN, Aug. 11, 2008, page 15). The contamination stemmed from the chemical maker's past operations.

The American Chemistry Council, a trade association of chemical manufacturers, criticized the proposal, saying it is unclear why EPA proposed the new cleanup goals before the agency has finished its comprehensive reassessment of dioxins.

EPA says the newly proposed preliminary remediation goals, which it intends to finalize by midyear, would be an interim measure until it finishes reassessing health and environmental risks posed by dioxins. That is expected by the end of 2010.—CHERYL HOGUE

PAPER STIRS CONTROVERSY

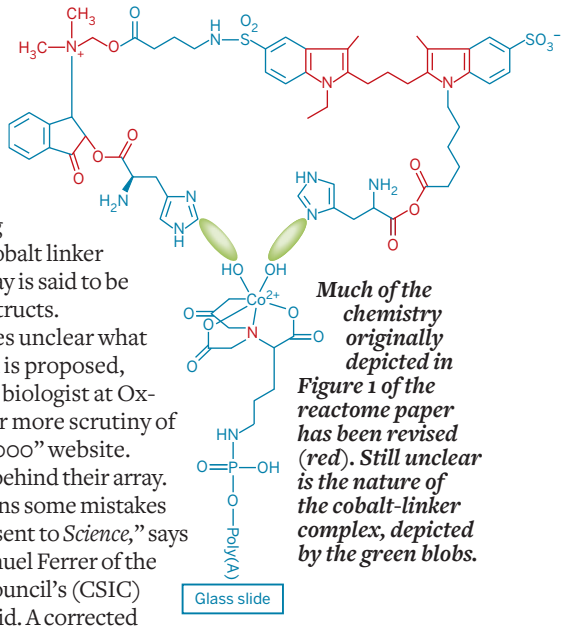
INTERDISCIPLINARY RESEARCH: Work on a new array describes chemistry that experts see as unclear at best

A BIOCHEMISTRY PAPER published in the Oct. 9, 2009, issue of *Science* is generating controversy on blogs, Twitter, and other networking forums. The paper describes a reactome array, a sensitive metabolite array for obtaining detailed quantitative profiles of a cell's metabolic networks (*Science* **2009,** *326,* 252). It has been viewed, at worst, as fraudulent and, at best, as a glaring example of the pitfalls of refereeing interdisciplinary research.

The outcry has been so intense that *Science* Editor-in-Chief Bruce Alberts has issued an "Editorial Expression of Concern" (DOI: 10.1126/science.1186078) to alert the journal's readers "to the fact that serious questions have been raised about the methods and data presented" in the article. Alberts writes that the journal has "requested evaluation of the original data and records by officials at the authors' institutions: These officials have agreed to undertake this task."

One of the first people to raise concerns about the paper was Laura L. Kiessling, professor of chemistry and biochemistry at the University of Wisconsin, Madison, and editor of *ACS Chemical Biology*. "The chemistry just doesn't make any sense," Kiessling says. Like many other experts, she is puzzled by the highly unstable array linkages depicted in Figure 1 of the paper, characterizing them as unlikely at best.

"The more I looked at Figure 1, the less I understood," says Timothy Mitchison, professor of systems biology at Harvard University. The figure depicts the reactome strategy, in which a small-molecule substrate is joined to both a dye and a cobalt-containing linker. When a metabolic enzyme reacts with the substrate, the dye is purportedly released, giving off a glowing signal, and the cobalt linker captures the enzyme. The array is said to be made of over 1,000 such constructs.



Much of the chemistry originally depicted in Figure 1 of the reactome paper has been revised (red). Still unclear is the nature of the cobalt-linker complex, depicted by the green blobs.

Figure 1

In particular, Figure 1 leaves unclear what sort of cobalt-linker complex is proposed, says Ben G. Davis, a chemical biologist at Oxford University who called for more scrutiny of the work on the "Faculty of 1000" website.

The study's authors stand behind their array. Figure 1, "as published, contains some mistakes that have been corrected and sent to *Science*," says co-corresponding author Manuel Ferrer of the Spanish National Research Council's (CSIC) Institute of Catalysis, in Madrid. A corrected figure and supporting information are available on a CSIC website, he says.

Davis notes that rigorous structural verifications of the team's intermediates are still largely absent from the revised supporting information. Ferrer says that all the team's structural information will be provided to the CSIC commission charged with evaluating the data, "and after that, they will be incorporated to the Web page."

"It's great that biological people are trying to use chemistry," Kiessling says, but she worries that the chemistry in some instances doesn't get enough scrutiny. "There should be appropriate reviewers," she says, noting, as have others, that no chemists reviewed the reactome paper. "There should be high standards," she adds.

Science will continue to monitor its review processes, in particular the review of supporting information, Alberts tells C&EN. "Reviewers are often overwhelmed by the amount of information contained there," he adds, "especially when an immense amount of information is added in a revision, as happened in this case."—CARMEN DRAHL AND WILLIAM SCHULZ

& MORE ONLINE

BIOTECHNOLOGY Biogen Idec's Mullen will step down as CEO in June

In the latest changing of the guard at a big biotech company, James C. Mullen, president and CEO of Biogen Idec, will retire in June. The move comes after several turbulent years at the Cambridge, Mass.-based firm.

Mullen worked at Biogen Idec for more than 20 years and has been CEO since 2000. Although the firm flourished in the early part of his tenure, it has struggled more recently to coax new products from its pipeline.

The company has not commercialized a new drug since 2005, when it launched the multiple sclerosis treatment Tysabri. The drug was quickly pulled from the market after it was linked to a life-threatening brain infection in a handful of patients. Tysabri eventually returned to the market and brought in $589 million in 2008, but the potential side effect makes reaching blockbuster status a challenge.

Biogen does have several key drugs in its late-stage pipeline, and sales of its staple products have started to grow again. Still, over the past two years, corporate raider Carl Icahn has been trying to force the company to sell or otherwise change.

Mullen's exit follows the departure of another Boston-area biotech CEO. In May 2009, Joshua Boger, founder of Vertex Pharmaceuticals, retired from the CEO role he held for 17 years just as the company prepared to launch an important drug for hepatitis C. Some industry observers believe Henri A. Termeer, CEO of Genzyme, could be next. Genzyme shareholders have called for change after manufacturing problems caused shortages of key products.

Biogen says it has begun a search for Mullen's successor.—LISA JARVIS

BURDEN OF POLLUTION

SUPERFUND: EPA explores tougher financial requirements to ensure that companies pay for cleanups

EPA wants to ensure that companies don't leave taxpayers to pay for costly toxic cleanups.

FANTAIL MEDIA

THE ENVIRONMENTAL Protection Agency is considering new regulations that will require chemical companies to have adequate resources to clean up environmental damage that may result from their operations. In a late-December announcement, EPA said it is taking the first step to ensure that plant owners—not taxpayers—foot the bill for cleaning up pollution under the Superfund law.

In explaining its concern, the agency cited the case of Vertac Chemical, in Jacksonville, Ark. When the firm went bankrupt in 1986, it left behind 29,000 drums of chemical waste and a $127 million cleanup bill to be paid by the federal government. EPA also singled out a Delaware chlorinated-benzene manufacturer that folded in 2002, sticking federal taxpayers with a cleanup tab that is expected to reach $100 million.

EPA has spent some $2.7 billion of taxpayer dollars through 2009 to clean up pollution from bankrupt chemical company plants. In the past, a Superfund tax on chemicals paid for the cost of cleanups when companies could not, but that tax ended in 1995.

By law, EPA must require facility owners to show "evidence of financial responsibility consistent with the degree and duration of risk" from plant operations, the agency noted. But chemical plants, which often handle large quantities of toxic chemicals, can sidestep these requirements by a change of ownership, EPA explained. The agency's view is supported by a 2005 Government Accountability Office report warning that chemical companies are at risk of incurring huge environmental liabilities but can avoid this liability through bankruptcy.

At this time, EPA said it is seeking comments only on the need for new financial assurance requirements and the form they might take. EPA's announcement affects not only chemical companies but also petroleum refineries, gas and coal-related industries, and electric power generation companies.

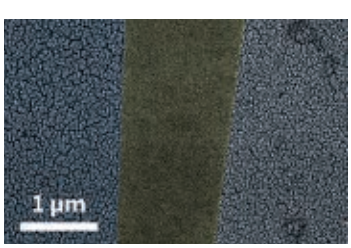
Future requirements are yet to be determined, an EPA official stressed, but options could include insurance or establishment of a dedicated cleanup fund. The American Chemistry Council, an industry trade association, is monitoring the issue and meeting with member companies to gauge the impact the requirements could have, an ACC official said.—JEFF JOHNSON

GILDED GRAPHENE

MATERIALS: Gold coat and microscopy methods offer new way to see and analyze atoms-thick carbon sheets

GRAPHENE FILMS between one and four atomic layers thick can be distinguished by coating them with a layer of gold. According to a new study, the gold layer adopts a unique appearance based on the number of graphene layers (*J. Am. Chem. Soc.*, DOI: 10.1021/ja909228n).

LIANFENG SUN/NCNT



COLOR CODED In this SEM image, a thin gold coat helps distinguish a four-layer-thick region of graphene (left) from bare silica (middle) and a bilayer region (right).

Graphene's exceptional electronic, optical, and mechanical properties have recently focused attention on the sheet of carbon as little as one atom thick. Yet advances in this area have been hampered by the small number of microscopy and spectroscopy techniques capable of "seeing" graphene and distinguishing between samples of various thicknesses.

The study, by Lianfeng Sun of the National Center for Nanoscience & Technology, in Beijing, and coworkers, adds to a short list of recently developed techniques for enhancing contrast between graphene films of various thicknesses and between the carbon films and the solid surfaces that typically support them.

Sun and coworkers used Raman microspectroscopy to benchmark the number of atomic layers in graphene samples and mapped out regions of differing thickness within a single sample. Then they evaporated gold onto the samples. They found that they could use scanning electron microscopy to recognize differences in the morphology, grain size, and general appearance of the gold films and that those differences depend directly on the number of underlying graphene layers. The SEM analysis can be done faster and with higher spatial resolution than the Raman analysis, they say.

"This work reveals an intriguing layer-dependent surface property of graphene," says Jiaxing Huang, a materials science professor at Northwestern University. That property may play a diagnostic role in future hybrid materials and electronic devices built from metal-graphene composites, he adds.

Huang's group just developed an alternative method for graphene imaging that exploits graphene's knack for quenching fluorescence in nearby dye molecules. Treating a solid that supports numerous graphene samples with fluorescein (which can be removed after analysis) causes the carbon films to appear dark, in strong contrast to bare regions of the support, which fluoresce brightly. The technique can distinguish between films of various thicknesses and works on films suspended in solution, they report (*J. Am. Chem. Soc.* **2010,** *132,* 260).—MITCH JACOBY

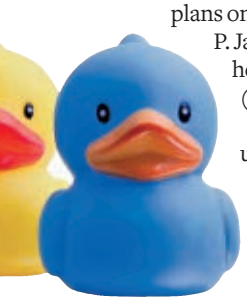
TARGETED FOR REGULATION

TOXIC SUBSTANCES: EPA names four categories of chemicals for action, including restrictions and bans

FOUR CATEGORIES of chemicals are squarely in the sights of the Environmental Protection Agency for possible regulation that could go as far as banning their production.

Targeted by the agency are phthalates, some perfluorinated compounds, polybrominated diphenyl ethers, and short-chain chlorinated paraffins, which are defined as having chains of between 10 and 13 carbons and three to 12 chlorines per molecule. EPA is concerned about the toxicity of all the chemicals, and some could also be persistent, bioaccumulative, or both.

The agency announced the first set of chemical action plans on Dec. 31, 2009. EPA Administrator Lisa P. Jackson had called for the plans as part of her chemical management reform efforts (C&EN, Oct. 19, 2009, page 28).



"We will continue to use our authority under existing law to protect Americans from exposure to harmful chemicals and to highlight chemicals we believe warrant concern," Jackson says.

Under the action plans, EPA is considering regulations to restrict or even ban eight phthalates, all short-chain paraffins, and two types of perfluorinated compounds: perfluorinated sulfonates and perfluoroalkyl carboxylates. The agency has not attempted to ban a chemical since 1989, when a federal court overturned EPA's ban of asbestos.

In addition, EPA says it will invoke a section of the 1976 Toxic Substances Control Act that it has never before used to allow the agency to create a list of chemicals that "may present an unreasonable risk of injury to health and the environment." EPA says it intends to add the eight phthalates and commercial penta-, octa-, and decabromodiphenyl ethers (BDEs) to that list.

Inclusion on the list publicly signals the agency's "strong concern about the risks that those chemicals pose and the agency's intention to manage those risks," EPA says. "Once listed, chemical companies can provide information to the agency if they want to demonstrate that their chemical does not pose an unreasonable risk."

Also, EPA intends to add six of the phthalates to the Toxics Release Inventory later this year. The remaining two of the eight are already listed.

Phthalates, used in some toys, are among the compounds in EPA's action plans.

SHUTTERSTOCK

Through a planned new regulation, EPA would reinforce a voluntary phaseout of commercial decaBDE by major manufacturers and importers (C&EN, Jan. 4, page 10). That regulation would require an EPA review of any new uses of this flame retardant before the chemical could return to the market.

The American Chemistry Council, an association of chemical manufacturers, says EPA's initial set of action-plan chemicals "seems to have been selected based on little more than their current 'high profile' nature." The process for choosing the chemicals, "to date, provides no evidence of a systematic, science-based approach to chemicals management," ACC President Calvin M. Dooley says.

More information on EPA's chemical action plans is available at epa.gov/oppt/existingchemicals/pubs/ecactionpln.html.—CHERYL HOGUE

INDUSTRIAL SAFETY Explosion at Japanese fluorine chemistry plant kills four workers

Four workers doing maintenance died when a tank used to store boron trifluoride blew up on Dec. 24, 2009, at a Morita Chemical plant in Osaka, Japan. The firm has appointed a committee of experts to find out what caused the accident.

At the time of the accident, the workers were sawing a hole into the tank to remove sludge that had been created while the vessel was being cleaned with water, the company told Japanese media. Company officials said there was no BF_3 in the vessel when cleaning started.

KYODO/AP

BF_3 is a gas widely used as a catalyst in organic synthesis. It is not described as explosive in the material safety data sheets of BASF, Air Liquide, and Praxair, three other companies that produce it.

But BF_3 reacts with water to form hydrogen fluoride, a toxic and unstable gas, says Yongxin Han, head of chemistry at the drug discovery services firm Chemizon, in Beijing. It's possible that the explosion was caused by excessive buildup of gas pressure, he speculates. Allan Hong, a partner at Shanghai-based China cGMP Group, an auditor of drug manufacturing plants, says moisture in the air is enough for BF_3 to generate HF.

Consistent with a gas buildup scenario, no signs of combustion are visible in photos of the accident scene (shown). Morita has focused on fluorine chemistry since it was founded in 1917.—JEAN-FRANÇOIS TREMBLAY

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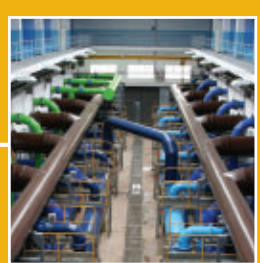

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IN THE RED Economists say demand for autos and other big-ticket items will remain sluggish this year.

WORLD CHEMICAL OUTLOOK

BUSINESSPEOPLE are optimists by nature, and that trait comes through in their predictions for the chemical enterprise's year ahead. Beaten and bruised by two years of the worst economic conditions since the Great Depression, they still expect better times in 2010.

Even economists, practitioners of the dismal science, have positive thoughts about the new year. The American Chemistry Council forecasts that U.S. chemical output will increase by 3.0% this year. The trade group's European counterpart, the European Chemical Industry Council, is more optimistic, predicting a 4.7% rise in output for that region's industry. Of course, these modest gains won't offset the losses of 2009.

Regardless of the region, some chemical markets will be more robust than others. For example, after collapsing in 2009, sales of electronic materials will jump by 18% in 2010, predicts Semiconductor Equipment & Materials International, a trade association. And Dow Chemical sees the photovoltaic market expanding by 35% this year and for several years thereafter.

On the opposite end of the spectrum, the outlook for coatings and other construction materials is positively dour: Growth predictions from industry executives range from 0 to 4% this year. Falling in the middle, U.S. chlorine demand could rise 10%, Occidental Chemical expects, thanks to a robust export market for U.S.-made polyvinyl chloride.

THE FATE OF certain markets this year depends on more than just the economy. For example, any recovery in demand for petrochemicals around the world may be swamped by a flood of long-dreaded new production capacity in the Middle East.

Success for pharmaceutical companies in 2010 will require circumventing the approaching patent expiration "cliff" with great new products or, barring that, big-ticket acquisitions. Likewise, manufacturers of pharmaceutical fine chemicals also need great new products from their drug industry customers or, barring that, more outsourcing of existing products.

Regular readers of this annual C&EN feature will notice that it has been revamped considerably for 2010. Gone are the five long geographic reviews of years past. In their place are 16 brief snapshots of markets and regions. Taken together, they offer a comprehensive view of what's in store for the chemical industry this year.

World Chemical Outlook was compiled by Assistant Managing Editor Michael McCoy, Senior Correspondent Marc S. Reisch, and Senior Editors Lisa Jarvis, Rick Mullin, and Alexander H. Tullo in New Jersey; Senior Editor Melody Voith in Washington, D.C.; Senior Correspondent Jean-François Tremblay in Hong Kong; and Senior Correspondent Ann M. Thayer in Houston.

ISTOCK

FINANCE: CREDIT RETURNS, BUT OVERCAPACITY CASTS A SHADOW

FOR HIGHLY LEVERAGED chemical companies, 2009 was a frightening year. U.S. firms LyondellBasell Industries, Tronox, and Chemtura filed for bankruptcy when they could not refinance debt in the frozen credit markets. Even DuPont, with its solid balance sheet, put the whole company to work finding ways to increase free cash flow.

"Free cash flow—what management can control—improved in 2009 compared with 2008. It's one of the things that went right to preserve credit quality during a grim period in the industry," reflects Kyle Loughlin, credit analyst at Standard & Poor's. Although the crisis in the financial markets has eased, the focus on cash and debt repayment will continue in 2010.

And the industry will have to pay more to borrow money than it did in the boom years of 2006–07. During that time, many companies let their credit ratings slip, and for them the cost of capital will remain high. But Loughlin reports that sequential earnings gains have prompted S&P to raise many credit ratings.

With slow volume growth expected in 2010, the new problem is lingering overcapacity. According to the European Chemical Industry Council (CEFIC), "The industry is operating far below its optimal capacity utilization levels, which in turn means lower production efficiency and reduced margins." Industry watchers agree that companies will preserve cash by cutting capital spending further in 2010.

Rather than wait for demand to return, "many of our clients really have to rethink their business models," advises Tim Hanley, global chemical group leader at business consultancy Deloitte. "They have to make sure the cost structure matches current demand. They'll be looking at supply chains, what and where they manufacture, and administrative costs."

Hanley puts a high value on the flexibility of chemical firms to respond to different growth scenarios. "They see much stronger demand in the developing world—Asia and Latin America—and constrained demand in the U.S. and Western Europe," he says, but they have to have a plan to capture it.

Loughlin and Hanley expect acquisitions to play an important role in the industry's restructuring. "With renewed growth in the economies of the world, you'll see the focus turn back to strategies for growth and profitability," Loughlin predicts. A Deloitte report suggests attractive U.S. chemical markets will be pharmaceuticals, heavy construction, and municipal water treatment. In Europe, personal care and pharmaceuticals will grow the most through 2014.

Worldwide, much of the economic growth in 2010 will be spurred by stimulus spending. But industry economists are concerned about what happens when the spending inevitably slows. The timing of any change in policies "will need to be finely judged in order that the recovery is not put in jeopardy," CEFIC warns.—MV

CONSTRUCTION: RECOVERY FROM RECESSION WILL BE LONG AND SLOW

IN A RECENT STUDY of the chemical industry, consulting firm Deloitte predicts that the recession will have a long-lasting effect on makers of construction chemicals and paint ingredients. The study's authors point out that the size of the U.S. housing market, for instance, dropped 47% between 2007 and 2009 to $178 billion. By 2014, Deloitte expects, the market will rise to $254 billion, still 24% below 2007 levels.

Although government stimulus spending on infrastructure projects in 2010 will increase demand for construction materials, Deloitte cautions that "what we could be seeing now as a rebound is more of a reset." In fact, the study suggests that "some key end markets in certain geographies may take half the decade or longer to reset to 2007 levels, and business models will have to be adjusted accordingly."

Luis Fernandez, vice president of Dow Chemical's coating materials business, forecasts that global paint demand will increase by 0 to 2% in 2010 compared with last year. However, the strength of coatings markets will vary depending on the region.

For example, the U.S. architectural coatings market in 2009 was about 30% below the peak year of 2006, Fernandez says. He expects 2010 sales to be flat compared with 2009, with a percentage increase in the high single digits in 2011.

On the other hand, Fernandez says he has seen a "tremendous rebound" in sales of architectural coating materials since the beginning of 2009 in China, Southeast Asia, and Brazil—in some cases at double-digit rates. And he looks forward to similar strong growth in 2010 and 2011. But even if 2010 sales are flat in many markets, "it will be an improvement over 2009," he says.

The global market for construction-related chemicals will continue to be "a challenge" in the first half of 2010, with improvements coming in the second half, says Andrew Bonham, president of W.R. Grace's construction unit. He predicts that world construction chemicals consumption will grow between 2 and 4% for the year. But those numbers will depend on the timing of the recovery in different regions and on construction material costs.

Bonham expects only a modest recovery in the North American residential market in 2010 and figures that commercial construction's rebound will lag residential by six to eight months. A bright spot in Western Europe will be U.K. spending on infrastructure to get ready for the 2012 London Olympics. Yet construction will be down in Spain because of earlier overbuilding. And "China, of course, will see higher growth in 2010," Bonham says, along with rapidly developing economies in Latin America, the Middle East, and India.—MSR

SHUTTERSTOCK

FMC

DIGGING OUT FMC mines soda ash in Green River, Wyo.

INORGANICS: CAUSTIC SODA, SODA ASH PRODUCERS HOPE FOR A CALMER 2010

LIKE MOST chemical makers, companies that manufacture inorganics look forward to a better year in 2010. But for producers of caustic soda and soda ash—two of the sector's staple commodities—a smoother ride is on the wish list as well.

Caustic soda, the chemical industry's workhorse alkali, has always traveled a bumpy road because it is coproduced with chlorine via the electrolytic separation of sodium chloride. Because chlorine is a gas and not easily stored, it drives chlor-alkali production. Caustic soda must make the best of the ride.

As 2009 began, poor demand for polyvinyl chloride, a plastic used extensively in construction, kept U.S. chlorine demand low and constrained output of caustic soda, recalls B. Chuck Anderson, president of Occidental Chemical, the world's largest merchant marketer of chlorine. Chlorine sales may have been way off, but OxyChem and its competitors were getting upward of $1,000 per ton for caustic soda.

Then destocking started. Seeking to hold on to cash, customers stopped buying caustic, letting their inventories run down instead. "People were desperate to move product, and that caused a freefall in prices," Anderson says. By June 1, caustic soda was selling for just $60 per ton on the spot market.

Business bottomed out at midyear, Anderson says, and chlorine demand perked up some in the second half, thanks to healthy exports of PVC, which benefited from low raw material prices. He sees the trend continuing and chlorine demand rising as much as 10% in 2010.

U.S. soda ash producers endured their own whipsaws last year as they faced down new Chinese competitors in the export market. Michael Wilson, general manager of FMC's industrial chemical business, the number one U.S. soda ash maker, says demand weakened significantly in the first half of 2009. But in the second half, the U.S. industry used its favorable cost position to gain export market share, particularly in Asia.

Wilson anticipates a modest recovery in soda ash demand across the globe this year. Even better, he expects that the U.S. industry will run at nearly 100% of its capacity in 2010.

FMC's other big inorganic, hydrogen peroxide, suffered last year, Wilson says, with North American demand falling as much as 25%. He expects an improvement of only 3 to 4% in 2010. Specialty peroxygens, such as persulfates and peracetic acid, weathered 2009 much better, he adds, and the outlook for 2010 is good, thanks to robust environmental and food safety markets.—MM

UNITED STATES Chemical industry prepares for a slow recovery in 2010

The deepest recession since the Great Depression is in the rearview mirror, and economists have turned their attention to the shape of the recovery. In the U.S. and other developed economies, the modest growth projected for 2010 will not make up for the precipitous drop in demand that began in late 2008.

For the U.S. chemical industry, output excluding pharmaceuticals declined by 9.4% in 2009, according to T. Kevin Swift, senior economist at the American Chemistry Council (ACC), a chemical industry trade association. In 2008, output fell 6.5%. Basic chemicals were especially hard hit in 2009, contracting 21.5%.

After bottoming out in June of last year, the chemical industry's fortunes began to turn in the third quarter as demand stabilized. Swift projects U.S. chemical output will grow 3.0% in 2010 and that pharmaceuticals will see a 4.1% boost.

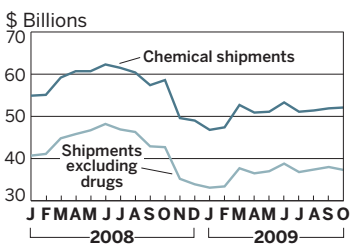
The beginnings of the recovery will be seen in rising inventories, now that the rapid destocking that followed the financial collapse has ended. "The construction and auto markets have run out of inventory and are upping production," Swift observes. However, underlying demand is questionable.

A normal economic recovery is *V*-shaped due to pent-up demand, but this one is expected to be more shallow, agrees Tim Hanley, chemical group leader at business consultancy Deloitte. "We should expect a reset environment rather than a rebound environment," Hanley warns. "Some consumer product end markets are strong—for example, soaps and detergents and personal care. But auto, housing, and construction markets will stay weak."

Swift says low natural gas prices and the weak dollar will make the U.S. more competitive than other developed economies. But many U.S. chemical plants that were idled during the recession will not come back on-line.

DEMAND

Early 2009 was a low point for chemical shipments



SOURCE: Department of Commerce

During the recession, the chemical industry conserved cash by cutting capital spending by 20.1%, according to ACC. Even if growth comes back, companies have significant excess capacity. In 2009, capacity utilization was extremely low, at 70.1%, and will grow only to 72.9% in 2010. Swift says firms won't begin investing again until 2011.

But any increase in spending will not reverse the loss in chemical employment. The industry lost more than 37,000 jobs, or 4.4% of its workforce, in 2009. Swift anticipates productivity gains will cause more job losses in 2010.—MV

ELECTRONICS: NEW PRODUCTS WILL PUT INDUSTRY BACK ON TRACK

THE ECONOMIC DOWNTURN that began in late 2008 savaged the global electronic materials industry. But optimism is returning. Demand has been unexpectedly strong over the past six months as electronic device developers launch new products and China stimulates consumer demand. Meanwhile, the solar energy market continues to expand.

Demand for electronics is driven by a fundamental trend that can be called "consumerism," says Sam Shoemaker, commercial leader for semiconductor technologies at Dow Chemical. Around the world, "people want mobile phones, personal digital assistants, and other small portable devices," he says. Another underlying trend is demand for alternative power sources like solar.

RECOVERING

Market will take years to return to its 2007 peak

GLOBAL ELECTRONIC MATERIALS SALES, $ MILLIONS	2007	2008	2009[a]	2010[a]	2011[a]
Silicon wafers	$12,830	$11,924	$7,179	$9,044	$10,149
Photomasks	2,975	2,900	2,491	2,590	2,846
Photoresists	1,144	1,116	926	1,091	1,198
Photoresist ancillaries	1,219	1,225	1,144	1,350	1,483
Wet chemicals	904	923	905	941	983
Gases	3,229	3,100	2,515	2,965	3,257
Sputter targets	480	508	356	391	438
CMP slurry & pads	1,024	1,007	897	1,092	1,218
Other/new materials	1,271	1,439	1,359	1,575	1,757

a Estimates. **SOURCE:** SEMI

In 2010, Shoemaker predicts, demand for semiconductor materials will be stimulated by strong sales of personal computers, mini laptops called netbooks, and smart phones. Interaction among electronic appliances, he points out, will rise.

To operate quickly, today's interactive devices require semiconductors that are integrated with other devices in ways that were impossible until recently, says Corning Painter, general manager of global electronics at Air Products & Chemicals. "Devices now feature silicon chips that look the same as before and are still loaded with transistors, but our industry is developing technology to combine built-in capacitors, antennas, and so on, integrating more components of the system into one package."

The breakthrough is great news for the electronic materials industry, Painter says. In fact, the downturn brought an unexpected side benefit, he adds. With production lines idle, semiconductor makers were receptive to trying out new materials. "While 2009 was a disaster economically, it was a good year for introducing materials that you had ready on the shelf, that were just at the cusp of being introduced," he says.

Near term, Painter is less bullish on the solar energy market, another big outlet for electronic materials. Solar project promoters are finding it hard to secure financing, he says, and thus the pace at which new solar cell manufacturing facilities are being built has slowed. In addition, buyers of solar energy components are more focused on costs than on innovation.

Nancy Chiarotto, global marketing director for Dow's photovoltaic business, is fine with that. "We're completely focused on decreasing cost per watt," she says. Unlike Painter, she doesn't see the industry's focus on cost as a limitation. Dow provides materials that didn't exist before, Chiarotto points out. One, for example, is a cleaner that removes debris from silicon wafers so solar cells can better absorb the sun's rays.

The photovoltaic market will grow 35% annually over the next five years, Chiarotto predicts: 45% for thin-film solar cells and 30% for cells made from polysilicon. "Dow is very interested in participating in this market," she says.—JFT

SPECIALTIES: 2010 WILL BE ALL ABOUT THE END MARKET

THE SPECIALTY chemical business has yet to recover in the U.S., says T. Kevin Swift, senior economist at the American Chemistry Council, a chemical industry trade association. U.S. production of specialties—including paper additives, inks, cosmetic chemicals, plastic additives, and detergent ingredients—dropped almost 15% in 2009 compared with the year earlier. And Swift doesn't see them improving by more than 1% in 2010.

Likewise, Frederick M. Peterson, president of chemical industry consulting firm Probe Economics, says economic recovery in 2010 will mean some demand increases for specialty chemicals, but he doesn't expect a robust rebound while banks remain cautious and consumers continue to pinch pennies. For these reasons, plastic additives used in cars, televisions, refrigerators, and other durable goods are not likely to do well in 2010. But plastic additives used for steady-selling nondurable goods, such as food packaging, are likely to do better.

SHUTTERSTOCK

Other specialties will suffer more because of technology trends than consumer affordability. Many past devotees of the printed word now are getting their news from the Internet or electronic readers such as Amazon's Kindle, meaning less demand for printing inks, says Ray Will, a senior consultant at SRI Consulting.

Will sets the global printing-ink market at about 4.2 million metric tons in 2008 and expects it to grow by less than 1% annually over the next five years. For the same reasons, he expects lower demand in the future for paper additives, which he projects will decline at an average annual rate of 0.2% between 2008 and 2013.

Cosmetic chemical suppliers just witnessed a year in which their luxury-brand customers experienced a 30% drop in sales compared with 2008, says Gillian Morris, director of chemicals and materials at consultants Kline & Co. But mass-market cosmetic makers saw only a small decline in sales last year, and it's now business as usual for them and their raw material suppliers, both of which hope to maintain market share gained from luxury brands.

With little or no growth expected for personal income in developed countries, shopping patterns have changed to an emphasis on "value brands," says Eunice Heath, general manager of Dow Chemical's home and personal care business. In those countries this year, demand for surfactants and other ingredients for personal care and laundry products isn't likely to grow more than 5% over 2009 levels, Heath says. But in developing markets such as Brazil, China, and other Southeast Asia countries, demand is "robust" and likely to grow between 5 and 10%, she says.—MSR

SYNGENTA

CROP PROTECTION: WATCHING OUT FOR EL NIÑO

COMPANIES IN THE crop protection business are generally wont to stress the rosy business prospects ahead of them. Long-term demand for their products is fueled by the rise in incomes and populations worldwide, higher production of biofuels, and the finite area of cultivable land on the planet.

On a year-to-year basis, however, the future is far less predictable. The age-old question of what kind of weather the year will bring always hangs over the business. During a drought, farmers are likely to put fewer seeds into the ground and spend less protecting what they do plant.

Amid high prices for major commercial crops, the past two years have been very good for suppliers of agrochemicals and seeds. Although sales at major crop protection product firms mostly slipped in the first three quarters of 2009, this came after an exceptionally strong 2008. That year, sales at leading Swiss firm Syngenta surged by 21%. In the fiscal year that ended March 31, 2009, Sumitomo Chemical expanded sales in its agrochemical segment by 11%.

In 2010, weather in the Northern Hemisphere will be the big story to follow. After three years of higher than usual rainfalls in Europe and North America, droughts are likely to follow, says Gautam Sirur, principal consultant at crop protection market research firm Cropnosis.

"We've had two years of drought in the Southern Hemisphere," Sirur says. "Normally, the El Niño cycle breaks that pattern. You get heavy rainfall in Latin America and Australia, and drought in North America, Europe, and parts of Asia." Typically, he says, by the time drought hits North America and Europe, most crops have been planted, and farmers spend less on insecticides and fungicides. In Asia, drought occurs before planting gets under way, so fewer seeds will be planted, he expects.

Weather is more than just a seasonal story for the crop protection business, Sirur points out. Worldwide, more water shortages are taking place, he says, and seed suppliers have been busy trying to develop crop strains that can thrive on less water. Because the needs of farmers keep changing, Sirur expects companies that come up with innovative crop protection products will continue to have the upper hand over manufacturers of generic products.

At Sumitomo, a spokesman reports that the 2010 outlook for the whole industry is sunny, and not just because of the weather. "Taking into account future climate changes, agrochemicals are essential for producing a stable supply of crops efficiently," he says. "All companies will probably continue to see strong revenues in 2010."—JFT

LATIN AMERICA Dodging the economic bullet, the region has ambitious plans

It used to be that a U.S. recession would mean a severe downturn for Latin America. The region has avoided that fate this time around, largely because many countries have gotten problems such as inflation under control.

National experiences varied last year, according to the International Monetary Fund (IMF). Mexico saw a 7.3% decline in gross domestic product; Brazil slipped merely 0.7%. Except for Peru, which posted 1.5% growth, most major Latin American economies fell somewhere between Brazil and Mexico.

IMF expects every Latin American country but Venezuela to rebound in 2010. "Brazil will lead the way, in part because of its large domestic market and diversified export products and markets, especially its increasing links to Asia," according to IMF.

Domestic polymer sales at Brazil's largest chemical maker, Braskem, were down 7% for the first nine months of 2009 versus the prior-year period. However, the company has seen demand improve since March, and sales were up 10% in the third quarter.

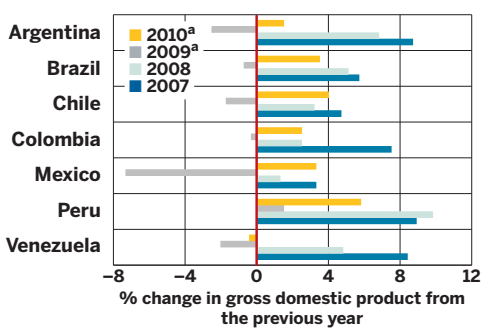
Despite the downturn in Mexico, results at Alpek, the country's largest private-sector chemical company, held up through the first nine months of 2009. Volumes in its polyester business increased 5% and volumes for specialty chemicals, polypropylene, and expandable polystyrene rose 11%.

This year and beyond, Braskem's ambitions will spur growth in Latin America's chemical industry. In November, the company unveiled plans with Mexico's Idesa and state oil company Pemex to build a $2.5 billion ethylene complex in Mexico by 2015. In contrast to an earlier Pemex plan, the Braskem project already has a preliminary feedstock deal in place, says Jorge O. Bühler-Vidal, director of Polyolefins Consulting.

In Venezuela, Braskem is planning a $1.2 billion polypropylene project and a $3.3 billion ethylene complex, both with state chemical firm Pequiven. It has a smaller project in Peru and is interested in a massive heavy-oil based complex in Brazil. By signing on to all of these projects, Bühler-Vidal says, Braskem is hedging its bets in a region where plans tend to change.—AHT

GDP

Latin America is set to recover in 2010



a Estimates. **SOURCE:** IMF

LONZA

CONSTRAINED Lonza sees only modest growth this year for chemical active ingredients.

FINE CHEMICALS: THE OUTLOOK IS GOOD, BUT THE CAVEATS ARE SEVERAL

THE YEAR AHEAD promises both push and pull for manufacturers of pharmaceutical fine chemicals. Major drug companies are expected to accelerate the outsourcing of intermediates and active ingredients to the fine chemicals industry, but continued financing woes will mean less business from small and emerging firms.

These macroeconomic trends will dominate in a business environment that began to improve late last year. "Over the last quarter, a lot of companies said they were seeing things moving up," says James Bruno, president of the consulting firm Chemical & Pharmaceutical Solutions. "People are talking about additional rounds of financing." In contrast, business ground to a halt earlier in the year, partly because major mergers put long-range planning on hold.

Aslam Malik, president of Ampac Fine Chemicals, agrees that the pharmaceutical chemicals market got off to a bad start in 2009. "But I think we hit the bottom early in the year and have pulled out. We are getting lots of inquiries—lots of things going back into development and clinical trials," he says.

Malik notes that increased outsourcing by large drug companies will help counteract general economic pressure for fine chemicals suppliers. "The sector will do well overall," he predicts, "but that doesn't necessarily mean more business for Western producers." Competition from India continues to grow. "And China is catching up quick," he says.

Steve Klosk, chief executive officer of Cambrex, says fine chemicals manufacturing for drugs in the early stages of development was hardest hit in 2009. Cambrex' preclinical work dropped by roughly 15% last year. But overall business was down by less than that in the first three quarters, Klosk says, and in recent months it has been back up to 2008 levels.

He is less certain than Malik that the sector is rebounding, however. Funding for emerging pharma and biotech R&D is still shaky, he says. And although the trend toward more outsourcing is encouraging, drug companies are still under pressure to utilize idle capacity.

Stephan Kutzer, head of custom manufacturing at Lonza, predicts slow growth—1 to 3%—sectorwide for traditional chemical active ingredients in 2010, although he recognizes the opportunity to surpass this rate, given increased levels of outsourcing on the part of big pharma. In contrast, growth in biopharmaceutical outsourcing could be as high as 10%, he says.

Technology specialization will be key to growth in 2010, fine chemicals executives say. Current interest in preclinical services, including process and media development, indicates activity in the earlier stages of R&D and a better year ahead, Kutzer says.—RM

CANADA Hard hit in the downturn, the country eyes recovery in 2010

Highly dependent on exports to the U.S., the Canadian chemical industry was knocked to the mat in 2009. Executives expect it will get back on its feet slowly and with wobbly knees in 2010.

Canadian sales of basic chemicals and resins declined 35% in 2009 to $14.4 billion, according to the Chemistry Industry Association of Canada (CIAC). Taking out the effects of inflation, the decline was 27%. The 2009 inflation-adjusted level of $11.0 billion was off 37% from its 2004 peak of $17.8 billion.

The Canadian industry has been hit hard by a decline in global trade. About three-quarters of Canadian chemical sales come from exports, says David Podruzny, CIAC's vice president of business and economics, and exports declined 31% in 2009.

Podruzny points out that the closures of chemical plants also contributed to the decline in volumes in recent years. For example, Pétromont, a joint venture between Dow Chemical and an arm of the Quebec government, shut its doors in 2008.

Chemical producers surveyed by CIAC expect a modest 2% improvement in sales in 2010. "The numbers point to a fragile recovery," Podruzny says. "It is going to take a while to get back to where we were."

One bright spot, CIAC says, has been industry profits, which managed to grow 2% in 2009 to $1.2 billion. Podruzny credits low natural gas prices, which gave Alberta's ethylene crackers an advantage over petroleum-based capacity around the world.

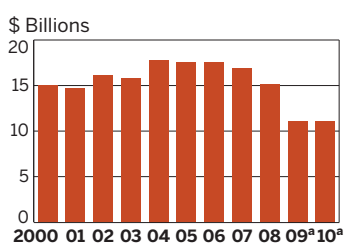
But the advantage may not last. Podruzny cautions that natural gas extraction has been declining in Alberta and that ethane will be in short supply if the government doesn't create incentives to find more.

Grant Thomson, president of olefins and feedstocks at Nova Chemicals, says supplies of ethane are balanced in Alberta. But, he notes, "if we are looking at expanding our facilities in Joffre, we have got to find new sources of ethane."

Alberta assets were a big reason why the International Petroleum Investment Co., in Abu Dhabi, United Arab Emirates, purchased Nova earlier this year for $2.3 billion. Thomson still sees the potential to eventually expand in the province. "Alberta may be the only place in North America where there can be sustained growth in petrochemicals," he says.—AHT

BIG STEP DOWN

Canadian sales of basic chemicals and resins declined sharply in 2009



NOTE: Sales figures are based on 1997 constant Canadian dollars converted to U.S. dollars at the average 2009 exchange rate of $1.00 U.S. = $1.149 Canadian. **a** Estimates. **SOURCE:** CIAC

PHARMACEUTICALS: BIG FIRMS WILL FIGHT THE PATENT CLIFF

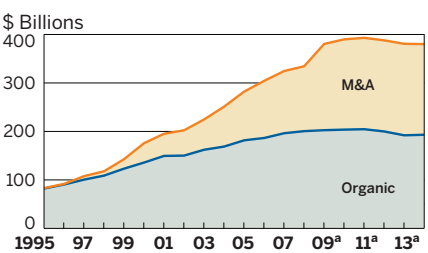
AS A WAVE OF PATENT expiries on major products approaches big pharma's shores, industry observers are calling 2010 the year of the patent cliff. Companies will continue to look for partners and purchases, both big and small, to offset the looming decline in sales.

Among the drugs facing generic competition this year are Pfizer's Alzheimer's treatment Aricept, Merck & Co.'s hypertension medicine Cozaar, and Sanofi-Aventis' breast cancer drug Taxotere. And by 2012, several firms will have lost protection on their most lucrative products, including Eli Lilly & Co. (Zyprexa), Bristol-Myers Squibb and Sanofi-Aventis (Plavix), and AstraZeneca (Seroquel). Most critically, Pfizer will face competition on Lipitor, the cholesterol-lowering drug that raked in nearly $13 billion in 2008.

Companies are using a range of tactics to stem the pending revenue drain. Last year brought three high-profile deals meant to buttress portfolios and pipelines: Pfizer paid $68 billion for Wyeth, Merck bought Schering-Plough for $41 billion, and Roche forked over $47 billion for the 44% of Genentech it did not already own.

BUYING GROWTH

Acquisitions will account for close to two-thirds of big pharma's sales growth from 1995 to 2014



a Estimates. **SOURCE:** Datamonitor

Yet even with this latest round of merger and acquisition (M&A) activity, no single firm commands more than 8% of the global prescription drug market, notes G. Steven Burrill, head of the venture capital and merchant banking firm Burrill & Co. "That would generally indicate that we have a ways to go on consolidation," he adds.

"There's definitely a couple of large M&A events left in big pharma," agrees Simon King, senior analyst at the health care consultancy Datamonitor.

King points to two companies that sat out the merger frenzy of the past decade. Managers at Lilly and Bristol-Myers focused on smaller biotech acquisitions and swore they weren't interested in bigger deals. However, they are now the smallest of the top-tier players, and King sees a potential shift in strategy going forward.

In 2010, big companies will continue to mine the pipelines of small biotechs to help sustain growth. In a positive twist for big pharma, the challenging funding environment for small firms will create some bargains.

Burrill notes that 2009 turned out to be the second-largest financing year in biotech history. Still, gloomy markets meant that small firms, unable to raise cash from stock offerings or venture capitalists, were forced to accept less favorable terms from partners or acquirers. In 2010, those harsh realities will persist.

Also this year, drug companies will continue to look to emerging markets for growth, Datamonitor predicts. In addition to India and China, where many firms increased their stake in 2009, Latin America, Central and Eastern Europe, and Turkey will be important acquisition locales for big pharma in 2010.—LJ

MIDDLE EAST A big chunk of ethylene capacity is coming onstream this year

It's showtime in the Middle East. In 2010, the region's petrochemical building boom, meant to tap its low-cost ethane feedstock, will peak. More than 5 million metric tons of capacity for ethylene—roughly 4% of the world's capacity of the chemical building block—will come onstream in Iran, Saudi Arabia, and nearby countries this year.

Those with memories of the industry that stretch back a decade might recall that the flood of new capacity was supposed to come sooner—in about 2007 or so. But petrochemical makers delayed construction because of escalating costs.

Roger Green, vice president for Europe, the Middle East, and Africa at the consulting firm Nexant, explains that the region has experienced a general building frenzy—witness the recent headlines about Dubai, United Arab Emirates—that crimped the supply of labor and materials. The problem has eased, making it easier for plants to be finished.

Traditionally, the Middle East's low production costs have made its products competitive in regions such as Asia that depend on higher cost naphtha-based feedstocks. But, Green notes, Middle Eastern producers don't want to be perceived as dumping. If Asian firms start buckling under foreign competition, they might clamor for tariffs. "The biggest threat to the Middle East is parochialism in trade regulations," he notes.

Green says the next slate of capacity to open in the region, beginning around 2015, will focus more than production currently does on liquid feedstocks such as naphtha and heavy oil and less on ethane. The versatile raw materials will expand the Middle Eastern industry beyond ethylene glycol and polyethylene and into premium products such as synthetic rubber and polycarbonate. "The chemistry will be much more inventive, and the facilities will have much more scope," he says.

One reason for the shift is that the supply of ethane, once considered an unwanted by-product of oil drilling, is increasingly being claimed as feedstock for existing petrochemical plants.

And Middle Eastern governments are keen on maximizing their resources. At the Gulf Petrochemicals & Chemicals Association forum in Dubai last month, ExxonMobil Chemical President Steve Pryor told local industry guests that they should partner with companies like his to make premium products, such as rubber for fuel-efficient tires, that promote conservation.

Middle Eastern companies have also been gaining expertise in value-added chemistry through overseas acquisitions. Saudi Basic Industries Corp. purchased GE Plastics in 2007. And International Petroleum Investment Co. of Abu Dhabi, U.A.E., purchased Canada's Nova Chemicals last summer.—AHT

& MORE ONLINE View a table of upcoming Middle East projects at www.cen-online.org.

PETROCHEMICALS: ALTHOUGH RECOVERING, THE INDUSTRY WILL SOON BEAR THE BRUNT OF NEW CAPACITY

IN 2009, the big problems for U.S. petrochemical and polymer makers were the financial crisis and recession. This year, executives expect a tenuous recovery, but it will do little to offset the onslaught of additional supply soon to hit the market.

After a challenging year for the industry, most observers don't expect much growth in 2010. Chemical Market Associates Inc. (CMAI) expects a "muted" recovery. Normal growth in ethylene demand of 4 to 5% per year won't resume until 2011, the consulting firm says.

Grant Thomson, president of olefins and feedstocks at Nova Chemicals, is counting on inventories to give the recovery a push. As producers and consumers of ethylene derivatives looked to raise cash late in 2008, they liquidated inventories. Cautious companies are still keeping stocks low. "We haven't gotten to the point in the cycle that customers and manufacturers have started to rebuild inventory levels," he says. "We think we'll see that in 2010."

Industry executives didn't realize the recession was coming until it was well under way, but they have been dreading what will happen in 2010 for almost a decade. They knew for a long time that companies in the Middle East and Asia were planning to build a massive amount of petrochemical capacity. Although delays have put off this new production by a couple of years, these regions are now poised to bring on as much as 10 million metric tons of capacity for ethylene and derivatives such as polyethylene.

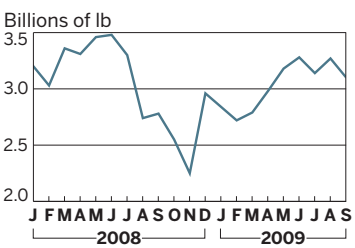
The new capacity, which will increase global petrochemical capacity by about 8%, may spell trouble for plant operating rates. In North America, ethylene operating rates have climbed from about 70% in the first quarter of 2009 to about 85% at the end of the year, according to John Stekla, CMAI's director of ethylene for North America. He says that in 2010, rates will likely slip somewhat as exports from North America are displaced by foreign competition and domestic demand recovers slowly, unless more domestic capacity is shut down.

"We believe that new capacity will ultimately be absorbed through the combination of market growth and high-cost producers shutting down noncompetitive assets," says Glenn Wright, vice president of Dow Chemical's North American basic plastics group. He notes that higher cost polyethylene producers in Europe have already taken 2 million tons of capacity offline and plan to cut another 1.3 million tons by the end of the year.

Although dreaded, the new capacity isn't here yet. Thomson says petrochemical exports from North America are still strong. "No one doubts that we are going to see a lot of capacity coming on in 2010 and 2011 in the Middle East, and it will impact the supply-and-demand picture," he says. "As an industry, we'll have to work our way through that."—AHT

A LONG CLIMB

U.S. polyethylene demand saw a tentative recovery in 2009



NOTE: Data are sales plus captive use of high-, low-, and linear-low-density polyethylene.
SOURCE: American Chemistry Council

EUROPE Fragile recovery awaits the return of end-market demand

In Europe, evidence suggests that most chemical sectors are over the worst of the downturn. But in the new year, the pace of growth will be modest and the overall recovery fragile. It will likely be several years before European chemical output regains the peak seen in the first quarter of 2008.

In 2009, chemical output excluding pharmaceuticals fell an estimated 12.4%, according to Moncef Hadhri, an economist with the European Chemical Industry Council (CEFIC). As in the U.S., basic chemicals suffered the most, thanks to steep drops in demand from the automotive and construction markets. As the turnaround begins, CEFIC forecasts that chemical output will grow 4.7% in 2010.

Hadhri calls 2010 a transition year. "As the considerable stimuli given by government incentives such as car scrappage schemes are withdrawn, real consumer demand has to take over," he says. But he sees no sign of major inventory rebuilding by customers. Firms will proceed with caution as difficult credit and liquidity conditions continue to plague manufacturing industries.

The recession took the biggest bite out of chemical powerhouse Germany, where the drop in demand for basic chemicals led overall chemical output to plunge 13.9% in 2009, says David Thomas, senior industrial economist at consultancy Oxford Economics. Oxford's "World Chemical Service" report predicts that German output will grow 9.0% this year.

Germany's turnaround began the second quarter of 2009, Thomas observes. "Basic chemicals grew more than 10% between the first and second quarter of 2009 and again in the third quarter." But the recovery has been modest. "Customers are not restocking to build stocks to a high level but to a level necessary to work with."

Compared with basic chemicals, German pharmaceuticals took a relatively gentle dip, declining about 3% in 2009. But Thomas forecasts slow growth of 1 to 2% in 2010. "There has been a lot of cutting back on new products," he says.

The economic picture is similar outside Germany. But because France, Italy, and the U.K. depend less on basic chemicals, the downturn was not as sharp, Thomas observes.—MV

EUROPEAN OUTPUT

A steep decline in 2009 will be followed by a partial recovery

	ANNUAL CHANGE			
	2007	2008	2009[a]	2010[a]
Basic inorganics	1.6%	-6.6%	-20.1%	5.0%
Consumer chemicals	3.9	-1.9	-6.5	2.6
Petrochemicals	3.6	-4.6	-10.6	6.0
Polymers	1.0	-5.5	-19.7	5.3
Specialty chemicals	1.0	-3.8	-9.3	5.5
Chemicals (excluding pharmaceuticals)	2.6%	-4.5%	-12.4%	4.7%

a Estimates. **SOURCE:** CEFIC

INSTRUMENTATION: NONINDUSTRY USERS BUOY BUSINESS IN LEAN TIMES

LABORATORY AND ANALYTICAL instrumentation makers would like to believe that 2009 was just a fluke. That's because, for the first time since 1982, global instrument sales declined, dropping 5 to 7% to an estimated $37 billion, according to research firm Strategic Directions International.

CDC/JAMES GATHANY

LITTLE BITS COUNT Sales to life sciences markets, such as those using PCR methods, remain strong.

"Customers were clearly managing to very tight budgets in 2009," says Thermo Fisher Scientific Chief Executive Officer Marc N. Casper, and capital outlays were hit more dramatically than overall R&D spending. In response, Thermo, Agilent Technologies, PerkinElmer, Waters, and other instrument suppliers looked to cut costs. "The difficult economic climate has been a catalyst for change that will benefit us in the long term," Casper contends.

The downturn hit different markets and technology areas differently, explains Lawrence S. Schmid, CEO of Strategic Directions. Sales to industrial users were down more than those to academic and government labs. And as manufacturing output fell, tools for materials characterization sold less well than those for life sciences markets.

For many suppliers, life sciences areas such as molecular biology and genomic analysis continue to grow. Sales of small to mid-sized instruments, such as real-time PCR systems, stayed consistent in 2009, unlike higher cost capital equipment and replacement systems, says Bernd Brust, chief commercial operations officer at Life Technologies.

"Academic funding has been very strong, and every indication is that it will continue to be," Brust adds. Government research spending is on an uptick as well. Applications emerging from research also bode well for growth in diagnostics and in applied markets such as quality and safety testing.

Despite the strength in life sciences, views are mixed on how big a factor the large pharmaceutical companies will be as they restructure in the year ahead. Previously cash-starved biotech customers are expected to reemerge in 2010, and growth is clearly occurring in India and China.

In general, executives say, market conditions started improving in the second half of 2009. "We think the worst of the economic downturn is behind us and markets have begun to stabilize," Thermo's Casper says. Government stimulus programs around the world are definitely a bright spot, he adds, although it's hard to predict when most of the money will flow. Thermo and Life Technologies both anticipate at least $100 million in sales opportunities from stimulus spending in 2010 and beyond.

During the lean times, fewer new products were introduced, but competition should intensify because "everybody wants to get back on the profit track," Schmid says. "Coming out of a recession you'd like to have new products that engender some enthusiasm."

As a result, Schmid is cautiously optimistic about 2010. "It's not going to be exciting, but it looks like we are going to see positive growth of about 2 to 4%," he says.—AMT

ASIA Economies are generally buoyant, except in Japan

In October 2009, a mainland China resident paid $57 million for a 6,000-sq-ft apartment on the island of Hong Kong, a price believed to be a world record. The transaction is an illustration of how little impact the global financial crisis has had on Asia.

When the world economy tanked in late 2008, many predicted that Asia would suffer heavily. Indeed, manufacturers in southern China laid off tens of thousands of workers in early 2009 because of slack demand for their goods in the U.S., Japan, and Europe. In Japan, business confidence plummeted and the economy shrank by about 6% last year.

The big surprise is that, with the exception of Japan, Asia ended up losing little ground during the financial turmoil of the past year. China managed to expand its economy by more than 8%, roughly the same as in 2008 and a welcome respite from the blistering 13% it expanded in 2007. India, Asia's other economic giant, grew 6% last year and is set to expand 7% in 2010.

Asia's laggard, Japan, will recover in 2010, but slowly. The Bank of Japan's December 2009 "Tankan," a survey of business confidence, revealed that although most major Japanese companies remain bearish about the Japanese economy in the short term, they are less pessimistic about the future than they were three months ago. The Asian Development Bank forecasts that the country will grow by a slight 1% this year.

But Japan will be aided in 2010 by the enduring vigor of the Chinese economy. China did not slow down much in 2009, largely because of government actions. Beijing introduced an economic stimulus package early in the year that boosted demand for cars and appliances, particularly in the Chinese countryside. And Shanghai is spending more money getting itself ready to host this year's World Expo than Beijing spent ahead of the 2008 Olympics.

Like China, India owes much of its resilience during the downturn to government measures. Partly to counter the effects of a bad harvest in 2009, India's national government has vigorously spent during the past year. India's central bank has also done its part to support the economy. Over the past year and half, it has lowered its key lending rate by more than 4% and cut in half the amount of cash that banks are required to keep in their books.

The Organization for Economic Cooperation & Development foresees that India's economy in 2010 will be buoyed by a better harvest and a recovery in the country's export-oriented manufacturing sector.

For Asia overall, the Asian Development Bank predicts slightly stronger economic growth than the region experienced in 2008. In other words, as 2010 dawns, Asia is positioned to be the world's economic growth engine.—JFT

& MORE ONLINE View a graph of Asia GDP growth at www.cen-online.org.

CLEANTECH FUNDING DECLINES IN 2009

According to preliminary data from the information provider Cleantech Group, venture capital funding for so-called clean technologies fell to $5.6 billion in 2009, a drop of 33.4% from 2008. But the company says final data are expected to show that 2009 was a record year for the number of investment deals and that the total dollar amount invested was similar to 2007. The solar sector attracted much less capital than in years past, with $1.2 billion in investments, 64% less than in 2008. Transportation and energy-efficiency firms attracted record funding during the year as private investors followed spending signals from government stimulus programs. In 2009, for the first time, cleantech attracted more venture capital money than software, biotech, or any other category.—MV

BASF ADDITIVES USED IN THE BURJ DUBAI

BASF's Glenium SKY concrete plasticizer was used in the world's tallest building, the Burj Dubai, which opened in Dubai, United Arab Emirates, last week. BASF says the additive, based on polycarboxylate ether polymers, improved the flow of concrete and helped the material withstand the high pressures needed to build the 800-meter, 160-story structure. Some 180,000 m^3 of concrete was used in the foundation and superstructure of the building.—AHT


BASF

INDIA'S DORF KETAL GETS DUPONT CATALYSTS

India's Dorf Ketal Chemicals has acquired DuPont's specialty catalyst business, which generated roughly $50 million in sales in 2008. Dorf Ketal calls the business the world leader in organometallic titanates—compounds used as catalysts in chemical manufacture, as curing and cross-linking agents, and as surface modifiers. Last year, Dorf Ketal acquired Intec Polymers, an Indian producer of organic titanates and other products. Dorf Ketal Chairman Sudhir Menon says he expects to close further acquisitions in the range of $100 million to $200 million by the end of the year.—MM

BAIN CAPITAL INVESTS IN INDIA'S HIMADRI

Bain Capital, the Boston-based private equity firm, will invest up to $124 million in Himadri Chemicals & Industries, a Calcutta-based maker of coal tar pitch and related chemicals. Bain will pay $54 million for new shares, giving it a 15% stake in Himadri. It will follow with a $70 million offer for 20% of the expanded equity base. Himadri CEO Anurag Choudhary says the firm will use the funds to expand, move further downstream, and invest abroad.—MM

DSM BUYS INTO SEGETIS, NYLON

DSM's venture capital arm has made an equity investment in Golden Valley, Minn.-based Segetis. The size of the investment has not been disclosed. Segetis, which earlier received funding from Khosla Ventures, is developing technology to turn nonfood agricultural and wood feedstocks into chemical building blocks such as levulinic ketals. Last February, the company opened a small plant in Minnesota capable of making 250,000 lb per year of chemicals from renewable resources. Separately, DSM's engineering polymer unit has acquired full ownership of a nylon 6 resin polymerization plant in August, Ga. The plant had been a joint venture between DSM and carpet maker Shaw Industries.—AHT

INEOS VENTURE TO MAKE PHENOL IN CHINA

Ineos Phenol and Sinopec Yangzi Petrochemical will form a joint venture to build and operate a phenol and acetone manufacturing site at Nanjing Chemical Industrial Park, in Jiangsu province. Ineos first revealed plans to build the plant in early 2007. When it is completed in 2013, the facility will have a capacity of 400,000 tons of phenol and 250,000 tons of acetone, making it the largest plant of its kind in China. Sinopec currently makes phenol and acetone in Shanghai and Beijing and is building a site in Tianjin.—MV

ELUSYS RECEIVES ANTHRAX CONTRACT

New Jersey-based Elusys Therapeutics could get up to $143 million in Department of Health & Human Services funding to complete the development, commercial manufacture, and regulatory approval of Anthim, a monoclonal antibody designed to prevent and treat inhalation anthrax. Anthim targets the protective antigens of *Bacillus anthracis* and neutralizes anthrax toxins. Elusys will get $16.8 million in the first year of the five-year contract. The company has already received $34 million in government funding to develop the antibody.—AMT

PIRATES NAB TANKERS

Pirates operating off the coast of Somalia hijacked two chemical tankers in recent weeks. According to the European Union's naval forces, the U.K.-flagged *St. James Park* was boarded on Dec. 28, 2009, in the Gulf of Aden on its way to India, and the Singapore-flagged *Pramoni* was taken on Jan. 1 en route to Thailand. EU Navfor, the European Union's armada that is patrolling a "safe corridor" through the gulf and the Indian Ocean, says the *St. James,* with a crew of 26, is now at the pirates' lair of Hobyo on the Somali coast. The most recent word on the *Pramoni,* with a crew of 24, is that it was headed toward Somalia. Despite the efforts of international patrols, Somali pirates have flourished over the past few years, seizing vessels and pocketing millions of dollars. According to the International Maritime Bureau, which tracks piracy, 32 vessels were hijacked by Somali pirates, and 85 were fired upon in the first nine months of 2009.—MSR

RANBAXY UNIT GETS FDA WARNING LETTER

FDA has sent a warning letter to Ohm Laboratories for not complying with current Good Manufacturing Practices. Based in North Brunswick, N.J., Ohm is a U.S. subsidiary of Ranbaxy Laboratories that produces liquid generic medications. Ranbaxy says it has hired the consulting firm PRTM to fix the latest problems that FDA found. Ranbaxy has had repeated run-ins with U.S. regulators in recent years. In July 2008, the Department of Justice said it would investigate whether the firm had falsified data for drugs manufactured at an Indian facility until 2006. Then, in September 2008, FDA banned drugs that the company makes at two plants in India.—JFT

ANIKA THERAPEUTICS BUYS BIOPOLYMER FIRM

Anika Therapeutics has acquired Fidia Advanced Biopolymers, a subsidiary of Italy's Fidia Farmaceutici, for $17 million in cash and nearly the same amount in stock. With about $11 million in annual revenues, FAB produces hyaluronic acid-based fiber, film, and textile biomaterials used in medical applications such as regenerating connective and structural tissues damaged by injuries, age, or disease. Anika gains manufacturing operations, laboratories, and about 50 employees.—AMT

RWE AND BRAIN IN R&D COLLABORATION

Germany's RWE Power and the biotech firm Brain will jointly develop biotech-based processes to convert carbon dioxide into microbial biomass for biobased materials, plastics, and other chemical products. The partners plan to equip microorganisms with new enzymes to create synthesis routes and pathways that will consume CO_2 from power plant flue gases. An experimental plant will be located at RWE's Coal Innovation Center at its Niederaussem power plant location near Bergheim, Germany.—AMT

RWE POWER

Scientists from RWE and Brain investigate biomass cultures.

PERKINELMER, VWR TO OFFER LAB SERVICE

Scientific instrument maker PerkinElmer and VWR International, a laboratory supply firm, have agreed to develop a one-stop equipment services offering for lab customers. The two firms say that with one contract, customers will be able to get supplies and lab equipment services from VWR and a suite of services for high-end instrumentation from PerkinElmer's OneSource.—MSR

PERKINELMER

A OneSource technician maintains an instrument.

PFIZER SIGNS ANOTHER INDIAN GENERICS DEAL

Pfizer has struck a deal with Strides Arcolab under which it will commercialize generic injectable and oral drugs in the U.S. supplied both by the Indian firm and its joint ventures with South Africa's Aspen. David Simmons, president of Pfizer's established products business, says the deal brings the number of products his business has licensed to more than 200. Among earlier agreements are deals with Claris Lifesciences and Aurobindo Pharma, two other Indian firms.—MM

BUSINESS ROUNDUP

LANXESS has acquired Clariant's business in *p-tert*-amylphenol, a disinfectant active ingredient. Lanxess will market the ingredient alone or in combination with two existing disinfectants, o-phenylphenol and chlorophen.

EXXONMOBIL and Qatar Petroleum have advanced plans to build a petrochemical complex in Ras Laffan Industrial City, Qatar, by 2015. The complex will have 1.6 million metric tons of ethylene capacity, plus downstream polyethylene and ethylene glycol plants.

ALBEMARLE has started up a 15,000-metric-ton-per-year plant at its Pasadena, Texas, site to make poly(α-olefins), used as lubricant base stock, under contract for ExxonMobil Chemical. Albemarle says the plant uses new and existing equipment and took only two years to complete after the initial feasibility study phase.

BASF has sold its Aurora special-effects films business to Peekskill, N.Y.-based RMS Packaging. Under terms of the agreement, BASF is selling manufacturing equipment and will lease a building at the site, where it also makes pigments, to RMS. The films are used in packaging and gift wrap.

KYOWA HAKKO KIRIN of Japan will pay $4 million up front as part of a drug discovery pact with Dicerna Pharmaceuticals, which uses siRNA strands containing more than the typical 21 nucleotides to knock out gene function. Dicerna could snag another $120 million in research funding and milestone payments as the partners develop drugs against oncology targets.

ROCHE will work with Evolva Holding to design oncology and anti-infective compounds. Evolva receives an undisclosed technology access fee and research funding in exchange for opening up its biosynthetic chemistry technology, which improves upon compound scaffolds found in nature.

CLEVELAND BIOLABS has formed a 50-50 joint venture called Incuron with Bioprocess Capital Ventures, a Russian venture capital fund. This joint venture will develop Cleveland BioLabs' Curaxin compounds for cancer treatment. Bioprocess Capital Ventures will potentially contribute $18 million, with an up-front payment of $5.8 million.

H. LUNDBECK, a Danish drug firm, says the European Commission is investigating the company for anticompetitive practices related to the generic antidepressant citalopram. The company says it is cooperating with the investigation and is confident that it has complied with all the relevant laws.

QLT has paid Othera Pharmaceuticals $7.5 million up front for the rights to OT-730, a prodrug of a beta blocker. It's currently in studies to treat glaucoma. Early-stage clinical trials have shown that the drug can be safely given as an eye drop and is about as effective as the beta-adrenergic-receptor blocker timolol.

MITCH JACOBY/C&EN

INSTRUMENT INNOVATORS Dionex R&D leaders Yan Liu (left) and Chris Pohl discuss design features of a prototype capillary ion chromatography system.

INSTRUMENTATION THE DIONEX WAY

Even after 35 years, CHROMATOGRAPHY COMPANY stays focused to retain technological edge

MITCH JACOBY, C&EN CHICAGO

IN A YEAR THAT will long be remembered for financial losses, plant closings, wide-scale cutbacks, and layoffs, analytical instrument maker Dionex managed to grow. In its past fiscal year, which ended June 30, 2009, the company reported sales of $385 million, up some 2% from the previous year. That most recent gain extends to 28 years the company's nearly perfect track record of annual sales growth.

Ask Frank Witney, Dionex' president and chief executive officer, to share the company's secret to success and he'll tell you there is no secret—just a relentless focus. Dionex is a "pure play" chromatography and separations-science company, says Witney, who joined the Sunnyvale, Calif., firm last year. "We're two inches wide and two miles deep," he says, meaning the company focuses almost entirely on a few areas in which it has built considerable expertise.

The principal areas are ion chromatography (IC, also known as ion-exchange chromatography), high-performance liquid chromatography (HPLC), and sample preparation. IC equipment and products account for about 65% of company sales. Roughly 28% comes from HPLC products, and the balance is due largely to sample-preparation products.

Analytical scientists working in a broad range of areas use Dionex products. The company's instruments are found in laboratories specializing in environmental, proteomics, life sciences, and pharmaceutical analyses. They are also widely used in the chemical, food and beverage, power generation, and electronics industries.

Dionex' tight focus on just a few analytical fields sets it apart from some larger instrument companies. Competitors such as PerkinElmer, Varian, and Thermo Fisher Scientific maintain extensive product lines in multiple areas ranging from chromatography to atomic and molecular spectroscopy to X-ray analysis. Rather than strive to make a presence in all those markets, "our approach is to be best in class in select technologies and instrumentation," Witney says.

Building cleverly designed lab instruments, however, isn't enough to guarantee straight A's in this industry. The keys to achieving top marks, in Witney's view, are working closely with customers to understand their needs in detail, meeting those needs with top-notch products, and backing those products with excellent service and support.

"Customers don't buy instruments and components. They buy answers to their analytical problems," Witney asserts. "We're not just equipment manufacturers. We're solutions providers."

THAT LOFTY LANGUAGE sounds like a marketing slogan, but longtime customer R. Ryan Williams says it's really the way Dionex does business. Williams is supervisor of chemical sciences at Chicago-based Celsis, a contract service provider specializing in chemical and microbial analyses. Running down a long list of Dionex IC and HPLC systems his lab uses, he raves about the instruments' pumping precision, gradient accuracy, sensitivity, and overall performance. But other vendors also make good instruments, Williams acknowledges. So equipment quality isn't the only draw to Dionex.

"More than anything else, the reason we stay with Dionex is the personal attention," he states. As a case in point, Williams says he has been "very pleased with the level of help and support" provided

"Customers don't buy instruments and components. They buy answers to their analytical problems."

by Dionex to configure Chromeleon, a Dionex data acquisition and management software package, to run all of his lab's chromatography equipment—not just the Dionex units.

Similarly, Celsis uses Dionex' new IC system and electrochemical detector in novel applications and to run recently developed analytical methods, for example in carbohydrate and heparin analysis. These instruments are versatile and can be configured and used in many ways. "The Dionex team has worked closely with us to help set up and run the instruments in the best way to get us the results we need," he says.

In the 35 years Dionex has been a company (it went public in 1982), ion chromatography has been its biggest business, accounting for up to two-thirds of sales in recent years. Unlike conventional chromatography, which separates neutral species, IC separates mixtures of cations and anions on the basis of charge. In IC, analytes are distinguished according to how strongly they cling by electrostatic interaction to an ion-exchange resin in the chromatography column. Some of the key developments in ion-exchange technology were made in the early 1970s at Dow Chemical. A subsequent licensing agreement led to the formation of Dionex, which gets its name from Dow Ion Exchange.

"We have patented technology surrounding ion chromatography that has given us a strong advantage in this area," says Craig A. McCollam, Dionex' chief financial officer. Coupled with a drive to constantly improve its products, that technological advantage has enabled Dionex to dominate the field as the number one IC company for years. According to McCollam, the company leads the field with a 70%-plus share of the roughly $325 million worldwide IC market. The Swiss firm Metrohm holds around 15% of the market, and the rest is fragmented, he says.

In the mid-1990s, Dionex expanded beyond IC by offering automated sample-preparation equipment. These instruments were designed to overcome the sample-extraction bottleneck common in analysis of food, soil, and other matrices, and they now account for about 7% of sales.

In conventional methods, extraction involves treating samples with solvents under conditions of standard temperature and pressure to obtain analytes for subsequent identification via chromatography or other methods. Raising the temperature and pressure increases analytes' diffusion rates and solubilities, which in turn speeds up extraction.

Dionex' accelerated solvent extraction (ASE) instruments exploit that process improvement and do so in an automated fashion (*C&EN Online,* March 30, 2009). For example, conventional sample preparation for typical pesticide-residue analyses of fruits and vegetables can take several hours and consume hundreds of milliliters of solvents. By using ASE instrumentation at 200 °C and 1,500 psi, researchers can reduce preparation to roughly 15 minutes with 15 mL of solvent.

Dionex entered the HPLC market in full force about a decade ago with the acquisition of Softron, a chromatography company based in Germering, Germany, near Munich. Development of HPLC products and software continues there today. Competition in this market, which is estimated at $2 billion worldwide, is intense, yet newcomer Dionex is making a strong showing.

In fiscal 2009, Dionex' sales of HPLC systems, columns, detectors, and related products reached roughly $120 million, according to Dietrich Hauffe, vice president for corporate marketing. The HPLC market as a whole shrank by 3–5% in the past three quarters, he says. Yet during that period, Dionex' HPLC-related sales continued to increase, he points out, putting it in roughly fourth place behind market leaders Waters, Agilent, and Shimadzu.

NO SINGLE FACTOR explains how Dionex has managed to increase sales every year since 1982 except in 2002, when revenue dipped about 2%. A strong international base certainly plays a role. This past year, when the recession pushed down sales by a few percent in North America and Europe, which account for roughly 30% and 40% of sales, respectively, Dionex grew by about 18% in Asia, notably in China, Taiwan, and India.

In addition, the company's strong commitment to research and product development—supported to the tune of $25 million to $30 million during each of the past three fiscal years—results in industry-recognized technological advances. For example, *R&D Magazine* recently selected Dionex' reagent-free IC technology as an R&D 100 Award winner for 2009. The technology enables laboratories to continuously perform analyses—of drinking water, for example—for about a month without the need to replace the eluent with a fresh batch.

It's not just cutting-edge technology that industry watchers recognize. Richard C. Eastman, a stock analyst with Milwaukee-based investment firm Robert W. Baird, is impressed with Dionex' business strengths. Dionex has a good position in the liquid chromatography marketplace and a solid installed base of customers, Eastman says. That base goes hand-in-hand with a high percentage of sales of columns, instrument parts, and other consumables, which are good profit drivers, he points out.

Competitors follow the industry trend of building broad portfolios that include many types of analytical instruments. That approach may appeal to customers who want a vendor that can supply complete analytical systems from start to finish, Eastman says. In contrast, Dionex' strength is its focus on liquid chromatography. The Dionex brand is well recognized, and the company is known for its chemistry competency and applications knowledge, Eastman says. "That's key from a customer perspective."

Witney expects the financial challenges of 2009 to continue through the first half of 2010 but isn't planning radical changes. "Our job is to continue making our customers more competitive in their jobs," he says. "We plan to do that by remaining focused and innovative and staying on the leading edge of the curve." ■

Dionex At A Glance

Headquarters: Sunnyvale, Calif.
Revenues: $385 million
Employees: 1,400
R&D spending: $29 million

BUSINESSES (% of sales)

Ion chromatography (65%): Instruments, columns, detectors, accessories, software

High-performance liquid chromatography (28%): Instruments, columns, detectors, accessories, software

Sample preparation (7%): Instruments for accelerated solvent and solid-phase extractions, accessories

Website: **www.dionex.com**

NOTE: Data are for fiscal 2009, which ended on June 30, 2009.

BASF PUTS ITS MARK ON A CIBA BUSINESS

BASF is trying to make the most of its new position in **PLASTICS ADDITIVES**

ALEXANDER H. TULLO, C&EN NORTHEAST NEWS BUREAU

WITH ITS $5.1 billion purchase of Swiss specialty chemical maker Ciba last year, BASF acquired one of the world's leaders in plastics additives, both in size and technological strength. Although BASF is a relative newcomer to the high-performance additives that are Ciba's hallmark, company executives say they have much to contribute to their new business to make it even better.

The plastics additives business generated one-third of Ciba's $5.5 billion in sales during 2008. It was the company's second largest business after chemicals for water treatment and paper processing. Other important Ciba businesses included coating ingredients, lubricant additives, oil field and mining chemicals, and personal care materials.

Thus far, BASF's integration of Ciba has focused on cost savings. By 2013, BASF aims to save $650 million annually, largely by eliminating 3,800 jobs. But Markus Kamieth, group vice president for performance chemicals in North America, says the combination will also create value by enhancing Ciba's R&D capabilities and by establishing a platform for launching innovative products.

Many of the plastics additive categories that came with the Ciba acquisition are entirely new to BASF. "Plastics additives was really one of the key components of the rationale for the Ciba acquisition as a whole," Kamieth says. "We really have closed a strategic gap for BASF because BASF was not active on a large scale in polymer additives."

For example, BASF didn't participate at all in antioxidants—materials that prevent oxidation from breaking down polymers during processing or in their final use. Ciba had a world-leading position in phenolic antioxidants and phosphite process stabilizers.

Ciba had a large presence in light stabilizers, whereas BASF had a much more modest role in the area. Ron Babinsky, managing director of Houston-based consulting firm Townsend Solutions, says the BASF light stabilizer business, which focused on hindered amines, was about one-fifth the size of Ciba's unit, which also was the largest in the world.

Kamieth says both companies had strong businesses in plastic colorants. "It was more of a merger of equals in that area," he says. According to Babinsky, BASF's historic additives portfolio included functionalized polyolefin impact modifiers of polyethylene, polypropylene, and engineering thermoplastics, as well as polyolefin waxes used to improve lubricity during plastic processing.

One strong BASF business that is not part of its plastics additives unit is plasticizers. BASF houses plasticizers in its petrochemicals division, Kamieth explains, because they are commoditized materials better left to a unit focused on manufacturing. These are products "not to be compared too much with the plastics additives that we predominantly got from Ciba," he says.

ALTHOUGH BASF has long been manufacturing-centric, it is taking a market-oriented approach to plastics additives. For example, BASF's manufacturing of pigments is handled by its dispersion and pigments division, which serves the coatings industry, but the plastics additives business will be in charge of marketing them to the polymer industry. "Looking at the chemistries that we put together under our plastics additives roof—antioxidants, light stabilizers, and pigments—chemically, they have nothing to do with each other, but the common denominator is that they all serve the plastics industry in a way that requires customer intimacy," Kamieth says.

SEEING CLEARLY With the acquisition of Ciba, BASF acquired a line of polypropylene clarifiers, used in plastic packaging.

For BASF, one of the attractions of Ciba's plastics additives business was its focus on polyolefins. By comparison, polyvinyl chloride, styrenic resins, and engineering thermoplastics were secondary sectors for the unit.

According to Babinsky, additives can do more to improve the performance of versatile polyolefins such as polypropylene than of PVC and polystyrene. Because they add more value to polyolefins, they also command bigger profits in that sector. "Ciba was very profitable in plastics additives because of its ability to change functional properties of polyolefins," Babinsky says. "In polyolefin additives, you can add functionality that determines what revenues you have and how profitable you are."

In recent years, polymer growth has been modest in the developed world. But Kamieth notes that BASF can expand its additives business faster than the underlying polymer market through new applications and geographic diversification. "The move of polymer capacities to the Middle East and Asia is well-known," he says. "We will have to align our business along with that to be able to catch up with the increasing demand there."

Kamieth argues that the BASF unit will always have business opportunities because customers demand ever-enhanced properties from polymers. For example, ultraviolet-light stabilization systems can

The last thing BASF wants to do with a critical piece of its multi-billion-dollar acquisition is lose what made it special.


BASF

increase the lifetime of polyolefin roofing membranes to as much as 30 years. "The material by itself without an additive package would never have been able to do this," he says. In a newer application, the company offers heat-reflective inorganic pigments for the membranes that can help prevent heat from penetrating the roof.

In addition, Kamieth sees opportunities for the Flamestab line of halogen-free flame retardants that it acquired with Ciba. Three top flame-retardant manufacturers recently pledged to phase out retardants based on decabromodiphenyl ether (C&EN, Jan. 4, page 10), potentially giving alternatives a boost.

Ciba's technological leadership should help BASF pinpoint new markets as well, Babinsky expects. "That is a pretty dog-gone good asset base that they are buying," he says. "It is pretty tough to beat Ciba's innovation."

For example, in recent years, the company developed antioxidants and light stabilizers for the automotive industry and additives for film. One of the last new products Ciba launched was a line of clarifying agents aimed at giving polypropylene a polyethylene terephthalate (PET)-like clarity in food packaging.

Kamieth argues that the greater size and scope of BASF, a company more than a dozen times bigger than Ciba, will lend scale and stability to future plastics additives R&D efforts. In addition, BASF has additive technologies that it would like to bring to bear on the polymer industry. For example, the company's Joncryl cross-linkers, based on epoxy-functionalized resins, were developed for coatings. The company wants to use them to improve the properties of recycled PET resins and biobased polymers such as polylactic acid. "Now that we have the plastics experts from Ciba and BASF together, we can get a faster and more effective launch for such technologies," he says.

And BASF can add value by subtracting. Last year, when C&EN quizzed Peter R. Huntsman about Huntsman Corp.'s integration of the textile effects business it acquired from Ciba, the chief executive noted that part of the challenge is to whittle down a portfolio containing superfluous products that few customers use.

Kamieth can relate. "You can't be everything to everybody," he says, acknowledging that Ciba and BASF differed somewhat on this issue. BASF, he says, is undertaking a strategic review of its businesses. "As soon as you realize that you are in an area where differentiation is difficult to translate into added value, you better rethink whether this differentiation is part of your value proposition in the end," he says.

Whether by paring down or expanding the portfolio that it now controls, the task at hand for BASF is to build something better. The last thing the company wants to do with a critical piece of its multi-billion-dollar acquisition is lose what made it special. ■

DOE TO INVEST $336 MILLION IN R&D HUBS

The Department of Energy announced in late December 2009 its intention to invest $336 million to establish and operate three Energy Innovation Hubs for the next five years. The hubs, Energy Secretary Steven Chu said, would be "integrated research centers," modeled on the Manhattan Project, MIT's Lincoln Lab, and AT&T Bell Labs. They would "ideally be under one roof," Chu continued, to encourage scientific interaction and "forceful centralized scientific management." Each hub would focus on one of three areas: production of fuel from sunlight, modeling and simulation for nuclear reactors, and design of energy-efficient buildings. The hubs are one part of a DOE R&D plan that also includes "energy frontier research centers," which work on basic energy science problems, and the Advanced Research Projects Agency-Energy, which funds entrepreneurs attempting to develop and commercialize advanced energy technologies. Universities, national labs, nonprofit organizations, and private firms may compete to establish and operate a hub. Chu expects the hubs to begin operating in 2011, subject to congressional appropriations. More information is available online at hubs.energy.gov.—JJ

CHEMICAL WEAPON DESTRUCTION AHEAD OF SCHEDULE IN ARKANSAS

The Army's Pine Bluff Chemical Agent Disposal Facility in Arkansas has destroyed more than half the mustard agent stored there in the final disposal campaign of the arsenal's chemical weapons stockpile, officials say. More than 2.8 million lb of mustard blister agent has been safely destroyed, according to site project manager Mark Greer. "We are confident that we will complete disposal operations by the Chemical Weapons Convention treaty date of April 29, 2012," Greer says. "Currently, we are operating ahead of schedule." He also says the disposal campaign could be complete by as early as December 2010. Chemical weapons disposal operations began at Pine Bluff in March 2005 with GB (sarin) nerve-agent-filled rockets. The second disposal campaign, VX nerve-agent-filled rockets, ended in February 2008, and the third campaign, VX nerve-agent-filled land mines, finished in June 2008. Prior to disposal operations, the arsenal stored about 3,850 tons of chemical agents, or 12% of the Army's chemical weapons stockpile. Chemical munitions are also being incinerated at installations in Alabama, Oregon, and Utah.—GH

ANTIMICROBIAL SOAP RAISES CONCERNS

Rep. Edward J. Markey (D-Mass.), chairman of the House Energy & Environment Subcommittee, is urging federal regulators to look more closely at two chemicals widely used in antimicrobial hand soaps and other personal care products. The chemicals—triclosan and triclocarban—are prevalent in U.S. waters and have the potential to disrupt the human endocrine system, Markey wrote in letters to EPA Administrator Lisa P. Jackson and FDA Commissioner Margaret Hamburg on Jan. 5. In the letters, Markey questioned whether products containing triclosan or triclocarban are more effective at reducing illness than regular soap, and he raised concerns about the chemicals' potential for increasing antibiotic resistance. Markey urged FDA to finalize a regulation on over-the-counter topical antiseptics, first proposed by the agency 37 years ago. He also requested EPA to consider regulating the two chemicals under the Safe Drinking Water Act and evaluating them under EPA's Endocrine Disruptor Screening Program. Both agencies have until Jan. 26 to respond to Markey's questions.—BEE

SUSAN MORRISSEY/C&EN

PRESIDENT EXPANDS EDUCATION CAMPAIGN

President Barack Obama announced on Jan. 6 a second wave of public-private partnerships under the Administration's Educate to Innovate campaign. The now more than $500 million campaign aims to move American students to the top of the global science and math achievement pack over the next decade (C&EN, Nov. 30, 2009, page 9). To this end, the new partnerships—valued at over $250 million in financial and indirect support—will help attract, develop, reward, and retain top math and science teachers by preparing more than 10,000 new teachers over five years and providing professional support for more than 100,000 current teachers. "The quality of math and science teachers is the most important single factor influencing whether students will succeed or fail in science, technology, engineering, and mathematics," the President said when announcing the new partnerships.—SRM

COURT BANS PESTICIDE, CITES BEE TOXICITY

A federal court in New York has banned the pesticide spirotetramat, which environmental groups say is potentially toxic to honeybees. The ruling makes it illegal to sell the pesticide, manufactured by Bayer CropScience under the trade names Movento and Ultor, in the U.S. beginning on Jan. 15. The decision settles a suit, filed by the Natural Resources Defense Council and another environmental group, the Xerces Society, which claimed that EPA did not follow proper procedures when it approved spirotetramat in 2008. EPA approved the insecticide for use on hundreds of crops, including apples, pears, peaches, tomatoes, grapes, strawberries, and spinach, but it did not provide advance notice or an opportunity for public comment. In addition, EPA did not publish its registration decision in the *Federal Register*. EPA is required to take all three measures under current pesticide law. The ruling orders EPA to reevaluate the impact of spirotetramat on beneficial insects, particularly honeybees. Bayer argues that it has already invested $90 million on the testing and registration of spirotetramat and that the court's decision was made because of EPA's procedural error, not because of concerns about bee safety.—BEE

GUNNAR SEIJBOLD/SWEDISH GOVERNMENT

SHIFTING CLIMATE

NEWS ANALYSIS: Copenhagen meeting falls victim to evolving global-warming politics

CHERYL HOGUE, C&EN WASHINGTON

IN THE END, all that the head of the United Nations could do was put an optimistic spin on the outcome of last month's climate-change talks in Copenhagen.

The international negotiations yielded little. They were stymied not only by shifting geopolitical dynamics but also by procedural maneuvers that stifled consensus and by disruptions from the unprecedented number of people observing the proceedings. The result raises the prospect that nations will eschew the UN process and negotiate legally binding treaties to limit greenhouse gas emissions on their own. It's too soon to tell how the political shifts will play out and whether nations of the world can agree to curb their emissions and usher in a new age of cleaner energy.

UN Secretary-General Ban Ki-moon called the agreement emerging from the conference "an essential beginning." But, he also acknowledged, "the Copenhagen Accord may not be everything that everyone hoped for."

Reached on Dec. 18, 2009, the pact didn't meet the expectations of many. Countries had agreed in late 2007 that the Copenhagen meeting, held for two weeks in mid-December 2009, would culminate in a new, legally binding treaty to address climate change. But two years of talks leading up to Copenhagen made little progress. The Copenhagen meeting itself was fraught with seemingly endless discussions about procedure rather than substance.

Eventually, a handful of world leaders, convened by U.S. President Barack Obama, short-circuited the UN negotiating process and crafted a nonbinding deal in the closing hours of the Copenhagen meeting. The agreement doesn't specify numbers for countries' emission cuts, nor does it specify how much money will come from the industrialized world to help developing countries adapt to climate change and mitigate emissions (C&EN, Jan. 4, page 8). The most optimistic view is that the Copenhagen Accord will form the basis of a legally binding international treaty to be completed by the end of 2010.

One of those most disappointed in the outcome might well have been Ban. The UN chief wanted the Copenhagen talks to produce a legally binding treaty. For months, he had encouraged world leaders to throw their political weight behind the Copenhagen talks. He even called leaders to a summit in September 2009, and about 100 of them attended (C&EN, Sept. 21, 2009, page 7).

CHANGING DYNAMICS India and China were key players in the talks that yielded the Copenhagen Accord.

By the end of October, however, prospects for the Copenhagen meeting had fallen, and the odds of the gathering producing a legally binding treaty became almost nil. A nonbinding political deal, such as the one that emerged, was the most realistically hopeful outcome (C&EN, Nov. 9, 2009, page 37).

THE COPENHAGEN meeting reflected a significant shift in the international politics of climate change. The dynamics of global affairs in 2009 are considerably different from what they were in 1997, when the last climate treaty, the Kyoto protocol, was completed, or five years earlier, when the first climate deal, the UN Framework Convention on Climate Change, emerged from the 1992 Earth Summit.

Both of those treaties divided the world in two—industrialized versus developing countries—reflecting the dominant geopolitical perspective of many years. But the Copenhagen meeting made it clear that dividing the world into this simple dichotomy is increasingly less valid.

Developing countries still stuck together in Copenhagen as a bloc of 130 countries called the Group of 77 & China. The group wants industrialized countries to accept mandatory emissions cuts and to provide developing countries with financing to adapt to the effects of climate change and to install greener energy technologies. G-77 & China is adamantly against any legally binding global requirements for developing countries to control their emissions.

But fissures exist within G-77 & China, and they are widening. For instance, small island states that could face obliteration by rising seas are calling strongly for emission cuts, which they see as critical to their survival. They want human-induced global warming constrained to less than 2 °C and are pushing for a 1.5 °C cap. They aren't

A nonbinding political deal was the most realistically hopeful outcome.

NEWSCOM

WEARY DIPLOMATS By the end of the conference, some negotiators snatched a few minutes of sleep at their desks during breaks in the around-the-clock talks.

picky about where in the world the reductions happen—whether in the developing or industrialized world. And several of them have pledged to control their own minuscule emissions.

Meanwhile, the African Group, which includes 33 of the 49 countries the UN has designated as the world's poorest, is focused on getting financial assistance for adaptation and low-carbon energy technologies. Poverty alleviation and aid to cope with projected increases in droughts are priorities for many African nations.

Then there's China. The fastest growing economy on Earth and the world's largest emitter of carbon dioxide sticks to its historical designation as a developing country. He Yafei, vice minister of foreign affairs, emphasized to reporters in Copenhagen that his country has 150 million people who live below the international poverty line of $1.25 per day.

Any action to combat climate change, He said, "should not be done at the expense of the right to development by developing countries." The top priority for the developing world, including China, He said, is reducing poverty.

In addition to China, other large, rapidly industrializing developing countries, such as Brazil, India, and South Africa, belong to G-77 & China. These countries are becoming major emitters of CO_2.

U.S. negotiators, backed by the European Union, pushed hard in Copenhagen to distinguish emerging economies with rising emissions from the rest of the developing world. Most of the growth in greenhouse gas emissions is taking place in emerging economies, said Todd Stern, U.S. special envoy for climate change. Any emission reductions by the industrialized world would be swamped by these countries. So if these emerging economies take no action to restrain their emissions, global warming would continue unabated, he stressed.

In addition to this physical reality, Stern is concerned about the political imperative to get China to agree to control its emissions—something the U.S. Senate has made clear is needed for it to ratify any global climate pact.

U.S. EFFORTS to involve emerging economies in the fight against global warming bore fruit in Copenhagen, despite resistance from G-77 & China. Involved in hammering out the Copenhagen Accord were China's Premier Wen Jiabao, India's Prime Minister Manmohan Singh, and South Africa's President Jacob Zuma.

Plus, several emerging economies had pledged to control their greenhouse gas emissions as part of the run-up to Copenhagen, marking a major shift in policy. For instance, China's President Hu Jintao announced in September 2009 that the country would ratchet down its emissions of energy per unit of gross domestic product—a measure called energy intensity (C&EN, Sept. 28, 2009, page 10). "China's commitment is very firm," Foreign Affairs Vice Minister He said in Copenhagen. "It is unconditional" and will be enforced under domestic law.

India, too, says it will cut its energy intensity. And Brazil has recently taken steps that arguably set it apart from other developing countries. President Luiz Inacio Lula da Silva signed a law on Dec. 29, 2009, that requires Brazil to cut its emissions by 36–39% from projected 2020 levels. About half of those reductions would come from slowing deforestation in the Amazon.

In Copenhagen, da Silva boldly suggested that Brazil is willing to donate money to help poorer countries grapple with climate change. Until now, only countries historically categorized as industrialized have provided financing for climate projects, which have thus far taken place under the Kyoto protocol.

Evolving economic distinctions among the countries classified as developing aren't the only way Copenhagen showed that the dynamics of climate discussions have changed in recent years. Another sign is the direct involvement of world leaders in climate-change discussions. The Copenhagen meeting wasn't just a negotiating session, it was also the largest summit ever to be held outside of UN headquarters in New York City, with 119 heads of state or heads of government attending. Those

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"The Copenhagen Accord may not be everything that everyone hoped for."

leaders generally agreed that climate change is happening. As a result, they said the world needs to cut greenhouse gas emissions and developing countries need financial assistance to adapt to climate change and to install clean-energy technologies.

Furthermore, ordinary citizens from around the world descended on Copenhagen in droves to participate in what many saw as a historic gathering that would determine the future of the planet. Of the 45,000 people registered for the meeting, nearly half were observers from environmental groups, businesses, or religious organizations, or were indigenous people or farmers, according to the UN. As a result of this overwhelming interest, toward the end of the meeting, many observers could not get into the meeting venue, Copenhagen's massive Bella Center, because their numbers overwhelmed the complex's capacity of 15,000.

Yvo de Boer, the UN's top climate official, said the meeting afforded more observers access to the official proceedings than any other UN conference before. But having hundreds of people wait in freezing weather for hours to get into the Bella Center and the disruptions some protesters caused inside the venue "test my courage to continue in this way," de Boer confessed. This admission suggests that the UN could limit the number of observers who can register to attend major conferences in the future.

The tens of thousands who came to Copenhagen also clogged the city's streets in mostly peaceful demonstrations. That so many people came to the city in the short days of winter and stood under cold gray skies to demand action against global warming puts more pressure on governments to act, according to many environmental groups.

AS THE TWO-WEEK meeting wore on, many participants—from government officials to protesters—held high hopes that Obama would save the negotiations from failure. They anticipated the change of the American presidency from George W. Bush, who resisted emission targets, to Obama, who has made clean energy a priority, would make a big difference in the global climate talks. But Obama's performance in Copenhagen on the last scheduled day of the meeting got mixed reviews.

Some portrayed Obama as a hero who intervened at the last minute and emerged with deal in hand. "President Obama's hands-on engagement broke through the bickering," said Sen. John F. Kerry (D-Mass.), chairman of the Senate Foreign Relations Committee.

Others were more measured.

"I applaud President Obama for his determination to not let these talks fail and his success working with China," said Larry Schweiger, president and chief executive officer of the conservation advocacy group National Wildlife Federation. "The deal is incomplete, and we're not done yet," he continued. "We will need far more ambitious global cooperation to fill in the missing pieces next year."

Obama's actions in Copenhagen attracted criticism, too, including from Kate Horner, international policy analyst of the environmental group Friends of the Earth U.S.

"This toothless declaration, being spun by the U.S. as a historic success, reflects contempt for the multilateral process, and we expect more from our Nobel Prize-winning President," Horner said.

That multilateral process—the open, consensus-based way the UN runs negotiations—is also in question for future climate negotiations in the wake of Copenhagen's outcome.

Some developing countries kept the negotiations in knots at Copenhagen by repeatedly raising procedural objections. And most countries and blocs remained entrenched in positions solidified over the past months or years, making no concessions. Near the end of the second week of the talks, the drawn-out and seemingly endless proceedings took place around-the-clock.

Breaking the impasse were the closed-door talks by leaders who came up with the Copenhagen Accord.

As a group, G-77 & China was frustrated at the deal and how it was reached, said Bernarditas de Castro Muller of the Philippines, a spokeswoman for the bloc. She complained that the long-standing UN negotiations on climate change, involving representatives of 193 countries, got trumped by a backroom deal put together by a handful of world leaders. "We were diverted by processes beyond our control," she said.

The Copenhagen Accord is "a strong strike against multilateralism and the democratic principles in the UN system," said Guillermo Kerber, program executive on climate change for the World Council of Churches, a fellowship of nearly 350 Christian churches in 120 countries.

CHERYL HOGUE/C&EN

PARTICIPATION More observers were approved to attend the Copenhagen climate meeting than at any other UN meeting in history.

So, although UN chief Ban might be disappointed that governments missed his goal for completing a new treaty in Copenhagen, he also may have significant worries about the continued relevance of the organization he leads for climate-change matters. Countries that are major emitters of greenhouse gases have been meeting for a few years, in a process that Bush began and Obama has continued. It is foreseeable—and, likely, politically easier—for these countries to come up with their own legally binding treaty to address emissions.

But if they do so, they would bypass key global equity and environmental concerns of poor countries that have contributed nothing to global warming yet are facing its impacts, de Boer said. "Part of the reason why people went to the trouble of inventing the United Nations," he said, "is to ensure that we address global issues like climate change equitably, taking the concerns of all into account." ■

LEE YONG-HO/POOL/SIPA/NEWSCOM

ALLIES Lee (right) and Obama vowed to work toward ratification of the U.S.-Korea Free Trade Agreement during their meeting in Seoul on Nov. 19, 2009.

TRADE DEAL IN LIMBO

Exporters seek ratification of **U.S.-KOREA TRADE PACT** amid rising protectionist sentiment in Congress

GLENN HESS, C&EN WASHINGTON

BUSINESS GROUPS are calling on President Barack Obama to follow through on his recent pledge to win congressional approval of a long-delayed free-trade agreement between the U.S. and South Korea. This pact has significant implications for chemical manufacturers and other big exporting industries.

"Words must now be matched by actions," says Thomas J. Donohue, president and chief executive officer of the U.S. Chamber of Commerce, the nation's largest business lobby. "Expanding exports are our best ticket for creating jobs, reducing deficits, and restoring prosperity. The rest of the world is not standing around waiting for the U.S."

The U.S. and South Korea signed the world's largest bilateral free-trade agreement in 2007. But the deal's ratification has been put on hold in both nations because of strong opposition by some stakeholders, particularly automakers and labor unions in the U.S.

The U.S. chemical industry, which shipped almost $5 billion worth of products to South Korea in 2008, wants to see chemical tariffs in the Asian nation eliminated as quickly as possible. South Korea is among the top 10 chemical-producing countries in the world and is the sixth-largest market for U.S. chemical exports.

"Our members view the South Korea free-trade agreement as the most commercially significant of the three pacts that have been negotiated and are awaiting votes in Congress," says Justine Freisleben, assistant manager of government relations at the Society of Chemical Manufacturers & Affiliates (SOCMA), a trade group that lobbies on behalf of nearly 300 small and medium-sized chemical companies. "It represents a huge market for them."

In addition to the deal with South Korea, bilateral trade promotion agreements with Colombia and Panama have also been on hold for more than two years. The Administration of former president George W. Bush negotiated all three pacts but was unable to persuade the Democratic-controlled Congress to approve any of them.

Obama has moved slowly on trade while focusing attention on health care reform and climate-change legislation. But on the last leg of his Asian tour in November 2009, the President indicated that he would strive to clear the obstacles that have blocked ratification of the U.S.-Korea trade accord.

"I am a strong believer that both countries can benefit from expanding our trade ties," Obama remarked at a press conference in Seoul with South Korean President Lee Myung-bak. "I have told President Lee and his team that I am committed to seeing the two countries work together to move this agreement forward."

Analysts have said that a free-trade pact between the two nations could lead to tens of thousands of new jobs in the U.S. The deal is the biggest of its kind for the U.S. since signing the North American Free Trade Agreement with Canada and Mexico in 1993. It is also Washington's first bilateral trade pact with a major Asian economy.

South Korea is the seventh-largest U.S. trading partner, with two-way trade between the two nations reaching almost $83 billion in 2008. But the U.S. has been losing ground to its competitors in the Asia-Pacific region.

After being ranked as South Korea's top trading partner in 2004, the U.S. now trails China, Japan, and the European Union. U.S. companies primarily export organic chemicals, agricultural products, aircraft, and machinery, and Korean firms sell cars, telecommunications equipment, and electronics in the U.S.

Under the U.S.-Korea accord, nearly 95% of trade between the two countries in industrial and consumer products would become duty-free within three years after the pact's enactment, and most remaining tariffs would be eliminated within 10 years. The pact would also ensure that American investors in South Korea have the same rights as Korean investors and that intellectual property rights are protected.

For decades, both Republican and Democratic presidents have pursued free-trade agreements that opened markets for U.S. products. But many Democrats have become deeply skeptical of the free-trade agenda that has dominated U.S. policy, blaming it for heavy job losses, particularly in the manufacturing sector.

Obama sided with unions and other opponents of the Korean and Colombian agreements during the 2008 presidential election campaign. But since taking of-

TRADING PARTNER Although chemical plants in South Korea, such as this Air Products facility, depend on imported raw materials, the country has become a significant chemical producer.

fice, he has inched toward embracing the deals. In March 2009, Obama ordered the White House trade office to conduct a comprehensive review of the pending agreements, and he vowed to make tougher labor and environmental standards prerequisites for concluding trade deals in the future.

The main opposition to the pact with South Korea comes from the U.S. auto sector. It contends that the agreement does little to address nontariff barriers that would continue to give Korean car manufacturers open access to the U.S. market while doing almost nothing to increase U.S. exports to South Korea. "This deeply flawed trade deal contains no enforceable measures to open Korean markets to U.S.-built goods," says Ron Gettelfinger, president of the United Auto Workers, an auto industry labor union.

South Korea imported just 10,000 U.S.-made vehicles in 2008 but exported more than 600,000 cars and light trucks to the U.S. That difference accounted for most of the $13.3 billion trade deficit the U.S. had with South Korea that year. "Something is obviously wrong with this picture, and this trade agreement will do nothing to make it right," Gettelfinger asserts.

LAWMAKERS in large car-producing states, such as Michigan, Illinois, and Ohio, have led the congressional opposition to the agreement, and they have demanded that additional safeguards be put in place to boost U.S. auto shipments to South Korea. On Nov. 19, 2009, Rep. John D. Dingell (D-Mich.) introduced a resolution in the House of Representatives calling on the Korean government to end its "unfair trade practices" related to the automotive industry.

"Before we move forward with the U.S.-Korea Free Trade Agreement, I feel it necessary to remind my colleagues in Congress that the draft agreement allows Korean discriminatory treatment of imported U.S. automobiles to perpetuate," Dingell said in a statement. "While U.S. automakers continue to have grave difficulties accessing the Korean market, Congress should insist that the free-trade agreement between our two countries remedy this patently unbalanced state of affairs."

AIR PRODUCTS & CHEMICALS

At the news conference in Seoul on Nov. 19, South Korean President Lee signaled that his country was willing to revisit elements of the deal negotiated by the Bush Administration. "If there is a problem in the auto sector, I think we can have an opportunity to talk about this issue again. We are ready to do it," Lee said. South Korea had previously opposed any formal renegotiation of the pact.

Industry officials are worried that further delay will undermine the competitiveness of U.S. products in a key Asian market, citing South Korea's move to forge similar pacts with other countries. The Korean government signed a free-trade agreement with the EU in October 2009 and is actively seeking deals with China, Japan, Mexico, Canada, Colombia, and Peru.

"The clock is now ticking for the Administration and Congress to ensure that U.S. businesses and workers can stay competitive in Korea's market," says Tami Overby, vice president for Asia at the Chamber of Commerce. If the U.S. pact with South Korea is not in place when Korea's agreement with the EU takes effect, "our global competitors will enjoy significant new market access in Korea before U.S. businesses do," Overby notes. "This will cut us off from significant opportunities to create new U.S. economic growth and jobs at a time when our workers and businesses need them most."

The failure to ratify the deal is alarming because South Korea is one of the fastest growing Asian markets for U.S. chemical exports, SOCMA's Freisleben says. "It's definitely a concern that Korea and other countries are moving forward and signing agreements within the region," she says. "It seems like everyone else is liberalizing trade while the U.S. is on the sidelines. It's too big of a market for us to be left out."

SUPPORTERS OF the pending trade deal with South Korea include the U.S.-Korea FTA Business Coalition, whose 800 members include companies and trade associations such as 3M, the American Natural Soda Ash Corp. (ANSAC), and SOCMA.

3M shipped more than $300 million worth of products to South Korea in 2008, including fluorinated fluids and gases for the semiconductor industry and brightness-enhancing films for televisions and other liquid-crystal display screens. Eliminating the 6.5–8.0% tariffs on these products will make them "more widely accessible to Korean electronics manufacturers," says Doug Whitman, 3M's trade compliance manager. "Continuing efforts to promote free and fair trade is critical to 3M's success and growth as a company."

Likewise, immediate elimination of South Korea's 4% duty on

soda ash would provide a competitive boost to U.S. producers "in a market now flooded by low-price imports from China," says John M. Andrews, president of ANSAC, the international marketing arm of U.S. soda ash producers FMC, General Chemical, Solvay Chemicals, and OCI Chemicals. "ANSAC expects that the elimination of Korea's import duty will result in an estimated $18 million to $20 million annual increase in U.S. soda ash exports to Korea," Andrews says.

On Dec. 15, 2009, U.S. Trade Representative Ron Kirk, the Obama Administration's top trade official, said his office is developing proposals in preparation for new talks with South Korea that will try to move the bilateral trade pact forward. "We are working to address outstanding concerns with the U.S.-Korea Free Trade Agreement, particularly with respect to autos, so that this Administration can present the agreement to Congress," Kirk told a forum hosted by the Washington International Trade Association.

Obama could face strong resistance from many members of his own party if he seeks congressional approval of the agreement in 2010, even if he negotiates side deals to address the automotive and other concerns that have held up the pact.

"It seems like everyone else is liberalizing trade while the U.S. is on the sidelines. It's too big of a market for us to be left out."

"I can't understand why we would want to pass a Bush-negotiated trade agreement, even with some side agreements that might sweeten the pot a little bit," says Sen. Sherrod Brown (D-Ohio). "I don't think the President will move on that. I think he will have great opposition if he does."

Brown, a labor ally who is one of the Senate's staunchest opponents of recent trade pacts, is sponsoring legislation (S. 2821) that would require a comprehensive review of the economic impact of existing trade agreements before any new deals could be negotiated.

"Trade done right means new jobs and new industry at home and means lifting up workers in developing nations," Brown remarked at a Nov. 30, 2009, press conference. "For too long our nation's trade policy has exploited workers, betrayed middle-class families, and destroyed communities. It is time for a trade policy that works for everyone, not just a few."

A similar proposal (H.R. 3012), introduced in June 2009 by Rep. Michael Michaud (D-Maine), has gained the support of 130 Democratic cosponsors—nearly half of the party's caucus in the House.

FREE-TRADE ADVOCATES say they have to do a much better job of convincing members of Congress that deals such as the agreement with South Korea will bring net economic benefits to their states and districts.

"I think there needs to be a huge education effort to help people understand what the benefits of trade are, what happens when companies are exporting, and how it helps to create jobs here at home," Freisleben says. "In talking with certain House members, there seems to be a misunderstanding about what's going on. Trade can benefit domestic manufacturing; we aren't exporting jobs abroad."

A study released by the Chamber of Commerce this past November estimates that the U.S. could suffer a net loss of nearly 350,000 jobs and $35 billion in export sales if it fails to implement the pending trade agreement with South Korea while the EU and Korea move ahead with their bilateral pact.

"If the U.S. fails to advance its trade agenda, American workers will pay a price and lose jobs," says John G. Murphy, the chamber's vice president of international affairs. "There is no time for delay. If we fail to move forward with the trade agenda, the upshot will be more loss of jobs."

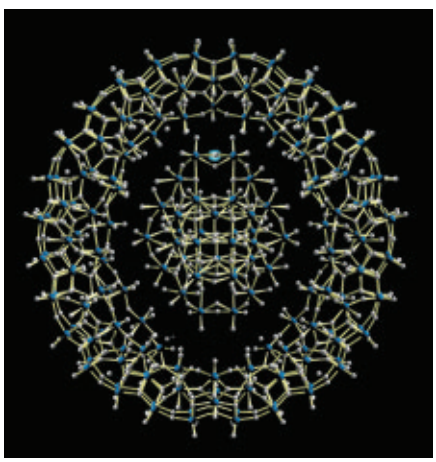
Freisleben says the chemical industry is encouraged that Administration officials have stated that boosting exports is a crucial part of the President's economic agenda. Federal agencies, such as the Small Business Administration and the Export-Import Bank of the U.S., "are really putting a focus on export-oriented growth, particularly with small to medium-sized manufacturers, realizing that is where innovation takes place and where job growth comes from," she remarks. ■

HUMAN BLUEPRINT CONTAINS CODE FROM SURPRISE VIRAL SOURCE

Some 8% of the human genome comes from viruses that have infected us throughout evolution; contributions from retroviruses have long been known to pepper our genome. Now, researchers in Japan report that a previously unknown source of viral genetic code infiltrated our blueprint about 40 million years ago (*Nature* **2010,** *463,* 84). In particular, genetic information from a bornavirus, an RNA virus that infects the brain and other tissues, was discovered in the genomes of humans, elephants, squirrels, and various other mammals by a team led by Keizo Tomonaga of Osaka University. The majority of the bornavirus genetic contribution is in noncoding regions of the human genome, but segments similar to a bornavirus gene that codes for a protein resembling the virus's nucleocapsid can be expressed in human cells. "The finding unveils bornaviruses as a potential cause of mutation and also as an unforeseen source of genomic innovation," notes Cédric Feschotte of the University of Texas, Arlington, in a commentary on the study. The work also sets the stage to test "the alleged but still controversial" association of bornavirus infection and certain psychiatric ailments, such as schizophrenia and mood disorders, he adds.—SE

MOLECULAR DONUT AND ITS HOLE

To construct an inorganic donut, start with the donut hole, suggests a group led by Leroy Cronin of the University of Glasgow, in Scotland, and Achim Müller of Bielefeld University, in Germany (*Science* **2010,** *327,* 72). The team studied the formation of a 3.6-nm-diameter donut-shaped Mo_{150} cluster with the formula $[Mo_{150}O_{442}(OH)_{10}(H_2O)_{61}]^{14-}$. The researchers used a flow reactor system that allowed real-time control of pH and reagent concentrations. By adjusting the system conditions, they were able to isolate and crystallize an intermediate with a $[Mo_{36}O_{112}(H_2O)_{16}]^{8-}$ cluster bound within the Mo_{150} donut through 22 sodium cations, which balance the negative charges of the donut and hole clusters. If the solution is reduced, the Mo_{36} cluster dissociates from the donut, and the two species can be isolated separately. The team hypothesizes that the Mo_{36} cluster serves as a structure-directing template for formation of the Mo_{150} donut, a strategy that chemists might be able to use for future efforts at molecular assembly. "The results show how a flow system can be used to understand and optimize a complex bottom-up assembly process that generates gram quantities of a nanomaterial with well-defined size, shape, and composition," Cronin says.—JK



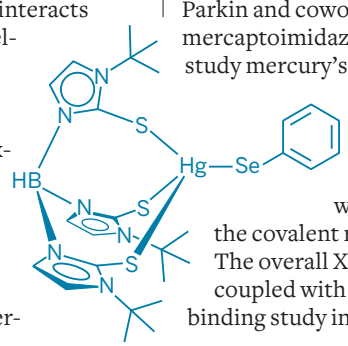
SCIENCE

A Mo_{36} cluster (center) serves as the template for the formation of a Mo_{150} donut (Mo is blue, O is gray).

& MORE ONLINE

SELENIUM'S ROLE IN MERCURY'S TOXICITY

An analysis of how mercury interacts with sulfur, selenium, and tellurium via a protein mimic compound has provided a better understanding of the mechanism of mercury's toxicity, according to a study by Columbia University's Gerard Parkin, Jonathan G. Melnick, and Kevin Yurkerwich (*J. Am. Chem. Soc.*, DOI: 10.1021/ja907523x). Mercury toxicity is typically associated with the element's high affinity for binding sulfur in cysteine residues of proteins and enzymes. A second toxicity mechanism involves mercury's interaction with selenium, an important antioxidant element in humans. Mercury is known to reduce the bioavailability of selenium by forming insoluble mercury selenide species and by binding to active sites of selenoenzymes. Parkin and coworkers used a tripodal mercaptoimidazolylborate ligand to study mercury's affinity for sulfur, selenium, and tellurium. One key finding is that the Hg–Se and Hg–Te bonds are shorter than would be predicted from the covalent radii of the elements. The overall X-ray structure evidence coupled with a competitive mercury-binding study involving sulfur and selenium show that mercury's "selenophilicity" is greater than its "thiophilicity," Parkin says. Ligands featuring selenium and possibly tellurium may thus prove to be effective in treating mercury poisoning and prompt the design of new chelating agents, Parkin adds.—SR



Selenophilic mercury complex

UBIQUITIN UNFOLDS DOOMED PROTEINS

Unneeded or damaged proteins that are destined for destruction within a cell are tagged with ubiquitin. This polypeptide marks a condemned protein for degradation in a proteasome, a large protein complex otherwise known as the cell's garbage disposal. Using computational techniques, Yaakov Levy and Tzachi Hagai of Israel's Weizmann Institute of Science have discovered that ubiquitin also assists the degradation process by altering the protein's thermal stability and thereby helping unfold the protein near the ubiquitin-binding site (*Proc. Natl. Acad. Sci. USA*, DOI: 10.1073/pnas.0912335107). The study "implies that, in addition to its known role as a recognition signal, the ubiquitin attachment may be directly involved in the cellular process it regulates by changing the biophysical properties of the substrate," Levy and Hagai

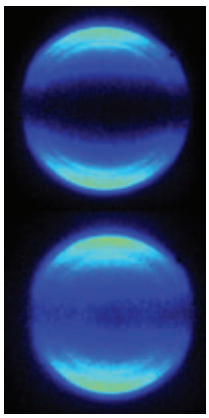
write. The researchers acknowledge that it is presently unclear how universal this mechanism is and to what extent nature exploits it in facilitating protein degradation. They add that ubiquitin's effect on protein folding might be relevant to other cellular processes regulated by the polypeptide, including DNA repair and endocytosis.—SLR

SPEEDY NONLINEAR OPTICAL ANALYSIS

Combining a novel laser-probe method with a fast data-analysis technique enables scientists to rapidly differentiate chemically distinct thin films solely on the basis of subtle differences in the optical properties, according to a research team at Purdue University (*Anal. Chem.*, DOI: 10.1021/ac901832u). Changes in the polarization of light reflected from thin films can serve as a probe of the structure, orientation, and symmetry of molecules at the film's surface. Yet those measurements can take hours to complete. Purdue's Nathan J. Begue and Garth J. Simpson report that polarization measurements can now be made in fractions of a second by using a surface-sensitive method they developed known as nonlinear optical Stokes ellipsometry. Time-consuming data analysis based on traditional nonlinear curve fitting likewise can be sped up by orders of magnitude, they say, by combining linear curve fitting with a statistical technique known as principal component analysis. The researchers showed that the new combination can be used to quickly distinguish among monolayer films of four similar dyes. The team plans to apply the technique to probing crystal polymorphism.—MJ

ATOM VERSUS SUPERATOM

The concept of superatoms—molecules or collections of atoms that behave like a single atom—has received a boost from a new photoelectron imaging spectroscopy study (*Proc. Natl. Acad. Sci. USA*, DOI: 10.1073/pnas.0911240107). A. Welford Castleman Jr., Samuel J. Peppernick, and K. D. Dasitha Gunaratne of Pennsylvania State University compared the electron angular distributions and electron-binding energies of several diatomic molecules and their isoelectronic atomic counterparts—titanium monoxide versus nickel, zirconium monoxide versus palladium, and tungsten carbide versus platinum. They found the electronic properties are almost identical in each case, suggesting that an atom's corresponding superatoms can be predicted by simply looking at the periodic table and finding combinations that collectively have the same number of outer-shell electrons as the single atom, Castleman says.



COURTESY OF WELFORD CASTLEMAN

The binding energies of electrons in Ni^- (top) and a TiO^- molecule (bottom), shown by bright spots, are similar in these photoelectron images.

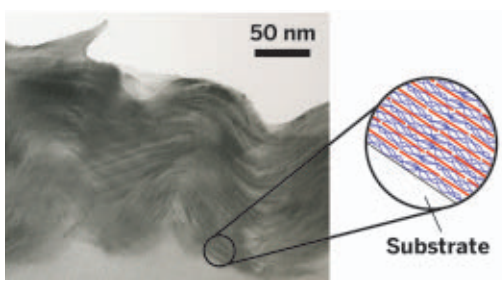
Although the study confirms the electronic similarity of some transition-metal atoms and their corresponding superatoms, the researchers are now working to determine if the similarities extend to the rest of the periodic table and to atom-superatom chemical reactivities. A periodic table of superatoms could have many uses, the researchers say. For example, tungsten carbide has been shown to exhibit reactivity similar to the much more expensive workhorse catalyst platinum.—EKW

INFECTIOUS PRIONS MUTATE STRUCTURALLY

Conversion of normal prion protein into a misfolded, infectious form has generally been viewed as a one-to-one process in which each strain of prion protein misfolds into a specific form. But in unexpected findings with implications for drug design, researchers have discovered that misfolded prions can refold and thus evolve structurally. Charles Weissmann and coworkers of Scripps Florida report that prions from infected brain cells change their properties, and by implication their structures, when transferred to cultured cells and then change further when transferred back (*Science*, DOI: 10.1126/science.1183218). They also found that, in the presence of the prion-inhibiting drug swainsonine, infectious prions evolve into a drug-resistant form. Prion diseases such as mad cow disease and Creutzfeldt-Jakob disease in people are lethal and incurable, so drugs to fight the conditions are being sought. Weissmann and coworkers suggest that in view of the newfound ability of infectious prions to mutate and potentially evade drugs designed against them, it might be best to design drugs that target normal prion protein instead of the shape-shifting infectious forms.—SB

CLAY-POLYMER NANOLAYERS IMPROVE GAS-BARRIER FILMS

A composite sheet composed of alternating nanolayers of clay and polymer could provide improved transparent and flexible gas-barrier films to protect electronics, food, and pharmaceutical products, report Morgan A. Priolo, Daniel Gamboa, and Jaime C. Grunlan of Texas A&M University



ACS APPL. MATER. INTERFACES

A TEM image reveals the 40 bilayers of a gas-barrier film made from clay platelets (red) layered with polyethylenimine (blue) on a polyethylene terephthalate substrate.

(*ACS Appl. Mater. Interfaces*, DOI: 10.1021/am900820k). Currently, such films are made from inorganic oxides, which are prone to cracking, and bulk clay-polymer composites, which offer poor transparency and serve as only a weak barrier to gases such as oxygen in the air. Grunlan and colleagues tried a new approach by layering sodium montmorillonite clay platelets with branched polyethylenimine, tuning the thickness of the polymer layers by adjusting the pH of the solution. The researchers liken the structure of the films to that of a brick wall, with the clay platelets as the bricks and the polymer as the mortar. A film of 70 clay-polymer bilayers, 231 nm thick when prepared at pH 10, remains flexible and transparent and has oxygen permeability lower than that reported for other clay-polymer composites, the researchers say. Grunlan's group is working toward developing gas barriers with fewer layers to make the composite sheets even more attractive for commercial applications.—JK

CHINA ASCENDANT

Measured by patent applications or journal articles, growth in Chinese SCIENTIFIC OUTPUT is stupendous

SOPHIE L. ROVNER, C&EN WASHINGTON

NO MATTER HOW you slice it, China is on a scientific roll.

This past year, China became the world leader in terms of the number of chemistry patents published on an annual basis, according to Chemical Abstracts Service (CAS), a division of the American Chemical Society. And growth in publication of scholarly papers by the country's researchers far outpaces that of other nations, reports Thomson Reuters, a news and information company based in New York City.

"If China's research growth remains this rapid and substantial, European and North American institutions will want to be part of it," says Jonathan Adams, director of research evaluation at Thomson Reuters. "China no longer depends on links to traditional G-8 partners [Canada, France, Germany, Italy, Japan, Russia, the U.K., and the U.S.] to help its knowledge development. When Europe and the U.S. visit China they can only do so as equal partners."

Thomson Reuters released "Global Research Report: China" in November 2009 as the third installment in a series designed to inform policymakers about the changing landscape of the global research base. Reports on India and Brazil were released earlier in the year.

Those three nations, along with Russia, "are beginning to build on their vast resources and potential in becoming significant players in the world economy," according to the China report, which Adams coauthored. "As their influence becomes felt economically, so their impact also becomes apparent in research and innovation. That impact is changing the world map of research; it creates a new geography of science," with China conceivably at its center.

But assessing the strength of a nation's science is not a straightforward exercise. China "is a highly competitive society, if not cutthroat," says Zhigang Shuai, deputy secretary-general of the Chinese Chemical Society and a chemistry professor at Tsinghua University, in Beijing. "Everybody is busy doing something. However, it has to be borne in mind that at this stage, China can only be regarded as a big country in chemistry, not yet a strong country. Highly original work is still rare," he adds. "Among the patents and papers, very, very few can be regarded as groundbreaking, or the best, or the first in their fields."

Nevertheless, Shuai expects growth will continue as individual Chinese researchers increase their average scientific output to the levels of productivity found in developed countries.

The extraordinary growth in Chinese chemical patenting and publishing is being driven by "the combination of economic development and awareness of the strategic importance of intellectual property protection," according to Sunny Wang, 2009 president of the Tri-State chapter of the Chinese-American Chemical Society.

The country is moving up the ladder of development from natural-asset-based industries that rely on inexpensive labor and raw materials toward R&D-based industries such as pharmaceuticals and microchips and information-driven businesses and services, adds Wang, who heads the patent search group at the pharmaceutical company Sanofi-Aventis in Bridgewater, N.J.

THE CHINESE government's insistence on "political stability and economic development above all other considerations has laid the foundation for long-lasting economic growth and sustained demand for research and innovation," Wang says.

China, whose economy is surpassed in size only by that of the U.S., is maintaining investment in its R&D sector at nearly 1% of gross domestic product, Thomson Reuters notes. Given the extraordinary expansion in the nation's GDP, that means

CHINA'S SHARE BY MAIN FIELD

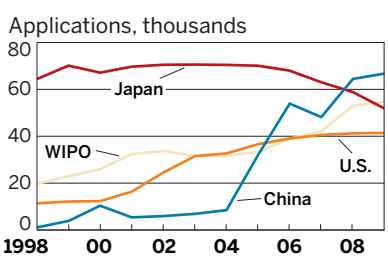
During 2004–08, 17% of chemistry papers included an author in China, up from 9% in 1999–2003

	1999–2003		2004–08	
	NUMBER OF PAPERS	SHARE (% OF WORLD)	NUMBER OF PAPERS	SHARE (% OF WORLD)
Materials science	20,847	12.2%	48,210	20.8%
Chemistry	44,573	9.3	99,206	16.9
Physics	31,103	8.0	66,153	14.2
Mathematics	7,321	7.4	16,029	12.8
Engineering	19,343	6.4	43,162	10.9
Computer science	3,943	4.5	16,009	10.7
Geosciences	5,322	5.0	12,673	9.3
Pharmacology & toxicology	2,259	3.1	6,614	7.3
Environment & ecology	3,171	3.3	9,032	6.9
Space science	2,055	3.8	3,514	5.9
Biology & biochemistry	6,697	2.7	15,971	5.9
Plant & animal science	5,915	2.6	14,646	5.4
Agricultural sciences	1,082	1.5	4,872	4.9
Microbiology	921	1.4	3,863	4.7
Molecular biology & genetics	1,642	1.4	6,210	4.5
Immunology	493	0.9	2,114	3.5

SOURCE: Essential Science Indicators, Thomson Reuters

CHEMISTRY PATENT APPLICATIONS

Surge from China's patent office began in 2004



NOTE: WIPO = World Intellectual Property Organization.
SOURCE: Chemical Abstracts Service databases

& MORE ONLINE Find manuscript-polishing tips for foreign authors and additional information on Chinese patenting trends by clicking on this story at *C&EN Online*, www.cen-online.org.

the average annual growth rate in R&D spending was almost 18% for the decade ending in 2005, according to the company's China report. That's much higher than in nations that are part of the Organization for Economic Cooperation & Development, including the U.S., Japan, and many European countries.

THE CHEMICAL enterprise is a beneficiary of that largesse. "The Chinese government appears to be investing a lot of money in chemical research in China, far more than Western governments are," says Matthew Toussant, senior vice president of editorial operations at CAS.

That investment could generate a huge return for the country. "Chemistry inventions, unlike almost any other invention, can be very lucrative," Toussant explains. "You can manufacture a consumer good like a cell phone," and other manufacturers can create a similar product to compete with it. But a patent on a molecule—such as a compound that treats a disease in a unique way—creates a period of protection during which no one else can sell the molecule for that particular purpose. And for that period, Toussant says, the inventor "can charge whatever the market will bear."

China is also investing in human resources, in part by welcoming its expats back home. Over the past decade or so, "a large number of well-trained scientists have been coming back from almost every leading group in North America, Japan, and Europe," Shuai says.

The nation also is benefiting from its emphasis on learning. "In Chinese traditional culture, education is in the center of our value system," Shuai notes. "Kids go to extra school in the evening and on weekends to learn math, music, and English instead of watching TV."

The number of students studying in Chinese universities has more than quadrupled in the past decade, he adds. And as those students have moved out into the work world, they have gotten busy, as evidenced by the explosion in the nation's patenting activity.

A significant fraction of that activity involves chemicals. "Chemical patents are a critical component to many industrial processes and scientific realms, including medicine and natural products," Toussant says. "In fact, on average, 35% of new patent invention applications globally involve chemical substances."

CAS has been mining its databases to track "the phenomenal growth of patent documents in the last decade," says Vice President of Marketing Christine McCue. The number of chemistry-related patent applications published by the U.S. Patent & Trademark Office (PTO) grew 240% in that time, and those published by the World Intellectual Property Organization (WIPO) grew 140%. But the number of chemistry-related patent applications published by the patent office in the People's Republic of China—known as the State Intellectual Property Office (SIPO)—increased by more than 1,600% during that same period.

ALTOGETHER, "the pace of growth in applications being disclosed in China is a magnitude greater than in every other developed area of the world," Toussant says.

As a result, the number of chemistry-related applications published on a monthly basis by China's patent office surpassed the PTO in 2005, WIPO in 2006, and Japan's patent office in 2008, CAS reports.

Last year was the first in which China recorded an entire year as the number one producer of chemical patents, and CAS projects that China will maintain its number one position for the foreseeable future. Totals for the year stood at about 67,000 for China, 55,000 for WIPO, 52,000 for Japan, and 41,000 for the U.S.

"This information is attention-getting," McCue observes.

CHINA'S SHARE BY SUBFIELD

During 2004–08, 32% of papers on crystallography and 19% of papers on polymer science included an author in China

	1999–2003		2004–08	
	NUMBER OF PAPERS	SHARE (% OF WORLD)	NUMBER OF PAPERS	SHARE (% OF WORLD)
Crystallography	3,476	11.5%	14,322	31.7%
Metallurgy & metallurgical engineering	7,019	17.6	16,624	31.2
Multidisciplinary physics	10,848	12.5	23,422	22.1
Applied mathematics	7,353	13.5	16,058	21.1
Materials: composites	1,170	10.9	3,070	19.9
Materials: ceramics	2,485	12.1	5,204	19.8
Polymer science	6,074	10.3	13,022	19.3
Materials: multidisciplinary	16,872	11.7	38,468	19.0
Inorganic & nuclear chemistry	4,953	9.6	10,470	18.1
Multidisciplinary chemistry	13,497	12.5	24,315	16.9

SOURCE: Web of Science, Thomson Reuters

ORIGIN OF *JACS* PAPERS

Researchers in China were primary authors of 5% of the articles in the *Journal of the American Chemical Society* in 2008, up from 1% a decade earlier

									CHINA		
YEAR	TOTAL PAPERS PUBLISHED	U.S.	JAPAN	GERMANY	U.K.	CANADA	FRANCE	ITALY	PEOPLE'S REPUBLIC OF CHINA	HONG KONG	SHARE (% OF TOTAL)
1998	2,477	1,378	232	114	74	112	74	50	10	10	0.8%
1999	2,235	1,327	234	103	71	83	62	54	9	9	0.8
2000	2,444	1,321	292	104	70	95	63	31	20	10	1.2
2001	2,542	1,369	295	95	75	113	81	45	30	8	1.5
2002	2,851	1,566	324	136	95	115	69	63	35	2	1.3
2003	3,193	1,702	352	124	119	142	82	66	77	6	2.6
2004	3,354	1,754	384	165	161	117	87	58	79	6	2.5
2005	3,616	1,851	399	178	141	139	102	64	117	6	3.4
2006	3,474	1,797	342	158	176	137	99	61	118	7	3.6
2007	3,157	1,647	302	164	130	135	85	65	130	6	4.3
2008	3,414	1,690	346	196	169	131	120	67	157	1	4.6

SOURCE: SciFinder, Chemical Abstracts Service

"China no longer depends on links to traditional G-8 partners to help its knowledge development."

For years, chemistry-related patent invention applications published by SIPO primarily concerned traditional pharmaceutical research, McCue notes.

But beginning about five years ago, Chinese patenting activity revealed diversification into several other chemistry-related fields, including genetic engineering, advanced materials such as ceramics, metals and alloys, and petroleum oil engineering.

Data gathered from the CAS Registry show that these efforts have generated tremendous growth in the creation of new compounds. The number of new chemicals disclosed in Chinese patent applications surged 2,400% to about 71,000 between 1999 and 2009, Toussant notes. References to all compounds—including existing substances, often in the context of describing new uses for those substances—were 6,600% higher in 2009 than in 1998. "This tells you that China is finding new uses for chemical substances that were already disclosed by others and is also creating new compounds," he says.

Nearly 70% of the chemistry-related patent applications published by SIPO are for inventors within China, "which indicates that Chinese scientists now recognize the importance of monetizing research discoveries," McCue says. Inventors in Japan represent the next largest set of authors of Chinese chemical patents, followed by those in South Korea and the U.S.

The growth trends revealed by patent data are reflected in China's journal article publication rates. Researchers in the People's Republic of China and Hong Kong were primary authors of just 0.8% of the articles published in the *Journal of the American Chemical Society* in 1998, according to data obtained via CAS's SciFinder, a research tool for scientific information in journal and patent literature from around the world. A decade later, however, the share of authors in China had grown to 4.6%.

China's output of journal articles in science as a whole expanded dramatically beginning around the mid-1990s, "commencing a steep upward trajectory that has only increased in recent years," according to the Thomson Reuters report. The findings are drawn from company databases that include data on articles from some 10,500 journals published worldwide.

Although countries including the U.S., Germany, and Japan have enjoyed only modest growth in publications over the past 10 years, the output of papers with at least one author in China—defined as the People's Republic of China and Hong Kong—surged more than fourfold. Researchers in China published just 20,000 papers in 1998 compared with more than 112,000 a decade later. During that same period, U.S. output rose from 265,000 papers to 340,000, an increase of less than 30%. "By the measure of annual output, China surpassed Japan, the U.K., and Germany in 2006 and now stands second only to the U.S.A.," according to the report.

China's largest share of world publications is in materials science, with papers by its authors accounting for 20.8% of output over the five years ending in 2008. That figure compares with a 12.2% share during the prior five-year period.

The country's second-largest share of world publications is in chemistry, a field in which its authors helped produce 16.9% of papers in 2004–08 versus 9.3% in 1999–2003.

The "investment in materials and related physical sciences and technology will provide China with a strong innovation platform" to modernize its heavy industry and primary manufacturing, the report states.

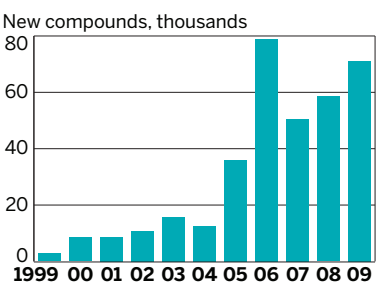
ON A MORE detailed basis, the share of papers published worldwide during the past five years with at least one author in China reached 31.7% in crystallography, 31.2% in metallurgy and metallurgical engineering, 19.9% in composites, 19.3% in polymer science, and 16.9% in multidisciplinary chemistry, according to Thomson Reuters.

Authors in China are most likely to collaborate with authors in the U.S. Over the past five years, such pairings accounted for 8.9% of papers with an author in China. Collaborations with second-place Japan represented 3.0% of such papers, whereas those with Germany, which is in third place, accounted for 2.3%.

Authors in China are also reaching out to collaborators in nations including South Korea, Singapore, and Australia. "Asia-Pacific nations are entirely happy to work with another's excellent research bases now," the report states. That means that when researchers in the U.S. and Europe approach their counterparts in China for possible collaboration, "the question that may be put to them is what they can bring to the partnership to make it worth China's while to share." ■

CHEMICAL SUBSTANCES IN CHINESE PATENT APPLICATIONS

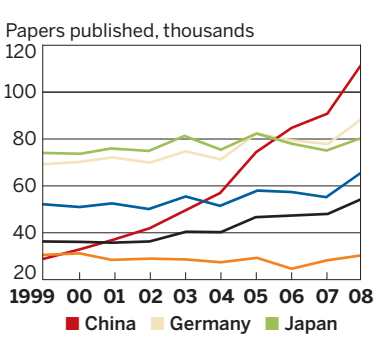
Disclosure of new compounds shows strong growth



SOURCE: Chemical Abstracts Service

INTERNATIONAL OUTPUT

Publishing by authors in China has zoomed up much faster than in other countries



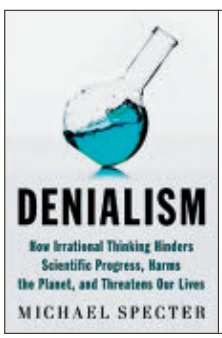
NOTE: Annual production of papers featuring at least one author in a given country.
SOURCE: Web of Science, Thomson Reuters

SAYING 'NO' TO SCIENCE

Book excoriates the antiscience crowd by examining RECENT CONTROVERSIES

REVIEWED BY SAM KEAN

SEVERAL WAYS exist to defend science against assaults on its integrity. There's the elegant-universe defense: that the laws of nature are inherently beautiful, and science alone can illuminate these deep truths. There's the luxury defense: that cars, computers, cheap food, the Internet all sprang from scientific advances, and we'd be immeasurably poorer without them.



DENIALISM: How Irrational Thinking Hinders Scientific Progress, Harms the Planet, and Threatens Our Lives, *by Michael Specter, Penguin Press, 2009, 304 pages, $27.95 hardcover (ISBN: 1594202303)*

Then there's the more ambiguous and pugilistic defense that Michael Specter employs in "Denialism: How Irrational Thinking Hinders Scientific Progress, Harms the Planet, and Threatens Our Lives." Specter is upfront, even harsh about some of the failures of science in the past few decades; among other cases, he cites the Vioxx debacle, shoddy tobacco science, and the Tuskegee syphilis experiments. And he acknowledges that breakthroughs like genetic engineering are often Janus-faced, with the potential for abuse fused into their very nature. Nevertheless, Specter argues that science propels humankind forward and that not doing risky science carries risks, too—an opportunity cost, even if we don't know what the opportunity will be. What's more, he's not about to let science get pummeled by people who almost willfully misunderstand it. Specter defends science by swinging back—at Oprah Winfrey, at British Lords, at African dictators, whomever.

A crucial question for Specter is why science has suffered assaults on so many fronts recently—think of vaccines accused of causing autism or genetically modified (GM) food supposedly poised to destroy civilization as we know it. He suggests that when scientific data conflict with what people want or want to believe, some strong emotion—pain, fear, suspicion, even a misguided desire to do good—overwhelms rational thought, and people deny scientific truth to assuage themselves. This need is all the more acute, he notes, because science has become omnipresent, a fingernail's scratch below every facet of modern life, and continues to expand its reach.

The spread of science wasn't always seen as a threat. A suspicious attitude has emerged only in the past few generations, Specter says, and to him, it's a revolutionary shift in the zeitgeist, perhaps as profound as the cultural shifts that led to science in the first place. But calling this switch abrupt plows over some historical exceptions: Mary (Frankenstein) Shelley, Ned (Luddite) Ludd, Jean-Jacques (Noble Savage) Rousseau, William (Dark Satanic Mills) Blake, and others, none of whom were wild about science and technology exactly. Even Robert Oppenheimer—"I am become Death, destroyer of worlds"—regretted what science had wrought.

But in its broad outlines, Specter's diagnosis rings true. Something has gone awry. Science is no longer just a grand intellectual adventure; people demand a return from the public investment in science, and their desires often don't match those of scientists. As evolutionary biologist Geoffrey Miller once rued, "Americans support science largely so they can, with impunity, exploit foreigners, eat cows, and avoid physical exertion." When the public also feels its value threatened by science, expect hostility.

Specter focuses on topics that whip so-called denialists into an especially rabid froth, either in protest or defense—genetic engineering, megadoses of vitamins, organic food, vaccines, geopolitical food distribution. And in some ways, his analyses of the different assaults mesh nicely: The perpetrators all deny scientifically established facts, after all, and treat science as a political faction. In other ways, though, these assaults are different phenomena, with different motivations. And it's not clear they can be yoked together so casually.

One thing Specter enjoys doing is defining denialism, by explaining its "hallmark" or "driving force" or sine qua non. But instead of his definition getting repetitious, it gets puzzling. At various times, he calls denialism a tendency to "shun nuance and fear complexity," or maintain a "willful ignorance," or "tell only one side of the story," or "run from the past and shun the future," or "confus[e] popularity with authority," or link "scientists ... often with the government, in an intricate web of lies." None of these traits are contradictory exactly, but they make denialism seem amorphous and protean.

AS A RESULT, the book comes out a little uneven, but not in the sense that some passages are poorly written or confusing. Specter writes for the *New Yorker* for a reason: Each chapter is clear, well paced, and thoughtful. But Specter treats the chapters differently. The only real narrative is the first, about the painkiller Vioxx. Here Specter pieces together, mostly through interviews, the story of the cardiologist who blew the whistle on Merck, the maker of Vioxx, for reportedly covering up the high incidence of heart attacks in people who took it. It's great detective work, but it doesn't illuminate denialism much. In fact, seemingly unconcerned about undermining his thesis, Specter writes that "a market disaster like Vioxx ... provided denialists with a rare opportunity: their claims of conspiracy actually came true."

NEWSCOM

The middle four chapters—on vaccine debates, the organic food "fetish," new age medicine and supplements, and race-based medicine—are more essayistic, and they admirably skewer and debunk denialists. But even here Specter swings widely. At different times he castigates Europeans, Americans, and Africans for opposing "progress," especially when the opposition hinges on fallacious notions of purity—for example, not getting vaccinated or not adopting GM crops. And while Specter is definitely political, he's not partisan: Both the

left and the right get black eyes. Interestingly, he skips over other ripe examples of denialism—religious fundamentalism, radical animal-rights protestors, and people who deny climate change. Whether he does so because they don't fit his thesis or because they're tired topics or because of another reason isn't clear.

In the book's final chapter, on the perils and promise of synthetic biology, Specter more or less abandons denialism and writes a long, straight news story instead. If genetic engineering means laboriously tweaking an organism's genome one or two genes at a time, synthetic biology means ripping the genomic engine out of the chassis and installing a custom genome, built from scratch. Specter's treatment of the peril and promise of synthetic biology is well done, but again, it doesn't help us understand denialism. The field is so new and speculative that, however spooky it might sound to them, denialists really haven't had a chance to work themselves into a lather on the subject.

Perhaps the book meanders because, unlike most polemics—for example, "The Republican War on Science" by Chris Mooney—Specter does not identify a coherent enemy. Sure, there are probably a few ignorant protestors out there who subscribe to every fallacy he points out—Unabomber survivalists or hippies with so many buttons pinned to their hemp jacket that you fear for the integrity of the fabric. Such people are no doubt happy, even ecstatic, to link Merck and Monsanto and the Food & Drug Administration and mercury-laced vaccines and GM tomatoes and the supposed suppression of the healing power of *Echinacea* into one "Protocols-of-the-Elders of Zion"-like conspiracy of greed and cover-ups, and they even have pamphlets to "prove" it all.

CONSPIRACY? One of the cases in the book discusses Vioxx.

BUT SPECTER isn't writing to convince those people, clearly. He's writing to convince thoughtful people interested in science and science policy, and such people might very well find themselves shaking their heads for different reasons—first a vigorous "yes," then an exasperated "no"—in consecutive chapters. I, for one, found Specter's chapter on the follies of pretending that doctors should never take race into account when diagnosing people with diseases both stimulating and, given what a touchy subject race is, brave. I found his damn-the-torpedoes attitude about inventing new technologies to push already taxed farmlands around the world even further a little reckless. Other readers may have the opposite reaction, or may single out other chapters.

Disagreement can be good for science, of course, but the reader may be frustrated that Specter has already seized the rhetorical high ground here, by painting any opposition to individual technologies as opposition to human progress generally. For example, he attacks Bill Joy, cofounder of Sun Microsystems, who penned an essay in 2000 for *Wired* magazine entitled "Why the Future Doesn't Need Us" on his qualms about genetic engineering, nanotechnology, and robotics. Joy ultimately floats the idea that humankind should consider not pursuing certain avenues of inquiry, lest they prove too dangerous for us to handle. Specter seems right, first, that a voluntary moratorium will never work and, second, that it's probably not a good idea—again, there are risks in avoiding risk. But Joy's essay is not the work of a hysterical Luddite who, Specter says, wants "to force a preventative lobotomy on the world." That's a false, all-or-nothing dichotomy.

"Denialism" is what the *New Yorker* would produce if, instead of an annual food or fashion issue, it produced a "mistrust of science" issue. Do read this book for a deeper understanding of contemporary science and public policy. At the same time, a themed issue doesn't strive for strict coherence, and Specter doesn't quite achieve it either. Tellingly, he spends virtually no time discussing remedies for denialism. That's probably because convincing the antivaccination crowd that MMR (measles, mumps, rubella) vaccines won't give their children autism would require different tactics than convincing an African strongman to accept GM seed corn from Western companies. Specter does a great service in breaking down such follies individually, but when he links them together one might be tempted to indict Specter himself for doing what he identifies as yet another cardinal sin of denialism: the tendency to "conflate similar but distinct issues and treat them as one."

SAM KEAN *is the author of "The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements" forthcoming from Little, Brown in July.*

NEW & NOTEWORTHY

HOW WE LIVE AND WHY WE DIE: The Secret Lives of Cells, ***by Lewis Wolpert, W. W. Norton & Co., 2009, 240 pages, $24.95 hardcover (ISBN 978-0-393-07221-1)***

Leads readers on a tour of the human cell and explores the crucial role cells play in every aspect of our lives, from birth to death. The book illuminates the scientific facts and ethical dilemmas behind such controversies as stem cell research, abortion, cloning, and the genetic basis for criminality and homosexuality. The author argues that a clear scientific understanding of cell theory is the only path to finding logical and morally defensible answers to each of these issues.

MORE THAN GENES: What Science Can Tell Us About Toxic Chemicals, Development, and the Risks to Our Children, ***by Dan Agin, Oxford University Press, 2009, 416 pages, $27.95 hardcover (ISBN 9780195381504)***

Makes the case that toxic chemicals in the environment are assaulting developing fetuses, as are substances (such as alcohol and nicotine) ingested by pregnant women. According to the author, this constitutes a silent pandemic that is causing untold damage to babies while they are in the womb.

Keeping Pace With Member Needs

DIANE GROB SCHMIDT, DISTRICT II DIRECTOR

THE WORST RECESSION in more than 50 years and the budget reductions it triggered did not prevent ACS from keeping pace with member needs in 2009. January is a fitting time to reflect on last year's innovations and accomplishments and to think about ways to improve ACS's offerings to better serve members in the future.

The society offers a wide range of products and services to meet the needs of a very diverse membership. From surveys, we know that the greatest needs are for scientific information, networking and collaboration, and professional advancement. ACS implemented several innovative services in these areas in 2009, and feedback from members is positive. Following are some highlights:

PROFESSIONAL ADVANCEMENT. ACS initiated a special effort in 2009 to make members aware of the benefits it offers unemployed members, including the dues waiver, free meeting registration, discounts on short courses, and free access to career consultants. Outreach activities included visits with companies going through major layoffs, telemarketing, and information in C&EN.

In addition to its jobs database, career fairs, and résumé and interviewing workshops, ACS continues to develop services to assist members looking for jobs. In 2009, the "Career Caffeine" video series was launched to help members plan job searches, develop résumés, and interview successfully.

And ACS didn't forget its members who are employed. The society helped these members advance in their positions and tool up for future ones by launching a suite of online business courses. These courses were developed with Harvard University and are designed for scientists. In addition, the ACS Leadership Development System debuted last year.

NETWORKING & COLLABORATION. ACS's online professional network grew last year and now has more than 20,000 members. The network enables members to find each other and ask questions, share information, and collaborate anytime and anywhere there is an Internet connection. Visit www.acs.org/acsnetwork for more information.

Despite budget woes, travel constraints, and movement toward virtual meetings, the fall ACS meeting was the largest society meeting ever in Washington, D.C. Regional meetings held their own in a bad economy and achieved an average attendance of 730 in 2009, down only slightly from 745 in 2008. Go to www.acs.org/meetings to read more.

Collaboration doesn't stop at national borders, so ACS increased international research cooperation in 2009 by organizing forums addressing global scientific challenges in the U.S., China, and Germany. The forums attracted leading scientists and drew support from national funding agencies. ACS also worked with collaborators in France, Germany, Italy, and the U.K. to provide international research experiences for chemistry students.

Two undergraduates were among those who wrote positive reviews. One enthusiastic student who participated in an exchange last year said the experience was the best she has had. "I gained a wide range of research experiences and a better understanding of how international labs function," she said. Of his time in Germany, another said, "The research was fascinating, and the support was outstanding. Studying abroad was an eye-opening experience that I think everyone should experience at least once. Through ACS, the transition to 'German life' was practically seamless." Visit www.acs.org/international to learn more.

SCIENTIFIC INFORMATION. Last year, ACS broadened access to national meeting content by recording and posting 200 national meeting presentations on the Web. These drew some 7,000 users after the spring national meeting and more than 7,000 after the fall meeting. More than half of the users surveyed stated that this is among the ACS services they value most and that it will make them more likely to renew their memberships.

An ACS member who calls himself a "generalist" says this service ranks "up there with C&EN as a reason to be a loyal ACS member." Another member goes further. "This will make me an eternal ACS member," he says. To access the presentations, go to www.acs.org/meetings.

Also in 2009, ACS developed bimonthly teleconferences and webinars on career and professional issues. The forums are aimed at industrial chemical scientists, including those at small businesses. Registration exceeded expectations, with 400 to 800 registrants per event.

Although we can't fix the economy, we can work to deliver products and services that current and future members value.

These events boast more than 90% attendee satisfaction. "Webinars like this are especially valuable to small businesses," says a member who participated in several of them. "I am very appreciative of the efforts ACS is making to increase the benefit to small-business owners and entrepreneurs and am happy to endorse the work." See www.acs.org/industry for information.

Finally, last year, ACS launched "Boil This Down" (www.boilthisdown.org), a new website for industry members. The site aggregates information from select scientific and business publications each day and spotlights ACS services most relevant to industry members. It also includes a popular section for members employed by small businesses.

Although we can't fix the economy, we can work to deliver products and services that current and future members value. We can help equip members with tools to enhance their knowledge and further their careers. That's where our focus will be now and in the years ahead.

If you have any comments or suggestions, please send them to pmr@acs.org. ■

2010 ACS NATIONAL AWARD WINNERS

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

FOLLOWING IS the second 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 on Aug. 22–26.

ACS AWARD IN PURE CHEMISTRY

Sponsored by Alpha Chi Sigma Fraternity and Alpha Chi Sigma Educational Foundation

"I'm just a simple boy from New Jersey who likes chemistry," says **Phil S. Baran.**

Baran, 32, a chemistry professor at Scripps Research Institute, is being honored for his approach to synthesizing natural products that are anything but simple (for example, see page 5). Baran's humility notwithstanding, colleagues describe his work as "bold," "inventive," and "stunningly beautiful."

"The target molecules Baran has synthesized are highly complex—often molecules that top synthetic organic groups around the world have been struggling with," says Larry E. Overman, a chemistry professor at the University of California, Irvine. And "in almost all of his total syntheses, there is at least one step that few competitors would even consider attempting."

COURTESY OF PHIL BARAN

Baran

Baran did undergraduate research with chemistry professor David I. Schuster at New York University, graduate work with K. C. Nicolaou at Scripps, and a postdoctoral fellowship with Nobel Laureate E. J. Corey at Harvard University. He credits all three for grounding him in the mechanistic logic that now underpins his approach to synthesis.

"We'll come up with an idea based a lot on instinct from what we know about physical organic chemistry and reactivity," Baran says. "If it does turn out to work, then we go back and do the due diligence" to figure out the exact mechanism, he adds.

As part of his approach, Baran also eschews the use of protecting groups, preferring instead to exploit a molecule's innate chemical reactivity. His vision is to make "complex natural products in a scalable fashion and in such a way that we avoid a lot of superfluous operations that normally confound organic chemistry, such as redox manipulations and protecting-group exchanges," he says.

The influence of Baran's work goes beyond individual syntheses. He's developed general reactions that can be applied to a variety of molecules, Nicolaou says. "Phil developed an elegant method for coupling heterocycles such as indoles and pyrroles with carbonyl compounds through oxidative carbon-carbon bond formation, a process that proved both practical and of wide scope and generality," he adds.

Baran says that in college he abhorred classes that required rote memorization and didn't do well in subjects like cultural anthropology and sociology. "I tried to exit college as fast as possible, paying attention only to chemistry because it was the only subject that I was passionate about. The excitement of exploration and the thrill of invention drew me in," he says. He did have to memorize the periodic table, he notes, "but for me it didn't seem like memorization."

Baran received a B.S. from NYU in 1997 and completed a Ph.D. at Scripps in 2001. He joined the chemistry faculty at Scripps in 2003. He has received a host of awards, including the ACS Nobel Laureate Signature Award for Graduate Education in Chemistry in 2003 and the National Fresenius Award in 2007.

Baran will present the award address before the Division of Organic Chemistry.—JYLLIAN KEMSLEY

EARLE B. BARNES AWARD FOR LEADERSHIP IN CHEMICAL RESEARCH MANAGEMENT

Sponsored by Dow Chemical

When **John L. LaMattina** was 10 years old, his aunt and grandfather gave him a homemade chemistry set. His aunt, who had earned a master's degree from the City University of New York, Hunter College, supplied the chemicals, reactants, and a list of experiments. His grandfather built a case so LaMattina could take the set to his friends' houses.

The gift inspired a curiosity about chemistry that has driven LaMattina for his entire career. As an undergrad at Boston College, he "really loved organic chemistry," LaMattina says. "I loved the idea of making molecules. I came from a lower middle-class family in Brooklyn in the '60s. I wanted to make useful molecules for medicine," he adds.

After graduating with a B.S. degree in chemistry in 1971, LaMattina went on to study organic chemistry at the University of New Hampshire. He worked with Robert Lyle, a chemist who specialized in heterocyclics, to get a Ph.D. Lyle gave LaMattina freedom to follow an unusual chemical reaction and then let him build his thesis on his findings. In 1975, LaMattina went on to do postdoctoral research with Edward C. Taylor at Princeton University, one of the world's premier chemists working with heterocyclics (see page 44).

In 1977, when LaMattina finished his postdoctoral research, he was happy to get a job with Pfizer in the coastal town of Groton, Conn. As a medicinal chemist in the gastrointestinal group there, he contributed to discoveries leading to ulcer treatments, such as the discovery of proton-pump inhibitors and H2 antagonists.

Pfizer's upper management quickly realized that LaMattina had a knack for leading scientists. In 1987, he was named director of medicinal chemistry at the Groton site. From 1993 to 1999, he assumed leadership, first of U.S., and then of worldwide discovery operations at Pfizer. Under LaMattina's leadership, the company grew into a number of new therapeutic areas. He is most pleased with the expansion of Pfizer's oncology research, which resulted in a robust cancer drug pipeline.

LaMattina says he sees the role of research leader "as coaching, not hovering. You hire good people, give them some initial direction, and then let them go."

COURTESY OF JOHN LAMATTINA

LaMattina

In 2003, he was named president of Pfizer Global Research & Development. The organization grew to the largest R&D enterprise in the industry. New molecular entities in Pfizer's portfolio grew from 145 in 2005 to 177 in 2007.

LaMattina, 59, recently retired from Pfizer. Rod MacKenzie, a Pfizer colleague and the current head of worldwide research in the pharmatherapeutics division, says LaMattina's legacy of growth includes new and expanded R&D in oncology, large molecules, and vaccines, as well as partnerships with organizations such as Scripps Research Institute.

Another growth area for Pfizer has been in its workforce diversity. LaMattina remembers that in the 1980s, the firm had no female Ph.D. organic chemists. He championed a new approach to hiring, and by the end of his tenure, 30–40% of new scientists were female. "Having a diverse environment makes everyone feel welcome, contribute, and give everything they have to offer," he says.

LaMattina will present the award address before the Division of Medicinal Chemistry.—MELODY VOITH

ACS AWARD IN ORGANOMETALLIC CHEMISTRY

Sponsored by Dow Chemical Co. Foundation

When it comes to approaching chemistry, **Clark R. Landis** is considered versatile. His influential contributions to the field of organometallic chemistry arise from a striking combination of theory, synthesis, and scientific methodology.

"Clark has demonstrated exceptional creativity, breadth, and insight and a commitment to bringing all tools to bear on the problems of understanding and developing asymmetric and polymerization catalysts," says Tobin J. Marks, a professor of chemistry at Northwestern University.

Landis' impact began with his graduate work under the direction of Jack Halpern at the University of Chicago. According to colleagues, his Ph.D. research transformed the field of asymmetric catalysis by elucidating, in unprecedented detail, the mechanism of rhodium phosphine-catalyzed hydrogenation of enamides and identifying the unexpected origin of the enantioselection. This classic work, colleagues say, is cited as a landmark contribution to the field of asymmetric catalysis.

COURTESY OF CLARK LANDIS

Landis

Moving on to other catalyst families, Landis used spectral and kinetic techniques to help delineate the mechanism of metallocene-catalyzed alkene polymerization. Although plastics manufacturers use such catalysts to make billions of pounds of polyethylene, polypropylene, and other polymers per year, good kinetic characterization of these catalysts was nonexistent at the outset of his research.

The long-standing challenges that Landis addressed in catalytic alkene polymerization include many firsts: the first determination of the number of active sites; the first elucidation of the kinetics of the initiation, propagation, and termination steps; and the first interception and characterization of the propagating species.

More recently, Landis has again influenced the field of asymmetric catalysis. His group has developed a modular, combinatorial synthesis of chiral 3,4-diazaphospholane ligands. These ligands are the most active, regioselective, and enantioselective hydroformylation catalysts available and can create carbon-carbon bonds from inexpensive reagents in a 100% atom-efficient process.

In addition to mechanistic and synthetic work on catalysts, Landis has developed calculation methods for studying and modeling organotransition metal complexes and new theories of transition-metal bonding. His group was the first to examine the structures and energetics of reaction pathways of enantioselective catalysts by full simulation methods. Experimentally, he employs sophisticated kinetic and spectroscopic techniques and has created new methods incorporating stopped-flow nuclear magnetic resonance and mass spectrometry.

Landis, 53, received a B.S. in chemistry in 1978 from the University of Illinois, Urbana-Champaign. After completing a Ph.D. degree at Chicago, he worked for three years as a senior research chemist in Monsanto's corporate research laboratory.

In 1986, Landis transitioned into academia at the University of Colorado, Boulder. He then moved to the University of Wisconsin, Madison, in 1990 and has been a full professor there since 1997. Keeping ties to industry, he has served as a consultant to Dow Chemical for the past 15 years.

Landis has been an honorary lecturer at the University of California, Berkeley, and at the University of Rochester, as well as a visiting lecturer at the University of Heidelberg, in Germany. He is a fellow of the American Academy for the Advancement of Science. In 2005, the University of Wisconsin recognized his educational contributions with the Chancellor's Distinguished Teaching Award.

Landis will present the award address before the Division of Inorganic Chemistry.—ANN THAYER

ACS AWARD FOR CREATIVE ADVANCES IN ENVIRONMENTAL SCIENCE & TECHNOLOGY

Sponsored by the ACS Division of Environmental Chemistry

Nearly two decades ago, when **Kimberly A. Prather** became interested in studying atmospheric aerosol particles, she

planned to purchase an instrument for her new laboratory. She wanted a device to directly measure the size and chemistry of individual particles in the atmosphere.

When Prather conducted her initial search in 1991, she discovered there was no such instrument on the market.

As a newly appointed faculty member at the University of California, Riverside, she didn't let that get in her way. She developed the aerosol time-of-flight mass spectrometer (ATOFMS) in-house. "There was clearly a major need for such an instrument," says Prather, now a professor with a joint appointment in the department of chemistry and biochemistry and Scripps Institution of Oceanography at UC San Diego. Nonetheless, she tells C&EN, "it was tough getting the initial stages of funding" to develop the device.

COURTESY OF KIMBERLY PRATHER

Prather

Early reviewers of her federal grant proposals commented that Prather had made such an outstanding case for the need for such an instrument that they wondered why it hadn't been invented yet. This, they concluded, might mean creation of the device was impossible, Prather says.

Eventually, however, she did receive federal support, and the ATOFMS was born. "Kim has developed an instrument that has pushed the boundaries of our understanding of atmospheric aerosols ahead by many orders of magnitude," says aerosol scientist Mark H. Thiemens, dean of the division of physical sciences at UC San Diego.

ATOFMS provides information that can help investigators answer a host of questions about the atmosphere. These queries include what is the origin and chemistry of particles and how quickly do they change, which particles make up the majority of air pollution and affect human health, and which ones nucleate water drops or ice crystals and form clouds. Such investigations will help improve computer modeling of climate change and make predictions of future scenarios more certain.

But the applications of ATOFMS don't stop with the atmosphere. The high-throughput mass spectrometry technique also finds applications in the chemical synthesis laboratory, scanning for reactants and products in real time, Prather says. It can also be used in the field to analyze water samples or soil extracts. And it holds potential for industrial applications such as checking the chemical purity of individual nanomaterials or powdered pharmaceuticals delivered via inhalers as aerosols.

Prather's laboratory is currently exploring whether early cancer screening is possible with ATOFMS. Her team is calibrating the device to determine whether it can rapidly detect the few cancer cells in body fluids that are generally present years before tumors can be detected.

Prather, 47, received an undergraduate degree in chemistry at UC Davis and continued there to earn her Ph.D. in physical chemistry for studying photodissociation dynamics of organic molecules with lasers. She continued this research as a postdoc at UC Berkeley with Yuan T. Lee, a Nobel Laureate in Chemistry.

Prather will present the award address before the Division of Physical Chemistry.—CHERYL HOGUE

JAMES T. GRADY-JAMES H. STACK AWARD FOR INTERPRETING CHEMISTRY FOR THE PUBLIC

Sponsored by ACS

This year's award winner began his career covering "kids and cops"—the traditional beat for a rookie reporter at a daily newspaper—at the *Champaign-Urbana Courier,* in Urbana, Ill. But **Ron Seely's** penchant for investigative journalism would eventually take him to the science desk at the *Wisconsin State Journal,* where for more than 25 years he has honed the craft of communicating the complexities of science to the readers of a daily newspaper.

Seely, who has a degree in journalism from Northern Illinois University, writes for a well-educated readership: The paper serves several university communities, including that of the University of Wisconsin. The paper also serves farm communities, and Seely's science reporting can be traced back to his early coverage of agriculture. The inherent link between science and the community's business and environmental concerns broadened Seely's coverage of science as a topic of general community interest.

"There is science behind every headline in the paper," Seely says. Getting the science into the headline, however, is not always easy. Over the course of his career, Seely has seen editorial emphases change and has at times had to fight to keep science as a distinct beat at the *Journal.*

He has also had to manage tensions between the science community and the press, dealing with long-standing reticence on the part of scientists to discuss their work with the public. But this tension has dissipated considerably in recent years, according to Seely.

"The pressure on scientists today to talk about what they do and to communicate to a general audience is greater than ever," he says, noting that issues ranging from environmental management to health care hinge on breakthrough science.

Seely attributes headway in researcher-reporter relations to the persistence of journalists who, like himself, come at science with degrees in subjects such as journalism, history, or English literature. "Because I don't come from a science background, I have to work very hard to make sure I understand what I'm covering," he says. "Still, I never have trouble finding scientists who want to talk about what they do."

This access accrues partly from the trust and respect Seely has established with scientists over the years. "He has a real talent for going into someone's laboratory and listening," says Phillip R. Certain, dean emeritus of the College of Letters & Science and professor of chemistry emeritus at the University of Wisconsin, Madison, where for the past 15 years Seely has lectured on science writing. Seely has a gift for taking information that would be accessible only to scientists and "making the final leap from there to something that anyone would understand," Certain says.

WISCONSIN STATE JOURNAL

Seely

James F. Crow, professor emeritus of genetics at Wis-

consin agrees. "I believe he has an unusual gift for taking a complicated subject and simplifying it without distortion," Crow says. "This is a rare trait."

Seely will present the award address at an invitation-only event being planned by the ACS Office of Communications.—RICK MULLIN

ALFRED BURGER AWARD IN MEDICINAL CHEMISTRY

Sponsored by GlaxoSmithKline

Edward C. Taylor, the A. Barton Hepburn Professor of Organic Chemistry Emeritus at Princeton University, is "one of the foremost heterocyclic chemists in the world," says department chair Robert J. Cava. "There is hardly a synthetic or medicinal chemist practicing today who has not benefited from Taylor's contributions to the concepts and methods of heterocycle synthesis."

Taylor's expertise "has been greatly valued by the pharmaceutical industry," adds former postdoc Huw M. L. Davies, now an Emory University chemistry professor. Taylor's "career-long fascination with the pteridine heterocyclic system resulted in a spectacular breakthrough with the discovery of a significant anticancer agent," Davies says.

For more than 60 years, Taylor, 86, "has explored the chemistry and synthesis of heterocyclic systems," Cava says. "He has repeatedly demonstrated that rational syntheses of complex heterocyclic systems can be devised by sequential condensations, ring cleavages, and rearrangement reactions."

PRINCETON UNIVERSITY

Taylor

Taylor's synthesis of 9-substituted adenines from furazanopyrimidines has "become the method of choice for the preparation of these important nucleoside bases," Cava says.

Taylor also helped create novel thallium reagents and more than 130 new chemical transformations that utilize them.

In addition, he studied heterocyclic folates and related compounds, including pteridines from butterfly wings. The work led to his discovery of an antitumor agent that interferes with cells' use of folates, which are needed for cell division and growth. During a subsequent collaboration with Eli Lilly & Co., Taylor designed and synthesized another antifolate that, when administered with folic acid and vitamin B-12, still kills cancer cells but is much less toxic to normal cells than other compounds.

This powerful cancer drug, which Lilly markets as Alimta, is "accessible through an effective synthesis from simple raw materials," Cava says. "This is a crowning achievement of an organic chemist who has shaped the field of heterocyclic chemistry."

Taylor recently heard from a mesothelioma patient who had been given two months to live. After being prescribed Alimta, the man "now has no visible evidence of residual disease," Taylor says. "I'm just tickled to pieces that Alimta works so well—and quite astonished."

That patient's fate could have been entirely different if a coin toss had gone another way. Taylor planned to major in English when he enrolled at Hamilton College, in Clinton, N.Y. He'd hated his sole high school science class, but Hamilton required him to take another, so he flipped a coin and ended up in chemistry. "I was fascinated from the very first lecture," Taylor recalls.

He transferred to Cornell University, where he earned a B.A. in chemistry in 1946 and a Ph.D. in organic chemistry in 1949. After postdoctoral fellowships at the Swiss Federal Institute of Technology (ETH), Zurich, and the University of Illinois, he joined the Illinois faculty. Taylor moved to Princeton in 1954 as an assistant professor and was promoted to full professor in 1964.

Taylor's honors include the ACS Award for Creative Work in Synthetic Organic Chemistry (1974), the International Society of Heterocyclic Chemistry's Senior Award in Heterocyclic Chemistry (1989), and ACS's Arthur C. Cope Scholar Award (1994).

Taylor will present the award address before the Division of Medicinal Chemistry.—SOPHIE ROVNER

ACS AWARD FOR CREATIVE INVENTION

Sponsored by ACS Corporation Associates

David R. Walt's career "exemplifies the very best in academia," says Joseph M. DeSimone, a chemistry professor at the University of North Carolina, Chapel Hill. "He has pursued fundamental scientific inquiries that have resulted in the discovery of new phenomena. He has made careful measurements that have quantitatively grounded his discoveries. He has had the vision to see where these discoveries could address important unmet technological needs. And he has had the talents of execution and tenacity to drive the impacts of his discoveries into the marketplace."

ALONSO NICHOLS

Walt

Walt, who is Robinson Professor of Chemistry and Howard Hughes Medical Institute Professor at Tufts University, has done these things while focusing on research in optical sensing arrays. He became interested in sensors through "serendipity," he says. His work in immobilized enzymes, which he began as a postdoc with George M. Whitesides at Massachusetts Institute of Technology, netted Walt a consulting job with a company interested in medical sensors. "After I stopped consulting, I thought that using surface immobilization to develop sensors was a good area for exploration," he says. "Almost no one knew what sensors were in those days, so it was a relatively open area with little competition."

Walt, 56, "became interested in chemical sensors before this area was fashionable," says Timothy M. Swager, professor of chemistry at MIT. "The era of chemical sensors, which now focuses as much on the materials as on the instrumentation, was ushered in partly by advances from Walt's group."

Walt pioneered using optical fibers for chemical sensing. One important advance involves selectively etching thousands of microwells at the ends of optical fibers used for imaging. Mixtures of microspheres labeled with different indicator chemistries can be assembled in random sensor arrays, with one microsphere in each well.

That technology became the foundation for the San Diego-based company Illumina, which is now a powerhouse in microarray and next-generation DNA sequencing technologies. "Founding a successful company has been a tremendous thrill and a source of great satisfaction," Walt says. He continues to serve on Illumina's board of directors and as the head of its scientific advisory board.

Walt is also the founder of the Cambridge, Mass.-based company Quanterix, which focuses on protein diagnostics that employ etched microwell arrays. The technology can detect binding of many single protein molecules simultaneously.

Walt received a B.S. in chemistry from the University of Michigan in 1974. In 1979, he received a Ph.D. in chemical biology—a joint degree in chemistry and pharmacology—from the State University of New York, Stony Brook, where he worked with Francis Johnson. From 1979 to 1981, he was a postdoctoral research associate with Whitesides at MIT.

Since 1981, Walt has been a member of the chemistry faculty at Tufts. He was promoted to associate professor in 1986 and to full professor in 1992.

He was elected to the National Academy of Engineering in 2008 and is a fellow of the American Institute for Medical & Biological Engineering and the American Association for the Advancement of Science.

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

ACS AWARD FOR RESEARCH AT AN UNDERGRADUATE INSTITUTION

Sponsored by Research Corporation for Science Advancement

Thomas J. Wenzel, 56, has led an internationally recognized research program for more than 25 years at Bates College, in Lewiston, Maine. That program has led to more than 70 peer-reviewed publications and two books, almost all of which involved undergraduate student coauthors.

As an expert on nuclear magnetic resonance shift reagents, lanthanide luminescence detection, and selective sorbents, Wenzel has developed new reagents and expanded applications for commercially available reagents. He has worked with 100 undergraduate research students whose efforts have been underwritten in part over 20 years through a Research at Undergraduate Institutions grant from the National Science Foundation.

PHYLLIS GRABER JENSEN

Wenzel

More than 50 of Wenzel's students have gone on to pursue graduate degrees in chemistry and to subsequent careers in chemistry or related fields. Several of his students are now faculty members at undergraduate schools, and more than a dozen of his students have gone on to careers in medicine. He has also encouraged diversity in the sciences by consistently recruiting students from minority groups to work in his lab.

"The true measure of his worth is the large number of undergraduate students that he has not just taught, but inspired," notes one colleague. "If we had 50 Thomas J. Wenzels distributed at colleges throughout the U.S., we would never have to worry about a lack of good young scientists."

A strong proponent of the value of research at an undergraduate institution, Wenzel was cochair of two Council on Undergraduate Research (CUR) national conferences, served as CUR president from 1996 to 1997, and edited the *CUR Quarterly* from 2001 to 2005. He has published more than 30 articles promoting the value of undergraduate research.

As a chemical educator, Wenzel emphasizes the use of ambitious, project-based, collaborative learning activities in both his introductory and advanced courses. These activities, which he has described in the articles he has written, are a deliberate attempt to incorporate researchlike experiences into required courses.

In 2003, at the invitation of NSF's Chemistry Division, Wenzel chaired the Undergraduate Research Summit. The report from the meeting provided recommendations for enhancing the quality and quantity of research at undergraduate institutions. More than 6,000 copies of the report were distributed to the academic community.

Wenzel received a B.S. in chemistry from Northeastern University in 1976 and, five years later, earned a Ph.D. in analytical chemistry from the University of Colorado, Boulder. He started as an assistant professor at Bates in 1981 and has spent his career there. Since 1997, he has been the Charles A. Dana Professor of Chemistry, and since 2006, Wenzel has also chaired the school's environmental studies program. From 1992 to 1996 and again in 2003, he chaired the school's chemistry department.

Awards Wenzel has received include the 1999 J. Calvin Giddings Award for Excellence in Education from the ACS Division of Analytical Chemistry. In 2002, he received the CUR Research Fellows Award, and in 2003–04, he was named a Camille & Henry Dreyfus Scholar.

Wenzel will present the award address before the Division of Analytical Chemistry.—MARC REISCH

JIM HARPER

WAIKIKI Oahu's famous beach as seen from the volcanic Diamond Head.

PACIFICHEM 2010

CHEMICAL SCIENTISTS and engineers in countries bordering the Pacific Ocean and elsewhere are invited to submit abstracts for the 2010 International Chemical Congress of Pacific Basin Societies (Pacifichem). The congress, which will take place on Dec. 15–20 in Honolulu, is sponsored jointly by the American Chemical Society, the Canadian Society for Chemistry (CSC), the Chemical Society of Japan (CSJ), the New Zealand Institute of Chemistry, the Royal Australian Chemical Institute, the Korean Chemical Society, and the Chinese Chemical Society.

Official and up-to-date information regarding Pacifichem 2010, including the technical program information, important deadlines, and exhibit availability, along with registration, hotel, travel, and visa information, is online at pacifichem.org.

The preliminary program for Pacifichem 2010 is scheduled to be published in the July 12 issue of C&EN. The final program will be published in the Oct. 4 issue.

CSC is the host society for Pacifichem 2010, and Howard Alper, a chemistry professor at the University of Ottawa, is chairing the congress. The vice chairs are ACS's Peter J. Stang, a professor of organic chemistry at the University of Utah, and CSJ's Kazuyuki Tatsumi, a chemistry professor at Nagoya University.

Pacifichem 2010 is the sixth in the series of meetings that are held in Honolulu approximately every five years with the goal of fostering collaborations among Pacific Basin chemical scientists. The program highlights recent research contributions aimed at improving the quality of life throughout the world. The most recent congress, Pacifichem 2005, attracted 11,484 professionals in academia, industry, and government from 67 countries representing all degree levels within the fields of chemistry and the chemical sciences.

The technical program of Pacifichem 2010 is being developed and will consist of 236 symposia spread over 13 areas of contemporary chemical science. All papers require an abstract submission via the Pacifichem website—pacifichem.org. The site began accepting abstracts on Jan. 1 and will continue to do so until April 5.

Unlike other conferences, Pacifichem 2010 is not accepting general papers. Abstracts must be submitted to a symposium to be considered for presentation. Abstracts not accepted into an oral session may be scheduled as posters at the discretion of the organizers.

The abstract system will limit the number of abstracts that one person may submit. An individual may submit up to two abstracts in which they are the invited presenting author and up to three abstracts in which they are the presenting author (total contributed and invited). There is no limit on the number of abstracts in which an individual is the corresponding author or a coauthor.

AREA 1—ANALYTICAL CHEMISTRY

036. On-Site & In Vivo Instrumentation & Applications
039. Innovation in Chemical Sensing & Separation Systems toward Advanced Chemical Analysis
056. Recent Advances in Bioanalysis: Ultra-Small Volumes, Global Metabolite Profiling & Single Cells
074. Optical Waveguide Techniques for the Analyses of Materials & Interfaces
084. New Frontiers of Plasma Spectrochemistry
113. New Frontiers in Separation Science
145. Analytical Applications & New Technical Developments of Soft X-Ray Spectroscopy
166. Ionic Liquids for Analytical Chemistry & Analytical Chemistry for Ionic Liquids
181. Fluorescent Sensors by Design
191. Comprehensive Multidimensional Separations
193. Electroanalytical Sciences
198. Microfluidic & Nanofluidic Devices for Chemical & Biochemical Experimentation
206. Analytical & Environmental Chemistry in Human Health
207. Advances in Flow-Based Analytical Techniques
253. Rapid, Multicomponent Environmental Analysis
255. Biochemical/Electrochemical Sensors & Sensing Materials
260. Novel Applications of Magnetic Fields in Analytical Chemistry
276. Non- & Minimally Invasive Diagnostics of Biological Systems Using Vibrational Spectroscopy
277. Enabling Mass Spectrometric Techniques for Proteomics

AREA 2—INORGANIC CHEMISTRY

009. Molecular Photonics
020. Controlling the Structure & Properties of Solids
022. Olefin Oligomerization & Polymerization Catalyzed by Early Transition Metals
025. Functional Molecule-Based Magnets
030. Metal Ion Complex Interactions with Nucleic Acids
035. Organoboron, Organosilicon & Organophosphorus as Optoelectronic & Energy-Related Materials
038. Actinides & the Environment: A Multidisciplinary Look at What We Know & What We Need To Know
046. Organo-f-Element Compounds: From Novel Chemical Transformations to Applications in Catalysis & Materials Science
060. Schiff Base Macrocycles & Materials

068. Frontiers in Organometallic Chemistry
094. Construction of Photofunctional Supramolecular Metal Complexes
096. Chemistry of Sulfur-Bridged Multimetallic Complexes
097. Syntheses & Applications of Metal-Organic Frameworks
100. Early Main-Group Chemistry
108. Dioxygen Activation Chemistry & Catalytic Oxidation Reactions
133. Structural & Functional Aspects of Coordination Polymers
143. Discrete Coordination Systems with Switchable Structures & Properties
146. Advances in Metal-Mediated Bond Activation: From Unusual Bonding Motifs to Applications in Catalysis
150. Preparation & Reactions of Early Transition-Metal & Lathanide Compounds
156. Functional Molecules of the Heavier Main-Group & Transition-Metal Elements
164. Self-Assembly & Coordination Chemistry
173. Molecular Design in Bioinorganic Chemistry
187. Electron Transfer & Electrochemistry of Transition-Metal-Containing Inorganic & Organometallic Materials
194. Coordination Chemistry toward Artificial Photosynthesis & Energy Conversion Processes
217. Redox Redux: The Renaissance of Non-Innocent Ligand Complexes
218. Advances in Nuclear Chemistry of Transactinide Elements
239. Chemistry & Materials Science at High Pressures
248. Carbon-Fluorine Bond Activation: A Crossroads for Inorganic, Organic & Environmental Chemistry
249. Fundamental & Applied Inorganic Fluorine Chemistry & Their Impacts on Energy Conservation & the Environment
251. New Frontiers in Polyoxometalate Chemistry
275. Nanoscale Characterization of Functional Materials by Nuclear Probes

AREA 3—MACROMOLECULAR CHEMISTRY

006. Polymeric Materials from Renewable Resources
007. Starch as a Polymer
012. NMR Spectroscopy of Polymers: Innovative NMR Strategies for Complex Macromolecular Systems
042. Chemistry & Functional Properties of Soft Interfaces
051. Advanced Polymeric Membranes for Environmental, Biomedical & Bioengineering Applications
057. Functional Block Copolymer Assemblies
064. Polymeric Materials: Performance, Degradation & Optimization
082. Hybrid Conjugated Polymer Materials
095. Biodegradable & Biomass Plastics
098. The New Age of Advanced Materials: Supramolecular Architectures & Smart Materials
102. Molecular-Based Ordered Materials Formed through Self-Organization
126. Biomimetic Engineering of Hierarchically Structured Polymer Materials
127. Polymer Nano-Hybrids at Bio-Interfaces
136. Synthesis, Structure & Physical Properties of Advanced Polymer Gels
144. Azobenzene Polymers for Photoreversible Structures & Surfaces
152. Nanostructure & Function of Organic-Inorganic Hybrid Polymers
160. Controlled/Living Radical Polymerization in Dispersed Systems
179. Separation & Characterization of Synthetic and/or Biological Macromolecules: Principles, Practices & Applications
211. Polyolefins Chemistry & Beyond: From Bench to Commercial Scale
219. Radical Polymerization Kinetics & Mechanisms
231. Amphiphilic Polymers: Fundamentals & Applications
236. Controlled/Living Radical Polymerization: Mechanisms, Catalysts, Reaction Engineering, Materials & Applications
257. Frontiers of Precisely Controlled Polymer Synthesis: Fine Control of Polymerization Reaction & Impact on Advanced Material Designs

AREA 4—ORGANIC CHEMISTRY

001. Reactive Intermediates & Unusual Molecules: Celebrating Bob Moss's 70 Years
004. Cooperative Catalysis
015. Anion Coordination Chemistry
018. C–H Functionalization: Memorial Symposium for Professor Keith Fagnou
019. Interface between Organic Synthesis & Chromatography
029. Designed Pi-Electronic Systems: Synthesis, Properties, Theory & Function
032. Diversity-Oriented Synthesis
045. Chemistry of Novel Nanocarbons: Fullerenes, Carbon Nanotubes & Related Materials
047. New Directions of Supramolecular Chemistry toward Nanomaterials Science, Biomedical Science & Supramolecular Catalysts
062. Asymmetric Organocatalysis
063. Novel Synthetic Methodology & Its Application to Natural Product Synthesis
080. Marine Natural Products: Isolation, Biology, Ecology & Synthesis
085. Science & Strategy of Process Chemistry: From Molecules to Pharmaceuticals
089. Mechanistic Organic Photochemistry
115. New Advances in Metal-Catalyzed Alkylation & Fluoroalkylation
124. Frontiers in Biocatalysis Applications to Organic Synthesis
125. Supramolecular Photochemistry
132. New Dimensions of Green Sustainable Chemistry: Novel Reactions & Catalysts

PACIFICHEM HOUSING OPENS IN FEBRUARY

Pacifichem 2010 will open for housing reservations in early February, well before conference registration opens in June or the preliminary program is printed in C&EN's July 12 issue.

All attendees who book their room through the Housing Connection, the official housing bureau, will receive complimentary Internet access in their sleeping rooms. The congress does not endorse booking hotel reservations through any other source. See pacifichem.org for information. Early reservations are encouraged.

Technical sessions will be held at the Hawaii Convention Center, the Hilton Hawaiian Village, the Sheraton Waikiki, the Royal Hawaiian Hotel, and the Westin Moana Surfrider. Sleeping rooms for Pacifichem 2010 have been blocked at the Hilton Hawaiian Village, the Ala Moana Hotel, the Sheraton Waikiki, the Royal Hawaiian Hotel, the Westin Moana Surfrider, the Sheraton Princess Kaiulani, the Hyatt Regency Waikiki, the Waikiki Marriott, the Holiday Inn Waikiki, and the Aqua Palms. Rates range from $99 to $259 per night plus taxes.

Residents of Japan may book their hotel reservations (as well as register for the meeting and book airline reservations) by contacting Nippon Travel Agency directly by calling 03-5369-4540 or by fax at 03-3225-1009.

134. Total Synthesis of Natural Products & Related Compounds
139. Achieving Efficiency in Organic Reactions via Greener Processes & Practices
148. Design & Synthesis of Biologically Active Compounds for Elucidating Mode-of-Action
155. Organic Solid-State Chemistry: Structure, Synthesis & Reactivity
157. Molecular Probes & Fluorophores for Cellular Imaging
199. Boronic Acids: Synthetic & Biological Applications
216. Molecular Complex Systems: Reversible Aggregation/Disaggregation of Organic Molecules
222. Practical Applications of Basic Research on Molecular Recognition
229. Carbanions: Modern Perspectives in Structure, Reactivity & Synthesis
279. Recent Advances in Natural Products as Anticancer Agents
280. Supramolecular Catalysis
282. Metal Catalysis for Asymmetric Synthesis
283. Transition-Metal Catalysis: Mechanism & Practice

AREA 5—PHYSICAL, THEORETICAL & COMPUTATIONAL CHEMISTRY

010. Computational Quantum Chemistry: Theory & Interactions with Experiment
017. Gas-Phase Studies of Metal-Ligand Interactions: Relevance in Organic Chemistry & Biochemistry
021. Recent Advances in Studies of Molecular Processes at Liquid Interfaces
024. Ultrafast Intense Laser Chemistry
031. Kuiper Belt Objects: Laboratory Studies, Models, Theory & Observations
037. Advances in Quantum Monte Carlo
040. Interfacial Electrochemistry: New Systems, Experimental Methods & Theoretical Approaches
066. Theory of Excited-State Structures & Dynamics: Application to Organic Materials & Biosystems
072. Frontiers of Surface-Enhanced Raman Scattering: Single Nanoparticles & Single Cells
075. Dynamics & Mechanisms of Photochemical Reactions of Biological Proteins
081. Challenges & Solutions to Accurate Calculations on Large Molecular Systems
087. Spectroscopic Probes of Intramolecular & Intermolecular Interactions in Molecules & Molecular Clusters
103. Systems Chemistry: Toward the Holistic Understanding of Complex Molecular Systems
116. Anharmonic Vibrations of Molecules & Clusters: Experiment & Theory
130. New Experimental & Computational Probes of Water in Biological Systems
138. Molecular Theory for Real Systems & Chemical Reactions
140. Re-Encounter of Computational Chemistry & Chemometrics
161. Quantum Coherence & Its Control in Condensed Phases
163. Cold Molecules & Quantum Computation/Information Processes
171. Nanostructure-Enhanced Photochemical Reactions
204. DNA Photonics
212. Frontiers of State-to-State Dynamics
220. Molecular Dynamics in Complex Environments: Theory & Experiments
228. Solid-State NMR Methods & Applications in Inorganic Materials
252. Interfacial Phenomena for Bubbles, Droplets, Films & Soft Matter
254. Advanced Linear & Nonlinear Vibrational Spectroscopy
258. Orbital-Free Density Functional Theory & Its Applications to Large-Scale Materials Simulations
259. Plasmonics & Nanophotonics for Chemical Sensing, Imaging & Spectroscopy
265. Frontiers of Colloid & Interface Chemistry
267. Frontiers of Biomolecular Dynamics

AREA 6—AGROCHEMISTRY

050. Cellulose-Based Nanomaterials: Fundamentals & Applications
088. Flavonoids: Synthesis toward Functions
111. Metabolomics for Fundamental & Applied Plant Sciences
118. Application of Liquid & Gas Chromatography/Mass Spectrometry to Agrochemical Challenges
162. Value-Added Food Products from Fruits & Vegetables
210. Ionic Liquids: Novel Processing Platforms of Cellulose & Biomass
214. Fungi & Mushrooms: Ecology, Chemistry & Agricultural Relevance
227. Rodenticide-Based Opportunities for Protection of Agriculture, Ecosystems & Public Health
230. International Food Safety Issues & Opportunities
243. Genomics Approach to the Analysis of Fungal Secondary Metabolites & Diversity

AREA 7—BIOLOGICAL CHEMISTRY

005. Chemical Biology of Botulinum Neurotoxin
041. Frontiers in Peptide Chemistry: Synthesis & Applications
043. Biomolecular Structure & Dynamics: Recent Advances in NMR
055. Molecular Control of Stem-Cell Fate
058. Advances in Solid-State NMR of Biological Molecules
076. Pectin: Effect on Structural & Functional Properties by Enzyme or Chemical Modification
090. Polypharmacology for Drug Discovery
093. Studying the Chemistry inside Living Cells with Infrared Spectromicroscopy

CALLING ALL STUDENTS

Student Poster Competition

All pre-Ph.D. students are invited to enter the Pacifichem 2010 Student Poster Competition. To do so, submit an abstract to one of the symposia within the technical program and mark the option to participate in the Student Poster Competition. An abstract must be accepted by the symposium organizers before it can be considered for the competition. Instructions for submitting abstracts are on page 46.

Because of the large number of submissions expected, a limited number of posters will be preselected based on the abstract. Judges will be appointed by the Pacifichem Organizing Committee from chemical scientists attending the conference.

Before the meeting, judges will select a maximum of 200 posters from all submissions for the on-site competition. The winners in this round will be notified at least one month before the meeting. These students will present their posters for judging on Saturday, Dec. 16, and winners will be selected.

Those selected for the on-site competition are expected to present their research at the student poster competition on Dec. 16 and also at the session that the paper was submitted in. Posters not selected for the on-site competition but accepted for a symposium within the technical program will be presented during that session.

105. Biomarkers: PET/SPECT Imaging
106. Biosynthesis of Natural Products
117. Chemical Approaches to Astrobiology
119. Gas-Sensor Proteins/Enzymes: Molecular Mechanisms of Gas Sensing & Intramolecular Signal Transduction
129. Bioorganic Reaction Mechanisms
149. Protein, Peptide & Peptidomimetics Design
200. Carbohydrate Recognition in Health & Disease
208. New Frontiers of Functional Nucleic Acids
213. Protein Alteration by Mutagenesis & Chemical Modification: Applications in Biochemistry, Drug Discovery, Diagnostics & Nutrition
235. Recent Advances in Research on Leukotrienes & Prostaglandins in Inflammatory & Respiratory Diseases
244. Ubiquitin Research: Structures, Mechanisms, Biology & Drug Development
256. Frontiers of Metalloproteins in Biology
278. Molecular Recognition of Nucleic Acids: Biological Applications

AREA 8—ENVIRONMENTAL CHEMISTRY

002. Interfacial Chemistry: Fate, Transport & Adsorption of Nanoparticles, Biocolloids & Trace Organics in Aquatic Systems
023. Environmental Forensics
026. Chemistry of UV Treatment for Water
048. Sources, Transport, Fate & Behavior of Global Contaminants
061. Advances in Water Disinfection & Disinfection By-Product Chemistry
073. Free-Radical Chemistry in the Environment
083. Environmentally Friendly Syntheses Using Ionic Liquids
086. Recycling of Polymeric Waste Materials: Challenges & Perspectives
128. Green Electrochemistry
131. Chemistry of Postcombustion Carbon Dioxide Capture
237. Environmental Chemistry of Aerosols
247. Sonochemistry & Sonoprocessing
250. Innovative Green Chemistry with Microwave Energy
262. Challenges of Heterogeneous Catalysts for Environmentally Benign Materials Conversions

AREA 9—MATERIALS & NANOTECHNOLOGY

013. Nanoparticles & Nanoparticle-Based Materials
065. Measurement Sciences for Life-Cycle Performance of Nanomaterials & Nanocomposites
077. Titanium Dioxide: Synthesis & Applications for Energy, Environment & Devices
092. Ionic Liquids in a Sustainable World
104. Synchrotron Radiation: Emerging Techniques & Applications
120. Nitroxide Radicals: Synthesis & Advanced Bio- & Nanomaterials Applications
121. Green Biomacromolecular Materials & Biocomposites
123. Nanofluidics & Chemical Manipulations in Restricted Environments
135. Carbon Nanotubes & Nanocarbon Materials
141. Emerging Perovskite & Spinel Compounds for Materials Science & Applications
142. Fundamentals & Applications of Nanomaterials for Electronics & Photonics
165. New Materials & Concepts for Next-Generation Membranes
168. Supramolecular Nanoassemblies & Extended Frameworks
178. Design of Zeolite Catalyts for Clean Synthesis of Chemicals
182. Computational Chemistry in Materials & Nanotechnology
184. Standard Reference Materials & Methods for Nanotechnology
202. Liquid Crystals in Materials Chemistry
224. Polymer/Organic Solar Cells
225. Organic Electronic Materials: From Small Molecules to Conducting Polymers
226. Biological & Bio-Inspired Materials Synthesis & Assembly
233. High-Performance Solution-Processed Materials for Electronic/Optoelectronic Device Applications
242. Self-Assembly & Directed Assembly of Small Molecules, Macromolecules & Colloids
264. Inorganic Nanowires: Syntheses & Growth Mechanisms
272. Redox Processes on Nanoparticles, Nanomaterials & Nanostructured Systems in the Environment

AREA 10—ALTERNATE ENERGY TECHNOLOGY

069. Advances in Chemistry & Materials for On-Board Hydrogen Storage
122. Nanoporous Materials for Renewable Energy & Chemicals
172. Clean Fuels from Coal, Natural Gas & Biomass
176. Thermochemical & Metal-Catalyzed Transformations of Biomass to Petrochemical Feedstocks, Polymer Precursors & Fuels
180. Chemistry, Structure & Properties of Fuel-Cell Membranes
205. Nanocatalysis for Fuels & Chemicals
221. Bioconversion of Lignocellulose to Fuel Ethanol, Chemicals & Materials
238. Light-Driven Generation of Hydrogen from Water
266. Petroleomics: A Road Map for Better Extraction & Processing of Petroleum

AREA 11—CHEMISTRY OUTREACH TO THE COMMUNITY

028. Green Chemistry & Micro-/Small-Scale Chemistry in the Curriculum
099. Two Sides of Research & Development
154. Best Practices for Teaching Chemistry at Every Level
185. Women at the Forefront of the Time: Challenges toward Next Decades
203. Chemical Security & Safety in the University & Laboratory
245. Pharmaceutical & Chemical Patent Protection & Enforcement around the Pacific Basin
246. Visualization in Chemical Education
273. Cultural & Professional Ethics

AREA 12—HEALTH & TECHNOLOGY

003. Advances in the Chemistry of Targeted Radionuclide Therapy
011. Biological Interactions of Engineered Nanoparticles: Novel Functions & Nanosafety Issues
071. Photodynamic Therapy & Photodetection
110. Phytochemical Antioxidants & Their Role in Human Health & Wellness
114. Chemistry, Safety, Quality & Regulatory Aspects of Functional Food Ingredients, Nutraceuticals & Natural Health Products
153. Nucleic Acid-Based Therapeutics
175. Tuberculosis Drug Development in the Pacific Rim
192. G-Quadruplexes & i-Motifs: Structures, Biological Roles & Therapeutic & Technological Applications
223. Chemical Glycobiology toward Development of New Diagnostics & Therapeutics
271. Advances in Nanomedicine 2010
284. Assembling New Biomedical Materials for Tissue Regeneration

AREA 13—SECURITY

044. Laser-Induced Breakdown Spectroscopy Detection of CBRNE Threats
137. Targeting Chemical & Biological Warfare Agents
167. Smart Materials & Devices for CBRNE Detection
201. Sampling & Analysis of Weapons of Mass Destruction Threats for Antiterrorism
240. Spectroscopic, Radioanalytical & Nuclear Methods for Security Applications
281. Laser-Based Detection of Chemical, Biological & Explosive Threats

C&EN
CHEMICAL & ENGINEERING NEWS

Serving the Chemical, Life Sciences, and Laboratory Worlds

Advertising Rate Information

CLASSIFICATIONS
Positions open, academic positions, situations wanted, and directory section.

ISSUANCE
Published weekly every Monday.

CLOSING DATE FOR CLASSIFIED ADS
Standard Set Ads—Friday, noon EST 17 days prior to publication date. Display Ads—Monday, 2 weeks prior to publication date. An order may be Fast Closed (FC) pending space is available until noon EST Monday prior to publication date. FC orders include a 15% premium on the standard ad rate. Cancellations must be received 14 days in advance of publication date (except legal holidays.)

SITUATIONS WANTED
"Situations Wanted" advertisements placed by ACS members are accepted at $6.60 a line per insertion, no minimum charge. State ACS membership status and e-mail to C&ENRecruitmentAds@acs.org. The advertisements will be classified by the chemical field designated by the members. If not designated, placement will be determined by the first word of text submitted.

EMPLOYER AD PLACEMENT
NON-DISPLAY LINE ADS: are $65 net per line; $650 minimum. One line equals approximately 50 characters and spaces, centered headlines equal approximately 32 characters, bold caps, and spaces. For an additional $150, your print ad will appear on www.acs.org/careers for 4 weeks. For more information go to www.cen-online.org, e-mail C&ENRecruitmentAds@acs.org, or call Renee Zerby at 202-872-8069.

DISPLAY ADS: For rates and information go to www.cen-online.org or contact a sales representative: East Coast—Lisa Kerr, kerr@acs.org, 610-964-3613; Midwest—Tom Scanlan, Scanlan@acs.org, 847-749-3030; West Coast—Bob LaPointe, Lapointe@acs.org, 925-964-9721.

TO SUBMIT A CLASSIFIED AD: E-mail ads to C&ENRecruitmentAds@acs.org. Do not include any abbreviations. C&EN will typeset ads according to ACS guidelines. All ads must be accompanied by either a purchase order number or a credit card number and a billing address. Purchase orders must allow for some degree of flexibility and/or adjustment.

CONDITIONS: In printing these advertisements ACS assumes no obligations as to qualifications of prospective employees or responsibility of employers, nor shall ACS obtain information concerning positions advertised or those seeking employment. Replies to announcements should carry copies of supporting documents, not original documents. Every reasonable effort will be made to prevent forwarding of advertising circulars. Employers who require applications on company forms should send duplicate copies. ACS considers all users of this section obligated to acknowledge all replies to their advertisements.

IMPORTANT NOTICES

- Employment in countries other than your own may be restricted by government visa and other policies. Moreover, you should investigate thoroughly the generally accepted employment practices, the cultural conditions, and the exact provisions of the specific position being considered. Members may wish to contact the ACS Office of International Activities for information it might have about employment conditions and cultural practices in other countries.
- Various state and national laws against discrimination, including the Federal Civil Rights Act of 1964, prohibit discrimination in employment because of race, color, religion, national origin, age, sex, physical handicap, sexual orientation, or any reason not based on a bona fide occupational qualification.
- These help-wanted and situations-wanted advertisements are for readers' convenience and are not to be construed as instruments leading to unlawful discrimination.

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Ph.D. / MS / BS

The ideal candidate will be capable of designing & conducting complex multi-step syntheses efficiently. Ability to independently solve synthetic and process problems is essential. Significant experience with the application and analysis of spectroscopic data and separation methods (HPLC, flash chromatography) is also required. Skill sets encompassing solution-phase parallel synthesis, *ex vivo* syntheses, green chemistry technologies, preparative microwave syntheses, and natural products isolation and relevant down-stream processing are also of interest. Demonstrated record of research success is important.

Successful candidates must have excellent verbal and written communication skills and the ability to work effectively in a team environment. These positions offer exceptional opportunities for dedicated individuals to develop their technical and leadership skills while making substantial contributions within a dynamic, entrepreneurial environment. We offer highly competitive salaries and a comprehensive benefits program.

Please send your resume to Adesis, Inc., Andrew Cottone, Ph.D., Vice President, Chemistry, 27 McCullough Drive, New Castle, DE 19720. *An Equal Opportunity Employer.*

POSITIONS OPEN

KPS TECHNOLOGIES, LLC, in **Atlanta, GA,** is seeking an experienced chemist or technician for its **Kilo Scale-up Laboratory.** The successful candidate ideally has a high level of experience in synthetic organic chemistry and in KG scale-up operations and knowledge of laboratory safety. Job duties require familiarity with synthetic process optimizing and minimizing process hazards, cost, and waste. Resumes may be submitted *via* e-mail to **kpstechnologiesllc@yahoo.com.**

ACADEMIC POSITIONS

THE ADVANCED MATERIALS SCIENCE AND ENGINEERING CENTER (AMSEC) of **Western Washington University (WWU)** invites applications for **a tenure-track faculty position** at the assistant professor level in the field of materials science, broadly defined. Qualified candidates in **all subfields of materials science** will be considered, with preference given to individuals whose research and teaching interests are in the areas of inorganic materials chemistry, energy-related materials, polymers and composites, or mineral physics. A Ph.D. degree in a related field is required. This interdisciplinary position will include appointments in two departments (Chemistry, Physics, Engineering Technology, or Geology), to be determined based upon the candidate's specialty discipline. AMSEC is a new $1.2 million program with a mission to educate students in materials science, support interdisciplinary research, and enhance regional industry competitiveness and innovation. The successful candidate is expected to establish a vigorous, externally funded research program involving undergraduate and graduate students and to teach courses related to their field of expertise. Applicants should submit their application online at **www.wwu.edu/jobs.** Applications should include a cover letter, full CV, statement of research plans, and statement of teaching philosophy and interests. In addition, applicants should arrange to have 3 letters of recommendation sent to **Tina Copsey, MS 9065, Western Washington University, 516 High St., Bellingham, WA 98225-9065.** Review of applications will begin on Feb. 15, 2010, and continue until the position is filled. WWU is an Equal Opportunity Employer.

Molecular Foundry Director

The Materials Sciences Division at the University of California's Lawrence Berkeley National Laboratory invites applications and nominations for the position of Director of the Molecular Foundry. The Molecular Foundry is a U.S. Department of Energy "User Facility", whose staff of 60 is engaged in a broad range of nanoscience research programs. Scientific staff pursue projects of their own design, and also collaborate with scientists (users) from around the world whose own research efforts benefit from effective use of the Foundry's equipment, techniques, and staff expertise. The Foundry Director will be appointed as a Senior Scientist at Berkeley Lab. The possibility exists for an additional affiliation with the University of California.

Duties of the Foundry Director:

- Articulate and implement a vision to guide the scientific direction, structure, organization, management and operation of internal research and user-support activities of the Foundry, as it continues to grow.
- Work effectively with Berkeley Lab and DOE management to ensure that sufficient resources are available to support both the user program and the internal research mission.
- Recruit and retain staff, and provide leadership to foster staff career growth and advancement.

Applicants should have:

- Distinguished record of excellence in nanoscience research
- Demonstrated record of breadth of knowledge and vision across a wide range of nanoscience fields
- Ability to manage the scientific, managerial and operational components of a large, complex, internationally recognized scientific enterprise

Please see the complete job posting and apply at http://foundry.lbl.gov/, # 23768.

BERKELEY LAB

Discover potential at the nanoscale.

The Molecular Foundry is a DOE-funded nanoscience research center that provides state-of-the-art instrumentation, scientific expertise and specialized techniques and training to help address the myriad of challenges in nanoscience and nanotechnology.

AA/EEO

RUHR-UNIVERSITÄT BOCHUM

RUB

The Ruhr University Bochum is one of Germany's leading research universities. The University draws its strengths from both the diversity and the proximity of scientific and engineering disciplines on a single, coherent campus. This highly dynamic setting enables students and researchers to work across traditional boundaries of academic subjects and faculties. Host to 32,600 students and 4,700 staff, the Ruhr University is a vital institution in the Ruhr area, which has been selected as European Capital of Culture for the year 2010.

PROFESSORSHIP (W2) / JUNIOR PROFESSORSHIP (W1, TENURE TRACK) IN HETEROGENEOUS PHOTOCATALYSIS

The Faculty of Chemistry and Biochemistry at the Ruhr-University Bochum, Germany, invites applications for a **Professorship (W2) / Junior Professorship (W1, Tenure Track) in Heterogeneous Photocatalysis.**

The independent research group is associated with the **Chair of Technical Chemistry** and is expected to link its activities within the Faculty as well as with the **Center for Electrochemical Sciences**, the semiconductor physics group, and the **Institute of Materials**. The research is expected to focus on photocatalysis with semiconductors, photocatalytic water purification, or photocatalytic water splitting. Access to state-of-the-art spectroscopic equipment is provided, and additional funding can be obtained in cooperation with the Research Department **Interfacial Systems Chemistry**.

The successful applicant must be able to fulfill all teaching obligations in **Technical Chemistry** (chemical reaction engineering, unit operations, industrial processes). Knowledge of German is not necessary in the beginning, but will be expected as a teaching language within the first five years. Supporting documents proving success in teaching and the ability to acquire and coordinate externally funded projects are required.

Depending on the level of qualification either a W2 professorship or a W1 junior professorship (tenure track) is offered. In case of a junior professorship, employment is initially limited to three years with the option of prolongation for another three years after evaluation. This position has the option for permanent employment. Ruhr University Bochum seeks to increase the participation of women in areas, in which they are currently underrepresented, and therefore explicitly urges women to apply. Disabled persons with equivalent aptitude will be favored.

Qualified candidates are asked to submit their application including C.V., list of publications and talks, list of teaching and research activities, and copies of degree certificates by **January 31, 2010** to the **Dean of the Faculty of Chemistry and Biochemistry, Ruhr University Bochum, 44780 Bochum, Germany**.
E-mail: chemie@rub.de

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RECRUITMENT ADVERTISING

ACADEMIC POSITIONS

McGILL UNIVERSITY
CHEMISTRY DEPARTMENT

Applications are invited for a tenure-track Assistant Professor position in Chemical Biology. This appointment will emphasize measurement/detection (spectroscopy, electrochemistry, imaging, etc.) in Chemical Biology. Applications from more senior candidates may be considered. Candidates should have a Ph.D. degree with postdoctoral experience, proven research ability, and a strong commitment to teaching. The successful candidate will be expected to teach undergraduate and graduate courses and to establish a vigorous research program. All candidates **must register on-line** at: **http://www.chemistry.mcgill.ca/chemicalbiology and send hard copies** of a curriculum vitae, three research proposals, a statement of teaching experience and interests, and arrange to have at least three letters of recommendation sent to **Chemical Biology Search Committee, Department of Chemistry, McGill University, 801 Sherbrooke Street West, Montreal, Quebec H3A 2K6, Canada.** Review of applications will begin immediately. The expected start date is July 1, 2010, but is negotiable. Salary will be negotiable, according to qualifications and experience. Information about McGill University and the Department of Chemistry may be found on our web site at **http://www.chemistry.mcgill.ca.** All qualified applicants are encouraged to apply; however, in accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. McGill University is committed to equity in employment and diversity. It welcomes applications from indigenous peoples, visible minorities, ethnic minorities, persons with disabilities, women, persons of minority sexual orientations and gender identities, and others who may contribute to further diversification.

STAFF POSITION IN MACROMOLECULAR X-RAY CRYSTALLOGRAPHY. The Department of Chemistry and Biochemistry at **ARIZONA STATE UNIVERSITY (ASU)** invites applications for a full-time, state-budgeted position as facilities manager, protein X-ray crystallography and computing resources. A PhD in the chemical sciences or related field and expertise in protein X-ray crystallography are required. Duties include the maintenance and repair of in-house X-ray equipment, management of crystallographic and instructional computing resources, and training of research personnel. Applicants must submit a *cover letter, curriculum vitae,* and *summary of research experience* as a single electronic PDF document to **xraysearch@asu.edu.** Applicants must also arrange for three letters of recommendation to be submitted to **xraysearch@asu.edu.** Cover and recommendation letters should be addressed to **X-Ray Crystallography Search Committee, Department of Chemistry and Biochemistry, Arizona State University, PO Box 871604, Tempe, AZ 85287-1604.** For additional information, please contact **Dr. Rebekka Wachter at rwachter@asu.edu.** Review of applications will begin February 1, 2010, and will continue every two weeks thereafter until the position is filled. **A background check is required for employment.** *ASU is an EO/AA Employer and is committed to excellence through diversity. Women and minorities are encouraged to apply.*

ASSISTANT IN CHEMISTRY
Elizabethtown College, in Elizabethtown, PA, invites applications for a part-time assistant in Chemistry beginning in August 2010. A minimum of a master's degree in Chemistry and a strong commitment to undergraduate learning are required. The successful candidate will have teaching responsibilities in general and organic chemistry laboratories. The candidate will also be expected to teach a chemistry core course. Particular interest will be given to applicants with expertise in forensic science, environmental science, or materials science. For full ad and application instructions, visit **www.etown.edu/humanresources — Job Opportunities.**

ASSISTANT PROFESSOR—PHYSICAL CHEMISTRY
Elizabethtown College, in Elizabethtown, PA, invites applications for a nine-month visiting faculty position in Physical Chemistry at the Assistant Professor level beginning in August 2010. Candidates are required to have a PhD in chemistry and a strong commitment to undergraduate learning. The successful candidate will have teaching responsibilities in junior level physical chemistry courses, advanced laboratory, and general or organic chemistry laboratory. For full ad and application instructions, visit **www.etown.edu/humanresources - Job Opportunities.**

ACADEMIC POSITIONS

DEPARTMENT OF CHEMISTRY AND THE CENTER FOR SCIENCE AND MATH EDUCATION AT LOYOLA UNIVERSITY CHICAGO (LUC) invites applications for a tenure-track faculty position in Chemical Education at the rank of Assistant Professor. The position will be a joint appointment between the Department of Chemistry and LUC's Center for Science and Math Education. The department offers Ph.D., MS, and ACS-approved B.S. degrees. Further information about the department is available at **www.luc.edu/chemistry.** For information about the center, visit **www.luc.edu/cse.** Applicants from all areas of Chemical Education will be considered. However, preference will be given to candidates whose research interests include the study of learning and teaching strategies to enhance student performance in chemistry courses. A Ph.D. in Chemistry or Chemical Education is required. The successful candidate will be expected to establish an internationally competitive, externally funded research program and participate in teaching undergraduate classes (especially, but not exclusively, introductory general chemistry courses) and classes in LUC's M.Ed. Program in Chemical Education. The successful candidate will also be experienced working with middle school or high school teachers as well as participating in science education reform efforts in large urban school districts. Application materials, consisting of a current *Curriculum Vitae,* cover letter, statement of teaching philosophy and research interests, writing samples, and evidence of effective teaching should be submitted to **www.careers.luc.edu.** At the same web site, applicants should submit the names of three individuals prepared to provide professional references. Applicants may forward additional material related to teaching qualifications and excellence as well as samples of scholarly publications to **Chemical Education Search Committee, Department of Chemistry, Loyola University Chicago, 1068 W. Sheridan Rd., Chicago, IL 60660.** Review of applications will begin after February 1, 2010, and continue until the position is filled. LUC, Chicago's Jesuit Catholic University, is an Equal Opportunity/Affirmative Action Employer with a strong commitment to diversifying its faculty. Applications from women and minority candidates are especially encouraged. For further information about LUC, consult the university's web site at **www.luc.edu.**

UMASS-AMHERST CHEMICAL ENGINEERING TENURE-TRACK FACULTY POSITION: Assistant or Associate Professor. Requirements include Ph.D. in Chemical Engineering or a related field, outstanding record of research accomplishments, and commitment to excellence in teaching and research. Preferred research areas are *Bioengineering* or *Renewable/Sustainable Energy.* This is one of several positions to be filled as part of campus-wide initiatives in *Cellular Engineering* and *Biofuels.* Expected starting date is September 1, 2010. Send curriculum vitae, research plan, and statement of teaching interests by e-mail to **chesearch09@ecs.umass.edu** *(applications should be submitted as a single PDF file).* Three letters of reference should also be sent by e-mail to the same address. Applications sent through regular mail should be addressed to **Prof. Peter Monson, Chair, Search Committee, Dept. of Chemical Engineering, University of Massachusetts, 686 N. Pleasant St., Amherst, MA 01003-9303** *(e-mail submission is preferred).* Reviews will begin January 15, 2010. Applications will be accepted until the position is filled. The University of Massachusetts is an Affirmative Action/Equal Opportunity Employer, promotes diversity, and encourages applications from women and members of minority groups.

POSTDOCTORAL POSITION IN ORGANIC NANOCHEMISTRY IN THE JOINT SCIENCE DEPARTMENT OF CLAREMONT McKENNA, PITZER, AND SCRIPPS COLLEGES
A two-year, NIH-funded postdoctoral position is available beginning September 1, 2010, to work with Professor David E. Hansen on the design and synthesis of organic nanostructures of defined size. Experience in organic synthesis, completion of Ph.D. work, and a record of scholarly publication are required. To apply, please upload a cover letter and CV online at **https://webapps.cmc.edu/jobs/staff/staff_opening_detail.php?PostingID=M881.** Applicants should also arrange to have three letters of recommendation sent directly to **Professor David E. Hansen, The Joint Science Department, 925 N. Mills Avenue, Claremont, CA 91711-5916.** Review of applications will begin on March 1, 2010, and the position will remain open until filled. The Claremont Colleges are an Equal Opportunity Employer.

ACADEMIC POSITIONS

FACULTY POSITION IN BIOMEDICAL OR BIOLOGICAL ELECTRICAL ENGINEERING AT NORTHEASTERN UNIVERSITY
Boston, MA

The Department of Electrical and Computer Engineering and College of Arts and Sciences at **Northeastern University** are seeking senior interdisciplinary applicants at the rank of Associate or Full Professor who are working at the interface of electrical and computer engineering and its applications to biology and medicine. Successful candidates will be jointly appointed in Electrical and Computer Engineering and a relevant department in the College of Arts and Sciences, with the locus of tenure to be determined according to the candidate's expertise. The search is open to candidates from the broadest range of fields of science and engineering with appropriate interdisciplinary interests and background. Applicants will be expected to play a leadership role in opening new areas of research or significantly enhancing existing areas of strength at Northeastern. Anticipated start date: Fall 2010. Qualifications for the position include a PhD, a strong record of scientific achievement and extramural funding, and a commitment to leadership in interdisciplinary research. Northeastern University is an Equal Opportunity, Affirmative Action Educational Institution and Employer, Title IX University. Northeastern University particularly welcomes applications from minorities, women, and persons with disabilities. Northeastern University is an E-Verify Employer. For more details or to apply, visit **http://www.coe.neu.edu/coe/.**

ASSISTANT PROFESSOR, CHEMISTRY, TENURE-TRACK

Teach courses in biochemistry, introductory chemistry, and their associated labs. Contributions to **Westfield State College** community (MA), student advising, and some scholarship expected. QUALIFICATIONS: Ph.D. with ability to expand biochemistry offerings and teach organic chemistry. ONLINE APPLICATION REQUIRED. Go to **http://jobs.wsc.ma.edu/** to view the full posting. For assistance, call **413-572-8809.** Affirmative Action/Equal Opportunity Employer.

SABBATICAL REPLACEMENT FACULTY POSITION AT REED COLLEGE. The Chemistry Department invites applications for a two-year visiting position within the fields of **Biochemistry and/or Analytical Chemistry** for the 2010–2012 academic years. The successful candidate will be capable of offering courses selected from the following possibilities: structural and metabolic biochemistry, biochemistry laboratory, analytical chemistry, and general chemistry. Expertise across these areas will be given greater consideration. The successful candidate will also be expected to involve senior thesis students in original research. Excellent facilities for teaching and research are available, including a 400 MHz multinuclear NMR in a modern dedicated chemistry building. Ph.D. is required; postdoctoral experience preferred but not required. Submit curriculum vitae, an outline of research interests, statement of teaching philosophy, and arrange to have three letters of recommendation sent to **Prof. Ronald W. McClard, Chair, Chemistry Search Committee, Reed College, 3203 SE Woodstock Blvd., Portland, OR 97202-8199.** Review of applications will begin on February 23, 2010, and continue until position is filled. An Equal Opportunity Employer, Reed values diversity and encourages applications from underrepresented groups.

SABBATICAL REPLACEMENT FACULTY POSITION AT REED COLLEGE. The Chemistry Department invites applications for a two-year visiting position within the field of **Organic Chemistry at the Assistant Professor level** for the 2010–2012 academic years. The successful candidate will be capable of offering courses in introductory and advanced organic chemistry targeted at chemistry and allied majors. The successful candidate will also be expected to involve senior thesis students in original research. Excellent facilities for teaching and research are available, including a 400 MHz multinuclear NMR in a modern dedicated chemistry building. Ph.D. is required; postdoctoral experience preferred but not required. Submit curriculum vitae, an outline of research interests, statement of teaching philosophy, and arrange to have three letters of recommendation sent to **Prof. Alan J. Shusterman, Chair, Chemistry Search Committee, Reed College, 3203 SE Woodstock Blvd., Portland, OR 97202-8199.** Review of completed applications will begin on February 19, 2010, and continue until the position is filled. An Equal Opportunity Employer, Reed values diversity and encourages applications from underrepresented groups.

ACADEMIC POSITIONS

TEXAS A&M UNIVERSITY—QATAR CHEMICAL ENGINEERING PROGRAM

Applications are invited for two chemical engineering faculty positions at all levels at **Texas A&M University's branch campus in Doha, State of Qatar.** Texas A&M University at Qatar is a partnership with Qatar Foundation. Now entering its sixth year of operation, Texas A&M at Qatar offers Bachelor of Science degrees in Chemical, Electrical and Computer, Mechanical, and Petroleum Engineering. The degree programs are identical to those of the main campus at College Station, Texas. A Texas A&M University diploma is awarded to graduates. A new, state-of-the-art engineering building for teaching and research opened in 2007. Texas A&M at Qatar is committed to provide a holistic experience to our students and faculty that includes exposure to cutting-edge research. Applicants for these positions must have a Ph.D. in Chemical Engineering or closely related field. Preferences will be given to individuals with research and teaching interests in the areas of process integration and design, process safety, petroleum and gas processing, environmental engineering, and thermodynamics, but outstanding candidates with research interests in other areas of chemical engineering will also be considered. Prior teaching experience in USA and familiarity with ABET accreditation is desirable. We offer competitive salaries and summer funding is guaranteed. Liberal allowances for professional travel and for relocation to Qatar are provided. Fringe benefits include free furnished housing in one of several gated communities, K-12 education for dependents, group health insurance, annual leave allowance, and a car allowance. Applicants should send curriculum vitae, detailed statement of research and teaching interests, and arrange to have letters of recommendation sent to **Dr. Dragomir Bukur, Chair, Texas A&M at Qatar CHEN Search Committee, Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, Texas 77843-3122, dragomir.bukur@qatar.tamu.edu.** Call **(979) 862-3985** for additional information. The complete dossier should be received by March 31, 2010. Early applications are encouraged since applications will be reviewed as they are received. Texas A&M University is an 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 veterans. More information about Texas A&M University is available on the web at **http://www.tamu.edu and http://www.qatar.tamu.edu/.** The university is responsive to the needs of dual-career couples. Texas A&M University provides equal opportunity to all persons regardless of race, color, religion, sex, national origin, disability, age or veteran status and encourages applications from members of groups underrepresented in engineering.

THE UNIVERSITY OF VIRGINIA SCHOOL OF ENGINEERING AND APPLIED SCIENCE is seeking applications to fill faculty positions in multiple departments, including Chemical Engineering, as part of an innovative partnership with **Virginia Tech, Rolls Royce, and the Commonwealth of Virginia.** Applicants are sought at all professorial ranks, including endowed professorships. All applicants must have an earned doctorate in an appropriate discipline. Technical areas of expertise include, but are not limited to: next-generation materials; high temperature reaction kinetics; electrochemistry; fluid and thermal systems; and modeling and simulation. Applicants must apply on-line at **https://jobs.virginia.edu and search by Posting Number 0603292.** Applicants are encouraged to submit a candidate profile, current curriculum vitae, statements of research and teaching interests and visions, and contact information for at least four references. The University of Virginia is an Equal Opportunity/Affirmative Action Employer committed to developing diversity in faculty and particularly invites applications from women and members of under-represented groups.

NATIONAL CHANGHUA UNIVERSITY OF EDUCATION, TAIWAN

The Department of Chemistry invites applications for an assistant professor (or higher) level position. Analytical chemistry preferred. Ph.D. required with minimum one year postdoctoral experience. Candidates are expected to establish an active research program and teach at graduate and undergraduate levels. Knowledge of Mandarin is essential. To apply please check our web site: **http://chem.ncue.edu.tw/English/chem/contents/enter.htm.** Deadline for fall hiring is January 31, 2010.

ACADEMIC POSITIONS

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.

A POSTDOCTORAL POSITION in polymer surface modification of inorganic particles is immediately available in the **Messersmith group** at **Northwestern University,** located in **Evanston, Illinois.** The position involves surface-initiated polymerization from oxide particles for purposes of efficient dispersion within a polymer matrix and control of the organic-inorganic interface. Experience in polymer chemistry, surface-initiated polymerization, and controlled/living polymerization methods are desired. Send CV and names of three referees to **philm@northwestern.edu.**

SITUATIONS WANTED

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FRIGID FLIES, IT'S IN HIS BUZZ

For people with late-summer birthdays, merrymaking on a frigid winter's day during the holidays likely led to their conception. But for some insects, cold periods aren't opportunities for snuggle time with a loved one but are times of selfish resource hoarding.

Among *Drosophila melanogaster* **FRUIT FLIES,** for example, those exposed to repeated cold periods trade survival of the species for their own survival, according to a study by Brent J. Sinclair, a professor in the University of Western Ontario's biology department, and Ph.D. student Katie E. Marshall (*Proc. R. Soc. B,* DOI: 10.1098/rspb.2009.1807). "Each organism has finite resources," Marshall says. When exposed to stress events, fruit flies have to decide whether to use those resources to be tough and survive or to reproduce and hope that their offspring survive. "It's a trade-off between reproduction and repair," she says.

For the study, the researchers exposed groups of *D. melanogaster* to a single 10-hour cold period or a series of five two-hour cold periods with 22-hour warm periods in between to give the flies time to repair. The flies exposed to cold periods multiple times had higher survival rates than the single-exposure flies, but they also had a significantly lower rate of population increase.

"There is a fitness consequence to repeated cold exposure," the researchers write. By analyzing triglycerides and glycogen at intervals after treatment, they determined that repeated stress events affect the flies' metabolic reserves. The multiple-exposure flies had lower levels of both compounds than the single-exposure group. Because the multiple-exposure flies are not reproducing at the same rate as single-exposure and control groups, they are likely allocating their metabolic resources to survival rather than to reproduction, Marshall says.

"In nature, animals are exposed to thermal stress on a regular and repeated basis," Marshall says. "Understanding the consequences of these repeated stresses is essential to interpreting and predicting climate-change effects in the natural world." For example, such research could aid in designing population models of agricultural and pathogen-vector pests such as tsetse flies and mosquitoes, whose geographical ranges could change as Earth heats up.

HEATH MACMILLAN/U OF WESTERN ONTARIO

ISTOCK

Cold case: Stressed-out flies save their energy for survival. What's the buzz?: Not just a warning system for mosquitoes' victims.

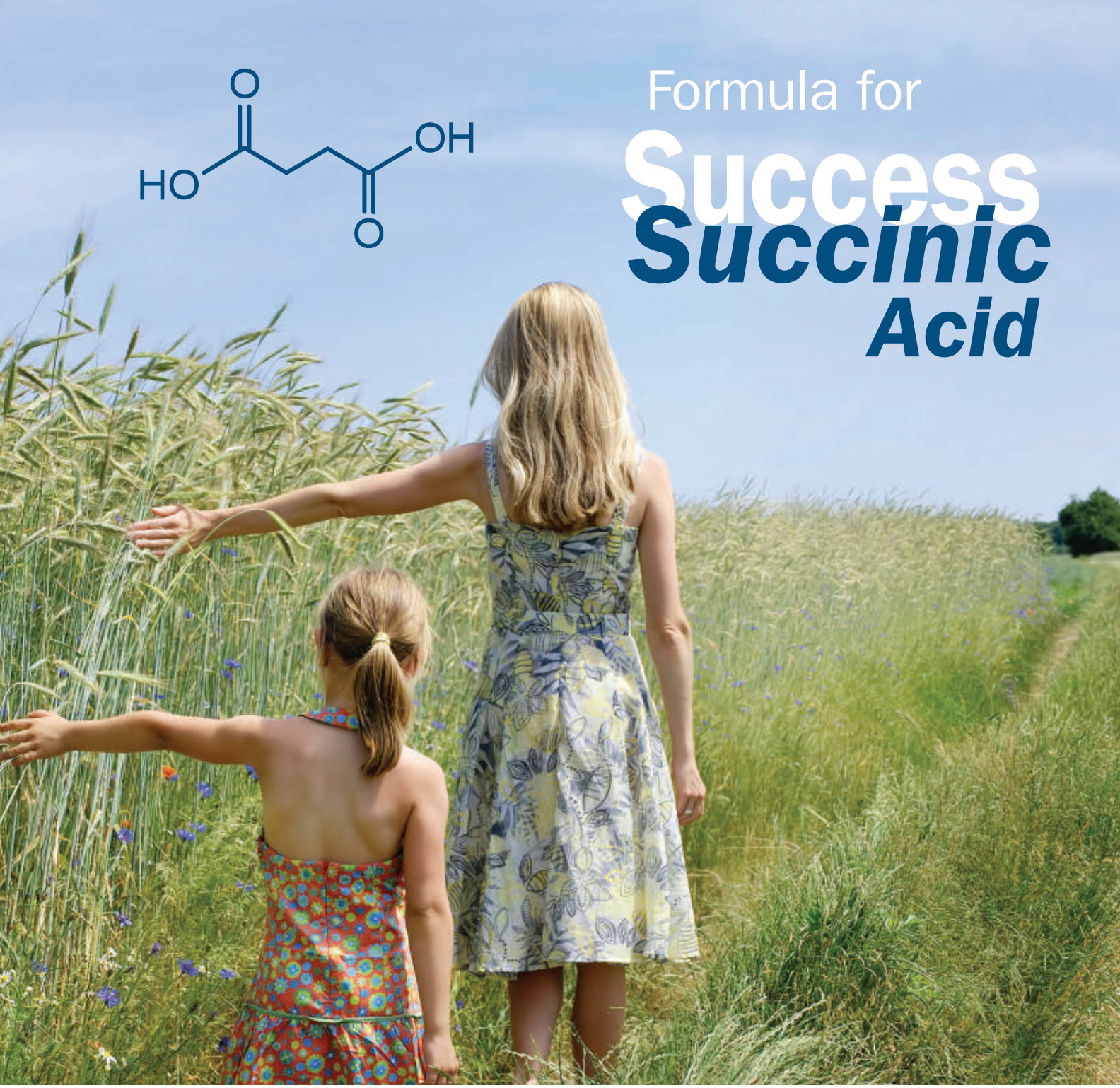
Although a mosquito's choice of domicile might be expanding because of climate change, its choice of mates is limited by its musical ear.

Anopheles gambiae is a complex group of seven species and several genetic forms of **MOSQUITOES** that host the malaria pathogen. Their genetic diversity allows them to adapt to new environments and is maintained by reproductive isolation, even when different types coexist within the same swarm. Scientists in the U.K. and the African country Burkina Faso report that these mosquitoes maintain reproductive selectivity by "singing" vibratory ballads to one another and harmonizing to find the perfect mate (*Curr. Biol.,* DOI: 10.1016/j.cub.2009.11.040).

The tones mosquitoes use to identify their partners are produced by their wings during flight. Two mosquitoes don't harmonize properly if they are of different types or of the same sex, the researchers show, and eventually dissonant pairs give up and move on.

"Even the most 'lowly creatures,' such as mosquitoes, have highly evolved neurosensory systems that can process relatively simple auditory inputs to produce motor outputs enabling them to distinguish between other types of mosquito that are so closely related we need to analyze their DNA to tell them apart," Gabriella Gibson, one of the report's authors and an entomologist at the University of Greenwich's Natural Resources Institute, says in a press release.

KENNETH J. MOORE *wrote this week's column. Please send comments and suggestions to newscripts@acs.org.*



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