

Bulletin *of the*

CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING

Volume 16,3 / Summer 2001



Activities of the Academy

Following is a list of major recent reports of the Academy. Reports are available for a nominal fee from the Academy office or website; executive summaries of the most recent reports are available on the Academy website at www.ctcase.org.

"Study of Radiation Exposure from the Connecticut Yankee Nuclear Power Plant" (2001)

"A Study of Bus Propulsion Technologies Applicable in Connecticut" (2001)

"Efficacy of the Connecticut Motor Vehicle Emissions Testing Program" (2000)

"Indoor Air Quality in Connecticut Schools" (2000)

"Efficacy of MTBE Use in Connecticut" (1999)

"Radon in Connecticut: Quantitative Perspectives about Effects on Public Health" (1998)

"Building Agricultural Biotechnology in Connecticut" (1997)

"Status of Connecticut Critical Technologies" (1997)

"Evaluation of Critical Technology Centers" (1996)

"Science and Technology Policy: Lessons from Six American States" (1994)

"A State Science and Technology Policy" (1992)

"Electromagnetic Field Health Effects" (1992)

"Economic Impact of AIDS Health Care in Connecticut" (1990)

Industry Clusters and Economic Development in Connecticut

Leaders and executives in the state's private sector must become "much more deeply involved" in addressing and solving those public policy problems that affect the economic climate in Connecticut if the state is to maximize its potential for economic growth, according to William Kaufmann, Chairman and CEO of the Connecticut Economic Resource Center.

At the same time, he noted, it is critical that those in the public sector and in non-profit organizations such as the Connecticut Academy of Science and Engineering (the Academy), help accelerate developments in technology in order to bring about necessary changes in the state's institutions, and to better understand the relationship between increasing prosperity, competitiveness, and innovative capacity.

Kaufmann, who as senior advisor to the Commissioner of the Connecticut Department of Economic and Community Development, in the mid-1990s played a key role in introducing a major industry cluster initiative in the state, used four successful Connecticut industry clusters—bioscience, aerospace components manufacturing, and transportation, as well as

(See Clusters, page 2)

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News from the National Academies

The following is excerpted from press releases of the National Academies and from *News Report Online*, a news resource of the National Academies which can be found at www.nationalacademies.org/onpi/newsrpt/

◆ Fuel Economy Standards

A new report from the National Research Council finds that while the federal program that sets fuel economy standards for cars and light-duty trucks—known as the Corporate Average Fuel Economy standards, or CAFE—has helped reduce US dependence on imported oil and lowered emissions of greenhouse gases, changes to the program could further decrease the nation's petroleum dependence and provide more flexibility to carmakers.

With the nation's overall fuel economy steadily declining over the last decade, Congress asked the National Academies to study the effects that the CAFE standards have had over the past 25 years, as well as effects that potential changes to the program might have. Sponsored by the US Department of Transportation, the study recommends a number of improvements to the standards, ranging from implementation of tradable fuel economy credits to elimination of the "two-fleet" rule that sets separate standards for domestic fleets and imports. The report notes that technologies already in existence, including engine advances that reduce friction and more efficient powertrains, could significantly reduce fuel consumption of new cars. See *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards* [www.nap.edu/books/0309076013/html/]

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Clusters *(continued from page 1)*

the Inner City Business Strategy Initiative—to illustrate how such mechanisms can stimulate institutional change, bringing about economic development, increased competitiveness and greater innovative capacity.

Speaking to more than 75 prominent scientists, science students, educators and state officials at the 26th Annual Meeting of the Connecticut Academy of Science and Engineering at the Rocky Hill Marriott on June 13, Kaufmann stressed the need to make "significant changes in the state's institutions" in order to build a business community that is more competitive in the global economy.

Defining economic development as the "increasing of prosperity," Kaufmann argued that prosperity is driven by increases in productivity and competitiveness, which are themselves driven by increased innovative capacity. Citing a recent study, he noted that innovation was a critical factor in the unprecedented economic prosperity America enjoyed during the 1990s, with virtually every element of that economic boom linked to the development and employment of new technology. The most effective way to create innovative capacity is to have a business environment that is "vibrant and competitive," he said, adding that the best way to achieve such an environment is to "nurture, seed, and reinforce industry clusters."

Citing the bioscience cluster as a strong case in point, Kaufmann noted that on issues such as tax credits and laboratory space, the cluster "made the case, educated the state, the governor, and the legislators." The result was a revision of existing tax credit legislation, and new legislation providing funds, through Connecticut Innovations, to reduce the risk to businesses and investors of investing in critical but costly laboratory space.

BioBus, a traveling school science laboratory, is another example of the successful interaction of public and private sectors. Funded by equal contributions from the state's pharmaceutical companies and Connecticut Innovations, the bus will provide science teachers with portable laboratory space and curriculum opportunities.

Connecticut's industry clusters represent key economic "drivers." A cluster can only exist if there is already a natural strength, noted Kaufmann. When a cluster's members become active and start working together instead of as competitors, they are able to influence the state and its institutions. Through the state's industry cluster initiative, collaborative efforts by the public and private sectors—including investments—have resulted not only in the development and application of innovative new technologies, but in enhanced competitive advantages as well. Most importantly, when public and private forces unite, Kaufmann noted, they can create institutional change, change that is critical to the state's future economic development. ◆

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Science and Engineering Notes from Around Connecticut



Communication

BRING ON THE BAND(WIDTH). Although optical fibers offer advantages over conventional copper wires for transmitting data, reliability can be a problem. "With a transmission bandwidth thousands of times greater than copper, optical fibers can carry significantly more data," says **Yale** engineering professor **Wilson Chiu**. "But harsh environments have considerably reduced the life expectancy of current optical fibers." Chiu was recently awarded grants from the National Science Foundation and the Office of Naval Research to develop new coatings able to protect the optical fibers under extreme temperature, pressure and chemical exposure. Chiu will also work on developing high strength optical fibers that could be used for acoustical sensing in the harsh marine environment; such technology could also be used to detect geothermal and geological activity, and to find weaknesses in industrial machinery, bridges, and other structures.

PRESCRIPTION CURE. About 7,000 Americans die each year from medication errors, with illegible handwriting singled out as one cause of the problem. To solve it, Connecticut hospitals have begun to have doctors use computers to prescribe treatments. Such computerized prescriber order entry systems offer more than just legibility. They can also determine whether a particular drug is paid for by a patient's insurer, check drug dose guidelines, and warn against interactions among multiple medications. Computerized systems for in-house drug ordering are being installed at **St. Francis Hospital**, the **John Dempsey Hospital** at the **University of Connecticut Health Center**, and at **Hartford Hospital**.

MOVING LIPS. An animated image projected onto a three-dimensional surface could be used to train the deaf to read lips. The technology, known as LIPS—Life Imaging Projection System—was developed by **Richard Gans**, artist-in-residence at **Yale's Digital Media Center**, who uses it to project the image of a person's face onto a die-cast model of a human head. While conventional films and videos can be effective in teaching lip-reading, it may be that three-dimensional images such as this are more effective, said a researcher at **Yale's Haskin's Laboratory**, a center for the study of speech and reading. Gans believes that the next step is to make three-dimensional digital images that can be projected directly onto a screen, with images of moving lips spliced in later to complete the animation.



Education & Cognition

WISDOM AND INTELLIGENCE. At **Yale's** new **Center for the Psychology of Abilities, Competencies, and Expertise (PACE)**, director **Robert Sternberg** hopes to expand the definition of intelligence to include abilities beyond the analytical. With grants from the National Science Foundation and the Army Research Institute, Sternberg hopes to foster the development and awareness of two other intelligences—creative and practical—which he believes are also necessary to succeed in life. Some evidence shows PACE methods to be effective: adopted in nine **New Haven** schools, they've helped to improve reading levels, according to **Charles Warner**, director of instruction for New Haven public schools. But the center conducts other projects as well. In conjunction with the University of Michigan, the center is creating a test for screening future corporate leaders. It's also conducting studies on leadership in the military, and on the psychology of wisdom, a quality that Sternberg believes can be taught.

KILLER SOUNDWAVES. A high school science fair project constructed by 14-year-old **Michael Nyberg**, of Old Lyme, could be adapted by the state **Department of Environmental Protection (DEP)** for killing mosquitoes. The non-toxic method is based on sound-waves: experimenting with a low-power transducer, Nyberg found that to mosquito larvae, soundwaves of 24 kHz are fatal, killing the creatures by rupturing air bladders near their heads. "I only need a quarter of a watt of energy to kill the larvae," said Nyberg. Because the sound is not audible to humans, and doesn't appear to harm other animals, Nyberg's discovery could be "a very exciting find," said **Paul Capotosto**, the mosquito management supervisor for the DEP. It remains to be seen, he said, whether the device will work in the wild, and whether it will work for all species of mosquitoes.

SIGNS OF READING. Teaching hearing children sign language helps them learn to read, according to **Marilyn Daniels**, a former instructor at **Central Connecticut State University**. Daniels conducted studies that compared preschoolers and kindergartners whose teachers used both signing and spoken English to those youngsters whose teachers did not sign. In each study, the youngsters exposed to sign language scored higher on standardized vocabulary development tests. In one study, children from a disadvantaged neighborhood, where scores typically fell below those of suburban youngsters by about 15 points, were able to nearly match those of the more advantaged kids. Daniels suggests that sign language helps because it gives children "portable prompts" to help them remember the names and sounds of the letters.

HEALING NERVES. With a \$300,000 Brain and Memory Disorders Award from an independent endowment fund, **Yale** professor **Stephen Strittmatter** will continue his research into the extent to which nerve cells can heal themselves after an injury. Earlier work by Strittmatter and others found that a specific protein, Nogo, served to inhibit the growth of axons after they had been traumatically damaged, and more recently, Strittmatter's laboratory identified a receptor protein that binds Nogo to nerve cell axons. Now, he hopes to develop mice that lack the receptor proteins, to determine whether, without them, the animals can regenerate axons. If they can, says Strittmatter, "then we would have a target to develop a drug." Strittmatter's research could be used to treat patients with spinal cord injuries, strokes, and multiple sclerosis.



Energy

BATTERIES WITH ENGINES. The **Yale Combustion Group** has been awarded a \$2.4 million Department of Defense grant to develop lightweight, readily rechargeable, micro-combustion batteries. The batteries, which will be fueled by hydrocarbons, will be used to provide soldiers with reliable, long-term sources of electricity while in the field. Because hydrocarbons contain so much potential energy—up to two orders of magnitude more than the best batteries available—it may be worthwhile to use combustion to generate power in systems that could be on the order of millimeters, or, at the most, centimeters. "The military is shooting for something that weighs as little as a few ounces to power, for example, a one-day mission in the field, or less than two pounds for a three-day mission, fuel included," says **Alessandro Gomez**,

Items that appear in the In Brief section are compiled from previously published sources including newspaper accounts and press releases. For more information about any In Brief item, please call the Academy at (860) 527-2161, write the editors at 179 Allyn St., Suite 512, Hartford, CT 06103-1422, or e-mail us at acad@ix.netcom.com

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director of the **Yale Center for Combustion Studies** and principal investigator on the project.

FUEL CELL CAR. A fuel cell vehicle that can easily be produced from an existing production line has recently been unveiled by **International Fuel Cells**, of **South Windsor**. Built from an SUV, it is, according to the company, the first stock vehicle that is completely powered by a fuel cell. Unlike fuel cell prototypes manufactured by other companies, the car does not sacrifice passenger and cargo space to the new equipment. The tank of compressed hydrogen that fuels the car is located where the gas tank used to be, and the fuel cell "stack" that delivers the power has been placed under the rear passenger seat; without a combustion engine, the car is hundreds of pounds lighter, and ballast must be added to the front end. The fuel cell delivers 87 horsepower, enough to allow the car to easily reach highway speeds.

FUEL CELL SCHOOL. The state is constructing what is believed to be the largest installation of fuel cells in the country, to power its new juvenile training school in **Middletown**. The system, which will use six 200-kilowatt fuel cells manufactured by South Windsor's **International Fuel Cells**, will showcase the state's commitment to alternative energy and cleaner air, said project officials. While the fuel cell system is more expensive to install and run than a conventional system, it provides several benefits. In addition to eliminating harmful emissions, fuel cells offer increased reliability. They will allow the school, a maximum security detention center, to remain independent of the power grid and therefore unaffected by outages. The system is expected to be in operation by late fall.

TIRE FIRE. At **Exeter Energy** in Sterling—the only power plant in the country powered by burning tires—over 2 trillion-kilowatt hours of electricity have been produced over the past ten years. The plant, which consumes about 10 million tires a year, is cleaner burning than conventional power plants, according to **Kenneth Wycherley**, general manager for the company. A lime-water slurry converts much of the potentially toxic gases generated by burning tires to gypsum, used in drywalls, and zinc oxide, collected from the flyash, is used to make sunscreen and fertilizers. The plant, one of a number in Connecticut that produce energy from trash or other nonconventional fuels, has just reached its tenth anniversary of operation.



Environment

HEALTHY POISON. Proteins produced by a poisonous Australian spider could lead to non-toxic, highly specific pesticides, according to **Glenn King**, a research scientist at the **University of Connecticut Health Center**. The venom of the funnel-web spider contains over 100 different compounds, and from those, King has identified several that kill only insects. By putting the compounds in a virus, King is able to deliver the toxin to a specific pest. Importantly, King's compounds attack a brain connection not targeted by most chemical pesticides; this means that insects, which are increasingly resistant to other pesticides, will be easily felled by this one. King believes that his discovery could replace chemical pesticides. Currently, he says, more than a billion pounds of pesticides are sprayed each year, amounting to about four pounds per person.

FLY AWAY HOME. Grasslands created around a prison complex in **Enfield** are scheduled to replace the 75 acres of rare-bird habitat lost to the **University of Connecticut's** new football stadium in **Rentschler Field**. In a project started last spring, a variety of tall grasses will be planted on the 150 to 200 acres surrounding the

Williard-Cybulski Correctional Institute. Within two years, the area should provide attractive habitat for northern harriers, grasshopper sparrows, and other species of endangered birds; the uninterrupted grasslands should attract birds that seek open areas before nesting, according to state **Department of Environmental Protection** biologist **Jenny Dickson**. Because the rare birds nesting at Rentschler Field follow a migratory path over Enfield, they are expected to be able to spot the substitute habitat.

LOOK OUT BELOW. With a \$571,000 grant from NASA, **Yale** scientists are using satellite sensors to help understand the long-term effects of logging and farming on tree growth in Africa. With the satellites, researchers can easily track the entire continent. Compared to earlier satellites, which had a resolution of about half a mile, the most recent technology can observe objects as small as one yard; this means that using satellite sensors, researchers can monitor individual trees. What's more, because the sensors can observe different wavelengths of light, researchers can distinguish between various kinds of trees: a tree with shiny leaves would have a different light signature than one with fuzzy leaves, and deciduous trees look different than coniferous trees. Researchers hope to track the effects of clear-cutting, and to find ways to manage Africa's valuable mahogany forests.

BETTER FACILITIES. Composting toilets will be replacing outhouses and even some flush toilets in many of Connecticut's state parks as part of a **Department of Environmental Protection (DEP)** project to improve park services and protect the environment. The toilets, increasingly popular around the country, use no water. Instead, they transform human waste into garden compost by mixing it with pine shavings and bacteria in an enclosed tank. In some parks, solar panels provide the energy to run the fans that help aerate the system. Several of the toilets have already been installed, and the state plans to add about 80 more by the end of the summer of 2002. Among the parks that will be refitted are those in **Redding, Kent, Oxford, Simsbury, East Haddam, and Pomfret**.



Food & Agriculture

KID-FRIENDLY AGRISCIENCE. At the newly-opened \$8.5 million agriscience school in **Trumbull**, youngsters can learn both traditional agriculture skills, like clipping nails on a sheep, and newer ones, involving computers and biotechnology research. In its greenhouse, for example, students learn to grow and clone plants using five separate controlled environments. The 35,000-square-foot building, which will allow the program to double the number of students it can accommodate, to about 200, was financed by the state because of the need to update the agriscience program in **Fairfield County**. "The scope and range of the entire agriscience field has vastly expanded. The focus now is on science and technology," said **Anne Gaulin**, educational consultant for **Connecticut Learns**, which oversees the state's public vocational schools.

FOOD SAVER. With a mixture of chemical compounds, tested in multiple combinations, at differing temperatures, and at varying levels, **University of Connecticut** research associate **Claudia Koerting** has been able to keep samples of unrefrigerated processed cheese fresh and bacteria-free for three weeks—10 times longer than normal. Working with chemicals regarded as safe by the federal Food and Drug Administration, Koerting has been trying to control the bacterium *listeria*, which can cause serious illness in humans. The challenge, she says, is to design a system that can control any dangerous microbes while using the smallest amount of harsh processing and chemicals, so as not to

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affect taste, color and texture, and to be aware of consumer concerns as well as cost. Her work, which could save the food industry hundreds of thousands of dollars, is sponsored by Nestle.



Health

ADULT STEM CELL RESEARCH. Adult stem cells, derived from bone marrow, can transform themselves into liver, lung, gastrointestinal, and skin cells, and possibly into other organs, according to a study done by **Diane Krause**, of the **Yale School of Medicine** and her colleagues. Building on earlier experiments that showed that bone marrow cells could generate new liver cells, the researchers transplanted a single male-derived cell into female mice, using the Y chromosome as a marker to identify all of that cell's descendants. "It's astounding that there are cells in our bone marrow that can become so many different cell types," said Krause. The challenge now, she says, is to understand how these changes occur, and to harness these findings to develop therapies for human diseases and injuries.

A TIPPLE A DAY. A **Yale** study adds support to the notion that moderate alcohol consumption keeps you healthy. The research showed that older people who drink low to moderate amounts of alcohol show a lower risk of heart failure than those who abstain. According to the study, participants who consumed one to 20 ounces of alcohol in the month preceding the study had a 21% lower risk of heart failure, while those who consumed 21 to 70 ounces of alcohol had a 47% lower risk. The research also showed that similar reductions occurred with various types of drinks—wine, beer, liquor—suggesting that it is pure alcohol rather than the type of beverage that provides the benefit, said **Yale professor Harlan M. Krumholz**, one of the study's authors.

ESTROGEN IN PROPER AMOUNTS. Low doses of estrogen may improve bone health in older women while minimizing side effects, according to a study conducted at the **University of Connecticut (UConn) Health Center**. The researchers, headed by **UConn professor Karen Prestwood**, found that as little as one-quarter of the 1 mg dose of estrogen currently recommended is just as effective as the full amount in increasing bone turnover. Bone turnover is the process by which new bone is formed as older bone is dissolved; osteoporosis occurs when more bone is dissolved than is created. "It's possible that different women require different doses of estrogen. It is also conceivable that the same woman may require different doses of estrogen at different times of her life," said **Prestwood**. More than 10 million Americans have been diagnosed with osteoporosis.

MICE WITH DIABETES. A protein studied by **Yale** researchers could offer a way to prevent Type 2 diabetes, which is the most common metabolic disease in the world. The disease is closely linked to the body's ability to respond to insulin, and much current diabetes research focuses on understanding the insulin signaling pathway: a domino effect of proteins that ultimately cause the cells to increase glucose use. The researchers found that when the Akt2 protein was inactivated in mice, the animals developed defects in the way insulin acted. "These mice develop diabetes in a pattern similar to human diabetes, and future studies will examine whether a mutation in the Akt2 protein is also seen in people with diabetes," said **Jason Kim**, one of the study's authors.

TAKE TWO ASPIRIN. In addition to easing headaches and muscle pain, aspirin is believed to prevent and treat a variety of cancers; **Timothy Hla**, head of the vascular biology laboratory at the

University of Connecticut Health Center, may have found a clue to the reason why. It could be related, he believes, to the drug's ability to suppress an enzyme known as Cox-2. The enzyme, which can cause inflammation and pain, is also found in large amounts in tumors, and, by increasing amounts of Cox-2, Hla's laboratory was able to induce breast cancer in mice. Hla believes that excess amounts of Cox-2 may interfere with the body's ability to destroy damaged or mutated cells, which may allow cancer cells to continue to exist. While studies have found that those who take aspirin regularly have reduced risks of colorectal and ovarian cancer, Hla cautions that not enough is known for aspirin to be prescribed as a preventative medicine.

ADDICTIVE INHERITANCE. **Yale**-led researchers hope to find the genes responsible for cocaine addiction, with the help of a \$6 million grant from the National Institute on Drug Abuse. The inheritability of cocaine dependence is quite high, says **Joel Gelernter**, a psychiatry professor at Yale, and principal investigator of the project. At about 60 to 70%, it's even higher than for alcohol dependence, which is about 55%, he says. But, because the genetic contribution to the problem is so high, the probability of finding specific genes is "very good." The researchers hope to recruit 500 families with affected sibling pairs in order to track down the genes.



High Technology

CHIPPING AWAY. RNA biochips developed at **Yale** could provide researchers with the ability to detect germs, screen blood, analyze industrial waste, and more. The silicon chips contain RNA molecules that, through test-tube evolution, have been developed to respond to specific molecules, said **Yale professor Ronald Breaker**, lead researcher on the project. "Advanced RNA biochips should be able to be used to detect almost anything to which RNA can bind," Breaker said. In the prototype, a gold-plated silicon wafer carrying seven RNA "switches" was able to distinguish between several strains of *E. Coli* bacteria. More advanced biochips could carry thousands of switches, enabling researchers to test for a multitude of compounds all at once.

A BIT OF BITE. False teeth made from the same materials used to construct airplanes are being tested at the **University of Connecticut Health Center**. The fiber-based composites offer advantages over the standard dental prosthesis, which are usually made of porcelain bonded to metal. "It's hard to make porcelain the right color, especially because you have to use opaque materials to cover up the metal substructure. Additionally, porcelain is so hard it can wear away other teeth," said **Martin Freilich**, the study's principal investigator. The new material is also better, he explains, because, unlike the metals currently used to make bridges over implants, it doesn't corrode, it's not toxic, and it can be repaired.

LIGHT DATA. Proteins from a 3.5 billion-year-old microbe can be used to improve computers, according to **University of Connecticut professor Robert Birge**. The protein, bacteriorhodopsin, is extremely efficient at converting light into energy, and Birge and his colleagues have been able, through a process he calls directed evolution, to adapt the protein and the chemistry that goes on inside it so that it can be used to store information inside computers. Because the protein is so small, it would take hundreds to reach the size of a single magnetic particle on a magnetic disk: a phial of bacteriorhodopsin the size of a man's little finger can store twice as much information as the Library of Congress. "Bacteriorhodopsin is the most cost-effective way to store data that is currently available," says Birge.

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Industry & Business

SAD CASE. Depression harms businesses more by reducing productivity in workers than it does by increasing absenteeism, and, importantly, depressed workers who report a poor quality of health care are most likely to suffer from persistent depression and lower work productivity, according to a study done at **Yale**. For this research, participants were asked to rate their health care. They were also asked whether they had missed one or more days of work in the past month due to health problems and to assess the impact of their health on their effectiveness. "The costs of depression on the workplace are greatest in depressed individuals with problems in obtaining good health care," said Yale professor and lead author **Benjamin Druss**.

RISKY BUSINESS. Brain cancer has been increasing in many industrialized countries, especially among the elderly, and, according to a **Yale** study, some occupations can be linked with the augmented risk. In men, a higher incidence of brain cancer is found in those employed as roofers or sheet metal workers, those who work with rubber or plastic products, and those who are employed in cleaning businesses. Among women, the risk is linked to agricultural and farm jobs, work with apparel and textiles, jobs in electronic equipment manufacturing, and waitressing. The increase could result from exposure to pesticides, solvents, dyes and formaldehyde, and metal fumes, said principal investigator and Yale professor **Tongzhang Zheng**, who also emphasized that more studies are needed to confirm his results.

DATA MINE. By reselling data provided free by the federal government, Norwalk-based **EDGAR Online** may have found the money-making niche eluded by so many dot-coms. The company relies on the EDGAR database (Electronic Data Gathering Analysis and Retrieval) at the Securities and Exchange Commission, which can be used by anyone without cost. However, with a single annual report from just one company able to exceed 900 pages, many analysts are willing to pay for "mined" data, and the company is able to provide that service, with software that is able to pick out the particular information that interests a specific customer.

IMPORTANT JUNK. With the decoding of the human genome, all human genes may have been identified. But it's the "junk" DNA, the non-coding, non-gene DNA material on our chromosomes that, according to **Yale** biology professor and Academy member **Frank Ruddle**, plays a critical role in determining how genes work. With his new company, **Epigenix**, Ruddle and his partners will analyze the non-coding DNA, which, Ruddle says, influences such things as the basic body plan of all organisms, the structure of chromosomes, and the process by which cells replicate. "It's almost a certainty that these [non-coding] areas are as important—perhaps more important—than the genes themselves," said Ruddle.

MICROBES IN SPACE. **Ray Lam**, a scientist in the natural products research department at **Bristol-Myers Squibb**, has designed the first pharmaceutical experiment to be conducted aboard the new international space station (ISS). A follow-up to three previous space shuttle experiments that found that bacteria could produce roughly 200 times as much antibiotic in space as they could on the ground, the 94-day experiment is an attempt to see what types of adaptations the bacteria, *Streptomyces plicatus*, makes in a microgravity environment. If researchers can find which adaptations allow the bacteria to produce antibiotics so much more abundantly in space, then they may be able to induce the bacteria here on earth to do the same thing.



Transportation

RADAR AT BRADLEY. A new \$2.23-billion radar automation system, scheduled for installation at **Bradley International Airport** this summer, is designed to let controllers get planes on and off the runway more quickly and safely. STARS—Standard Terminal Automation Replacement System—uses a digital display to provide a constant view of Bradley and a 60-mile radius around it. STARS should also offer increased reliability, with a system that contains redundant microprocessors able to quickly compensate for any computer failure. Bradley is the first major airport to receive the upgraded system; over the next few years, STARS will be installed at airports and military airfields throughout the country.

WALK-ABOUT. Using a version of functional electrical stimulation (FES), **University of Connecticut** professor **Pouran Faghri** believes it may be possible to help paralyzed people to use their legs and, possibly, even walk again. Faghri had previously used FES to develop an exercise cycle for those with neurological disabilities. The device requires attaching electrodes to the patient's legs, which allows electrical impulses to trigger muscle contractions; these, in turn, cause leg movement. In Faghri's new project, she and a colleague will use nano-technology to develop tiny stimulators that can be implanted inside muscles. A remote control, rather than wires, will activate the nerve impulses. This technique has already been used to reduce nerve damage in stroke victims; Faghri and her partner will be the first to use it on those with spinal cord injuries.

MOVABLE POWER. With the help of a device designed in part by Guilford-based **Abba Corp.**, train locomotives could supply emergency electricity during power outages. The machine, an inverter, transforms locomotive power output, which fluctuates in voltage and frequency, into the more stable power required to run household appliances. Equipped with an inverter, a single 3,000 HP General Electric locomotive could produce 2 megawatts of power, enough to power 1,000 homes. The locomotives could travel to wherever power is needed, and then return to hauling freight when the emergency has passed.

TEST FLIGHT. Wind tunnels filled with super-refrigerated helium could make it easier to test airplane designs, according to research being conducted at **Yale**. Engineers often prefer to test their designs using scale models, rather than building full-size models. But smaller objects behave differently in, say, air, than larger ones: dust will float, a stone will drop. In order to obtain realistic test results from a scale model, certain characteristics—flow velocity, object size, fluid density, and fluid viscosity—must be kept in a fixed ratio. In order, for example, to make a 1/100 size submarine model behave realistically, the liquid traveling past it must move 100 times as fast as for a full-size vehicle. Liquid helium, chilled to a few degrees above absolute zero, has a much lower viscosity than air or water, so using it as a fluid makes it possible for researchers to obtain realistic results using small-scale models moving at lower speeds. The work, which is funded by a \$5 million grant from the National Science Foundation, is being done by Yale mechanical engineering professor and Academy member **Katepalli R. Sreenivasan** and **Christopher White**, a Yale graduate student. ♦

—Compiled and edited by Karen Miller

National Academies *(continued from page 1)*

◆ Global Warming Summary

In a report requested by the Bush administration, a committee of the National Research Council summarized the scientific community's current understanding of global climate change by characterizing the global warming trend over the last 100 years, and examining what may be in store for this century as well as the extent to which warming may be attributable to human activity. Among its findings, the committee said the conclusion of the Intergovernmental Panel on Climate Change (IPCC) that the global warming that has occurred in the last 50 years is likely the result of increases in greenhouse gases accurately reflects the current thinking of the scientific community. However, it cautioned that uncertainties about this conclusion remain and stressed that much more systematic research is needed to resolve these uncertainties, which are due to a variety of factors, including the level of natural variability inherent in the climate on such long time scales, the questionable ability of models to simulate natural variability on such scales, and the degree of confidence that can be placed on estimates of temperatures going back thousands of years based on evidence from tree rings or ice cores. The report urges that a strong commitment be made to basic research as well as to improving climate models and building a global climate observing system. More comprehensive measurements of greenhouse gases and increased computational power also will be needed. *Climate Change Science: An Analysis of Some Key Questions* [<http://books.nap.edu/books/0309075742/html/>]

◆ Child Development Policies

A new report from the National Research Council and the Institute of Medicine finds that the United States has not taken full advantage of scientific knowledge about children's development between birth and age 5, and urges policymakers to re-examine policies and practices affecting this group. Citing 40 years of scientific research, coupled with dramatic social and economic changes during that time, the report recommends that the social and emotional needs of young children receive the same attention as their academic achievement.

Among its recommendations, the report calls for expanding coverage of the Family and Medical Leave Act to all working parents. Policymakers also should extend the amount of time that welfare recipients with infant children are excused from meeting work requirements, and explore ways to financially support low-income parents who take family leave. Additionally, major sources of funding for child care and early education should set aside money to support initiatives aimed at increasing the skills, pay, and benefits of child-care professionals. The report urges establishment of a task force of officials on all levels to review public investments in child care and early childhood education and produce a 10-year plan that focuses on ways to improve the quality of care in a range of settings, and addresses the needs of children with developmental impairments or disabilities, and of those with chronic health conditions. *From Neurons to Neighborhoods: The Science of Early Childhood Development* [<http://www.nap.edu/books/0309069882/html/>]

◆ Partnerships for Schools

Efforts in the United States to train both current and prospective teachers in science, mathematics, and technology are disjointed and inadequate, according to a report from the National Research Council. The report recommends forging stronger ties between K-12 and post-secondary educators; creating partnerships to create a more integrated system to train future elementary and secondary school teachers; and providing challenging professional-development opportunities over the course of a teacher's career. In addition, partnerships that team up school districts with community colleges and four-year colleges or universities could foster a greater sense of professionalism among K-12.

The report suggests numerous ways that school districts could work with colleges or universities, and recommends that colleges and universities take the lead in providing experienced K-12 teachers of science, mathematics, and technology with coordinated professional-development opportunities. School districts should assume primary responsibility for organizing field experiences for all considering teaching careers, and creating high-quality internship programs for teachers new to the field. And these alliances should receive input from representatives of academic societies, scientists from private industry, and scholars from all relevant disciplines. See *Educating Teachers of Science, Mathematics, and Technology: New Practices for the New Millennium* [<http://www.nap.edu/books/0309070333/html/>]

◆ HIV Prevention

The US government needs to rethink its prevention efforts in light of new trends in the HIV/AIDS epidemic, according to a report from the Institute of Medicine. Recent reports indicate that a false sense of security and growing complacency brought on by treatment advances may be contributing to a resurgence of risky behaviors in some areas. Additionally, a shift in which populations are living with AIDS suggests that prevention efforts may not be effectively reaching those at risk. The government needs a better tracking system and a more systematic approach to evaluating programs and allocating funds, according to the report, which recommends that the Centers for Disease Control create a national surveillance system that can accurately track new HIV infections. In addition, thousands of new infections could be avoided each year if greater emphasis were given to prevention and the government spent its prevention dollars more effectively, the report says.

The report calls for additional improvements, such as routinely offering prevention services during visits to clinics and doctors' offices that serve high-risk populations. Federal agencies also need to do a better job in working with state and local organizations to apply the latest research on effective prevention at the community level. To spur the development of new technologies, federal agencies should increase research funding and provide incentives to the private sector to invest in research. For these steps to be effective, federal, state, and local officials must exert greater leadership to remove social and political obstacles, the report warns. *No Time to Lose: Getting More from HIV Prevention*. [<http://www.nap.edu/books/0309071372/html/>] ◆

Meet the Executive Editors ...



GEORGE FOYT (ENGINEERING) is currently Director of New Business and Technology at the Connecticut Resources Recovery Authority. He has enjoyed a rich technical career, largely in the fields of semiconductors and microelectronics. His work has included high-speed transistors (at the Bell Telephone Laboratories), Gunn Effect devices, ion implantation, infrared detectors, avalanche photodiodes,

long-lifetime diode lasers, opto-electronic devices (at the MIT Lincoln Laboratories), and high-temperature electronics, precision pressure sensors and accelerometers, low noise oscillators, and high-density microelectronic packaging (at the United Technologies Research Center).

He received a BS, MS, and ScD in Electrical Engineering from the Massachusetts Institute of Technology, is a fellow of the IEEE, a member of Sigma Xi and Eta Kappa Nu, has served as chairman on Industrial Advisory Boards for the University of Illinois and the University of Connecticut, and has been active in the IEEE Electron Devices Society.

At the Connecticut Academy, he was co-chairman of a committee that advised the CT-DOT and CTTransit on bus technology, was a member of a panel that advised the state of Connecticut on electrical power generation, was a member and chair of the nomination committee, and is vice chairman of the energy committee.



JAN A. J. STOLWIJK (SCIENCE) is Professor Emeritus in the Division of Environmental Health Sciences of the Department of Epidemiology of the Yale University School of Medicine. His current research interests focus on the epidemiology of lung cancer in connection with residential radon exposures.

Additional research interests include the possible association between community and occupational exposure to magnetic fields and excess risk of different leukemias and central nervous system tumors, and possible other risk factors for childhood acute lymphoblastic leukemia. Other research interests include the development and application of risk assessment methodologies in the area of uncertain and low-level exposures associated with hazardous waste sites and other environmental hazards especially as these relate to the development of exposure guidelines and standards aimed at health-based strategies for managing such risks.

He received a BS, MS and PhD from Wageningen University, the Netherlands, and holds an honorary degree from Yale University.

At the Connecticut Academy, he has chaired the Public Health Technical Board, and has chaired several studies, including "Electromagnetic Field Health Effects" (1992) and "Radon in Connecticut: Quantitative Perspectives about Effects on Public Health" (1998).

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