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REPORTS

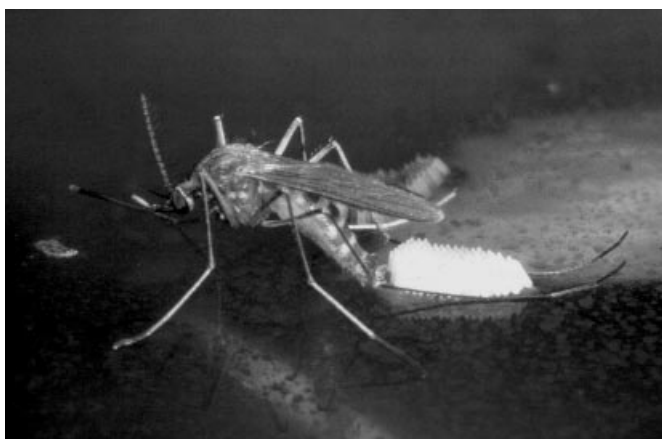
HIGHLIGHTS OF SCIENCE AND TECHNOLOGY IN CONNECTICUT
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WEST NILE VIRUS

How Connecticut Scientists Helped Crack the Case of An Exotic Arbovirus

West Nile virus (WNV), a name that conjures up the perils of the tropics, has now found its way to Connecticut. WNV, first isolated in 1937 from a woman in the West Nile District of Uganda, rarely causes any disease in those infected. The original viral isolation was not associated with a specific disease. It was not until 1950 that patients suffering with fever and rashes in Israel and Egypt were found infected with the virus. WNV outbreaks now occur sporadically, not only in Africa and the Middle East, but also in Europe and western Asia.

WNV is not transmitted directly from person to person, but by the bite of an infected mosquito. WNV, like other arthropod-borne viruses (arboviruses), is



A *Culex pipiens* mosquito lays her eggs. (Photo: CAES)

maintained in an enzootic cycle in non-human hosts, such as birds. Avian-feeding species of mosquitoes transmit the virus from bird to bird. When the population of infected birds reaches a high level, other mosquito species that feed on birds as well as mammals may trans-

mit the virus to the latter. Humans and most mammalian hosts are "dead-end hosts"; they do not maintain a viremic state long enough for a mosquito to pick up the virus and transmit it to another host.

In August, 1999, several seemingly unrelated events in New York foreshadowed the start of an arboviral outbreak. Horses on Long Island developed neurological pathology—stumbling, seizing and dying. In Albany, hundreds of crows died, and by early September, Bronx Zoo workers observed neurologic dysfunction in a cormorant and a bald eagle. The cormorant and several Chilean flamingos at the zoo succumbed to the unknown illness, and concomi-

(See West Nile Virus, page 2)



(Graphic: T. Ouimet, Yale U.)

Laboratory Safety Offices Help Universities Toe the Line

It's been said with some truth that directing research scientists is like herding cats. Independent, highly trained, and overworked, scientists tend to resent any outside interference in their activities. Nonetheless, it is the task of university laboratory safety offices to train scientists in safe laboratory practices and in the proper handling and disposal of hazardous materials, and to ensure that scientists comply with government regulations. Being squeezed between the demands of government regulators and the needs of research scientists sounds like a recipe for frustration. But, even in the current atmosphere of tight government control and large fines, safety officers are finding ways to meet the needs of the research community that allow them to carry out their responsibilities with grace and good humor.

Safety regulations at universities are nothing new. In fact, the services provided by safety offices, which include safety training, hazardous waste pick-up and disposal, and oversight, have always aimed at one

(See Laboratory Safety, page 10)

FROM THE ACADEMY

Indoor Air Quality in Connecticut Schools

On January 15, 1999, CASE accepted an inquiry from the Environment Committee of the Connecticut General Assembly to investigate indoor air pollution in the schools of Connecticut. The Inquiry invited CASE "to conduct an investigation on this issue: 1) to assess health hazards to schools children and adults from indoor air pollution in Connecticut schools, 2) to identify protective measures, and 3) to assign priorities among these measures."

In early 1999, a committee, chaired by CASE member John E. Yocom, was organized to address the Inquiry and prepare a report to the Environment Committee. The study committee consisted of members of CASE plus representatives of state and federal agencies and private consulting groups dealing with various aspects of the overall problem. The agencies participating included the Connecticut Departments of Public Health, Labor, and Education, the University of Connecticut Health Center, and the US Environmental Protection Agency.

The areas covered in the study report included: Sources of Indoor Air Pollution; Health Effects of Indoor Air Quality; Indoor Air Quality Standards; Heating and Ventilating in Relation to Indoor Air Quality; Review of Indoor Air Quality Programs in Connecticut and Other States; Investigations of Indoor Air Quality in Connecticut Schools; and Department of Education Funding for Improving School Indoor Air Quality. The principal findings of the study included:

- Indoor air quality in schools is an especially serious problem, since young children tend to be more sensitive than adults to irritating air contaminants.
- There is an increased prevalence of asthma in school age children, much of which can be related to exposure to indoor air contaminants in the school and the home environments.
- While poor indoor air quality may not produce lasting health effects, exposure to irritating substances may affect the mental concentration of both students and teachers, thus degrading the learning experience.

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West Nile Virus (from page 1)

tantly, New York City physicians saw patients with encephalitis. Patient sera were sent to the Centers for Disease Control (CDC) for diagnostic testing. Early serological tests indicated antibodies to St. Louis encephalitis virus (SLEV), a virus transmitted by mosquitoes, not known to kill livestock.

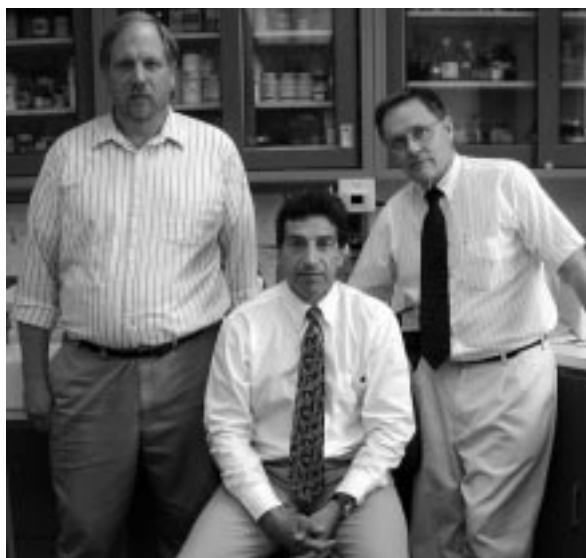
New York and New England epidemiologists, on hearing the laboratory results, speculated that the pathogen was a new strain of SLEV, because previous outbreaks of the virus in the midwestern United States, the Caribbean, Central and South America didn't cause pathology in non-human hosts.

How did Connecticut get involved? For about 60 years, medical entomologists in Connecticut have been alert to the possibility of an outbreak of mosquito-borne encephalitis. Human outbreaks of Eastern equine encephalitis (EEE) have occurred sporadically for decades in New Jersey and Massachusetts, and Connecticut has the same mosquito species, bird species and horses, providing the epidemiological backdrop for a similar outbreak. Although no human cases of EEE have occurred in the state, isolation of EEE virus from pheasants in Connecticut from 1938 to 1959 led to studies by the University of Connecticut (UConn), the Connecticut Agricultural Experiment Station (CAES) and Yale University School of Medicine (YSM). The latter two institutions carried out limited mosquito and arboviral surveillance from 1952 to 1977. Arthropod surveillance programs shifted focus to a quest for a Lyme disease vector in 1977. Mosquito surveillance at multiple sites across the state and viral isolation attempts on a regular basis were begun in 1997 by Dr. Theodore G. Andreadis at CAES, following the isolation of an unprecedented number of viral isolations of EEE from mosquitoes in the fall of 1996. Andreadis and CASE member and CAES Director Dr. John F. Anderson responded quickly to the first reports of a mosquito-borne disease outbreak in neighboring New York.

On September 4, 1999, Anderson and Andreadis were informed that the CDC

had found SLEV antibodies in patients. On September 5, Anderson set out light traps for mosquitoes in Greenwich and Stamford. Within a few weeks, Anderson and Andreadis had placed traps in 12 additional towns in Fairfield County. Dead crows were collected in Fairfield County from the second week of September. These were sent to Dr. Herbert J. Van Kruiningen at UConn who, along with UConn colleagues Dr. Antonio Garmendia and Dr. Richard French, performed necropsies. Brain tissues from birds appearing to have encephalitis were examined, and frozen brain samples were sent to CAES for viral testing. Virus was isolated from a crow that died on September 13 in Westport, from 27 out of 30 others that died in Fairfield and New Haven Counties from September to October 12, and from a Cooper's hawk that died on September 25 in East Haven. All crows from which viral isolates were made had histopathological evidence of viral encephalitis. All viral isolates reacted with SLEV antibodies.

A total of 3398 adult mosquitoes representing 21 species, collected by CAES scientists in Greenwich, Stamford and 12 other towns from September 9 to October 14, were assayed for viruses. An additional 41,622 mosquitoes, collected at 37 other sites across the state as part of the regular mosquito/virus surveillance program, were also tested. Tests on 1361 mosquitoes from Greenwich and Stamford yielded viral isolations from two mosquito species, *Culex pipiens* and *Aedes vexans*. The viral isolates were identified as SLEV. No isolates were made from mosquitoes trapped in the other towns. *Culex pipiens* is a common mosquito found in northern temperate regions around the world, where it feeds almost exclusively on birds. *Aedes vexans* has a broad distribution, not only in north temperate regions, but also in tropical Africa, Central America, and Southeast Asia, and feeds on bird and mammal species. The viral isolates in Connecticut were consistent with the propagation of a bird-to-bird cycle, with occasional spread of the virus to humans via the bites of *A. vexans*. But, if the virus was SLEV, why was it killing crows and other birds, when SLEV had not caused such mortality during past outbreaks?



From left to right, CAES scientists Charles Vossbrinck, Theodore G. Andreadis, and Station Director John Anderson (Photo: CAES)

Shortly after the Connecticut viral isolates were made, tissues from a dead bird at the Bronx Zoo that had been sent to the National Veterinary Services Laboratory in Ames, Iowa, were found infected with a virus. This isolate was sent to the CDC, where sera from New York City encephalitis patients were being tested against a wider array of viral antigens. When the test antigen pool was increased to include arboviruses not known to occur in North America, the antigen-antibody response to WNV was found to be much stronger and more specific than the test against SLEV, and the Bronx Zoo isolate was identified as a "West Nile-like virus."

On September 24, Andreadis was informed of the CDC finding. Following the initial reports that the New York outbreak was caused by SLEV, CAES had tested its isolates against EEE, SLE and other viruses, all known to occur in North America. SLEV, as part of a viral serocomplex that also includes WNV, Japanese encephalitis virus and others, cross-reacts serologically with WNV. Therefore, the early testing with a panel of viral antisera that lacked WNV antiserum necessarily resulted in the identification of the unknown agent as SLEV. Given the rapid global spread of infectious agents via human, animal and arthropod hosts, the CDC was too parochial in its selection of viral agents in its initial screening for identification of the New York virus.

Following the news that the virus was a WN-like agent, partial genomes of virus-

es isolated in Connecticut from *A. vexans*, *C. pipiens*, a crow, and the Cooper's hawk were analyzed by Dr. Charles Vossbrinck of CAES along with experts from CAES, YSM, and UConn. These isolates were closely related genetically to a strain of WNV isolated in Romania during an epidemic in 1996. Similarly, CDC compared genetic sequences of viruses isolated from a diversity of sources including: a Chilean flamingo that had died at the Bronx Zoo, dead crows, brain tissue from patients that had died in the New York outbreak, *Culex pipiens* collected in New York, and isolates from past outbreaks of WNV in Romania, Nigeria, and Israel.

Although there was a strong correlation between the New York isolates and a Romanian WNV strain, the New York isolates were most similar to a viral isolate from a goose that died in Israel during an outbreak there in 1998. CAES had not had the genetic sequence of the goose virus for comparison with their Connecticut isolates. Nonetheless, the serological testing of the Connecticut and New York isolates were consistent with an outbreak of WNV, characterized by mortality in birds and horses, and illness in humans, leading in some cases to death. The CDC noted that the 1998 Israeli outbreak was also associated with a high rate of avian mortality.

Over 40 species of mosquitoes have been found naturally-infected with WNV during past outbreaks. In 1998, Dr. Leonard E. Munstermann of the Yale School of Medicine collected mosquitoes in Hamden that were not identifiable as a Connecticut species. In 1999, Andreadis collected these mosquitoes in Hamden and several other towns and identified them as *Aedes japonicus*, a species known only from Asia. Although never found naturally-infected with WNV, the species is a very efficient vector that can transmit the virus from laboratory hosts that have much lower viral titers than required for transmission by either *C. pipiens* or *A. vexans*. The incidental finding of this efficient vector in Connecticut raises further questions about the epi-

(see *West Nile Virus*, page 4)

West Nile Virus (from page 3)

demology of WNV in New York and Connecticut.

No one knows how WNV got here. It had never been seen in North America before. No one knows how long the virus may have been circulating in populations of sparrows and other birds, because many birds show no disease or mortality when infected. Domestic and exotic birds destined for the Bronx Zoo are held in quarantine for evaluation, including viral screening. Legally or illegally imported birds or other animals, unintentionally imported infected mosquitoes or ticks, or traveling infected humans are all possible sources of the virus that reached New York. Infected mosquitoes stay infected for life, and are readily transported.

How the virus got here is not as important as what will happen now that it *is* here. Overwintering mechanisms of arboviruses are still largely unexplored. However, there is evidence that some overwinter in birds or mosquitoes. UConn's Antonio Garmendia isolated WNV from a red-tailed hawk that died on February 6, 2000 in Westchester County. In addition, CDC scientists found that overwintering adult *Culex pipiens*, collected in Queens, New York during January–February of this year were infected with the virus.

The question remains: Even if the virus is present in some birds and mosquitoes, will it spread to humans again? In other countries where WNV outbreaks have occurred, the disease has not recurred on a regular basis, but has appeared sporadically, causing fewer cases of encephalitis than during the initial appearance. Was there something unique about the summer of 1999 that led to the outbreak? It was an unusually dry summer. The drought conditions in New York and neighboring states caused marked lowering of water levels in lakes, ponds and reservoirs. Such a drop in water sources would appear inimical to survival of mosquitoes, but larvae of *Culex pipiens* can thrive in very small accumulations of stagnant and polluted water. It is possible, as suggested by Munstermann, that the lack of rain precluded the usual flush-

ing of water containers, storm drains and gullies that in other years may have caused a rapid turnover of these water deposits, preventing the long-term growth and reproduction of *C. pipiens*. CDC scientists, in cooperation with Romanian investigators, determined that from May to October, during the Romanian WNV outbreak in 1996, there was less precipitation than at any time during the previous 18 years. Similarly, dry summers have been associated with SLEV outbreaks.

Now that New York and Connecticut scientists know that WNV is here, what can citizens expect? Different scientists give different answers. Anderson has stated that "if established in North America, WN virus will continue to have severe effects on human health and on avian populations." CDC scientists state: "Because it cannot be predicted whether the WN virus will reappear in the year 2000 transmission season, all components of the public health system must be prepared..." Whether pessimistic or optimistic about the persistence of WNV, Connecticut and New York scientists are taking a proactive approach trying to identify WNV in birds and mosquitoes, enabling control of mosquitoes in "hot" areas, with the hope of preventing transmission of the virus to humans. Andreadis and Anderson have begun a mosquito surveillance program in 73 locations, including 24 towns from the New York border in Greenwich, east to Madison. Yale scientists Dr. Durland S. Fish and Munstermann are continuing a mosquito/viral surveillance program started in the fall of 1999 at the Bronx Zoo. Van Kruiningen and the state Department of Public Health are doing pathological studies and viral testing of birds found dead in Connecticut. The control strategies used in Connecticut and New York will depend on when and where the virus turns up, if it should recur in mosquitoes or birds.

State and federal funds have been allocated for these increased surveillance and control programs. The most efficient method of reducing mosquitoes is by treating or eliminating standing water in which mosquito larvae feed and grow.

West Nile Update

On July 21, state officials announced the first confirmation of West Nile Virus (WNV) in Connecticut this year. CAES scientists isolated the virus from mosquitoes collected in Stamford on July 11. The pool of mosquitoes that tested positive was *Culex restuans*, primarily a bird-biting mosquito. On the evening of July 25, the state DEP began low-level ground spraying in areas of Stamford, New Canaan and Darien using the pesticide Scourge. On July 26, officials in Boston confirmed the presence of West Nile Virus in a crow found dead in a city park, the first such confirmation in the state of Massachusetts. Five states—New York, New Jersey, Maryland, Connecticut and Massachusetts—have now reported positive isolations of the virus.

Many Connecticut towns are treating mosquito breeding sites with BTI (*Bacillus thuringiensis israeliensis*), a relatively specific and safe biological larvicide. Such treatment has generally been better accepted by the public.

What is the risk? Most people who become infected have subclinical infections. They do not develop disease and do not die. Elderly individuals and immunocompromised persons are most susceptible to developing the disease. Mortality rates of about 3-15% occur in these populations. In the 1999 outbreak, 62 human cases of WNV disease were identified in the New York metropolitan area; there were seven deaths, all in patients at least 75 years old. Antibody tests showed that only 2% of people exposed developed disease. No human cases occurred in Connecticut. Education of the public should emphasize that the chance of a person succumbing to the disease is minuscule. Nonetheless, public health education should encourage individuals, especially those in the most susceptible groups, to take precautions to prevent exposure to mosquitoes. The most effective means of control is to avoid being bitten by mosquitoes in the first place. Personal protection (including use of repellents, emptying of outdoor containers holding water, and awareness of the biting habits of mosquitoes) remains the best way to combat the disease.—**William L. Krinsky, Associate Clinical Professor of Epidemiology/Public Health, Yale University**



Communication

HEARING SHAPE. People can detect the shape of an object by the sound it makes when it's hit, say researchers at the **University of Connecticut (UConn)**. In a series of experiments, listeners were able not only to determine whether steel plates were square or oblong, but they were also able to estimate the plates' dimensions. Participants were also asked to distinguish between circular, triangular, and rectangular plates, and in each category, they could identify the objects at a level well above chance. Although much research has been done on aspects of hearing such as pitch and tone, says UConn psychologist **Michael Turvey**, research on how listeners hear events in the world is sparse. Turvey and **Andrew Kunkler-Peck**, also of UConn, authored "Hearing Shape," an article recently published in the *Journal of Experimental Psychology*.

WIRELESS. Folks living in **Orange, Connecticut** will likely be first in the state to have high-speed, wireless Internet access. Town officials have allowed California-based Metricom to use local utility poles as a site for devices that will allow residents to subscribe to wireless Internet access at rates of 128K (a typical dial-up connection is 56K). The service, which requires a special palm-sized modem, will provide Internet access to subscribers anywhere in the coverage area. It works even when subscribers are mobile, which means that municipal police and fire departments can use it.

UNDER THE SEA. Maybe we can't understand dolphin language just yet. But, according to **Meriden** native **Kathleen Dudzinski**, a scientist who studies these sea mammals, they communicate in much the same way humans do, with a combination of sounds, postures, and behavioral signals. In conjunction with colleagues, Dudzinski has developed a mobile video acoustic array that records dolphin behavior along with their noises. "The lab work is where you see the patterns emerge," she said. "You can play it over and over again. Then you go back in the wild and see it happening again." It can take her up to 16 hours to analyze each hour of recording. Dudzinski, a **University of Connecticut** graduate, was featured in a recent IMAX film.

SILENCING THE VOICES. Magnetic stimulation could ease the symptoms of schizophrenics who suffer from auditory hallucinations, according to research performed by **Yale** psychiatrist **Ralph Hoffman**. Fifty to 70% of schizophrenics hear imaginary voices, which are believed to be caused by the pathological activation of the neurocircuitry responsible for speech processing and perception. The treatment studied by Hoffman, transcranial magnetic stimulation (TMS), involves administering magnetic pulses at a rate of one per second for short intervals over a period of several days. The pulses are given via a handheld electromagnetic coil, which is held over a specific area of the brain. Early results are promising, according to Hoffman. Over the past two years, he says, 25 patients were treated with TMS, and 70 to 80% experienced improvement.



Education & Cognition

EARTH MOVES. There's a seismograph under the stairwell at **Rockville High School** in Vernon, and it's sensitive enough to detect an earthquake in Japan. This unusual piece of equipment is available to high school students thanks to the efforts of earth sciences teacher **Robert W. Sexton**, who requested the device as part of a program to bring more technology into the schools. Sexton, whose classroom also contains a weather satellite hookup that helps students track hurricanes, and a computer that displays weather data, believes that the live data makes learning more

esting. When an earthquake struck in Japan, Sexton used information from the seismograph to teach students about the waves produced by earthquakes.

MULTIPLE INTELLIGENCES. Construction has begun on a regional magnet school whose curriculum will be based on the idea of "multiple intelligences." This theory, developed by psychologist **Howard Gardner**, holds that people have at least seven kinds of intelligence. The idea suggests that children learn through visual, kinesthetic and musical intelligences, as well as through the verbal/linguistic and logical/mathematical intelligences traditionally fostered by teachers. The **University of Hartford Magnet School**, which is scheduled to open in the fall of 2001, will serve about 360 elementary school students from Hartford, Avon, Farmington, Simsbury, West Hartford, and Wethersfield. The new school will include a preschool, a health center, and a family resource center.

BRAIN FOOD. Mothers who eat large amounts of fish could have smarter babies, according to research done by **University of Connecticut** professor **Carol Lammi-Keefe**. Cold water fish, such as salmon and tuna, offer a good source of DHA (docosahexanoic acid), a fatty acid necessary for brain development in newborns and fetuses. Unfortunately, infants are unable to manufacture DHA; they obtain it primarily from their mothers until they are about two. Lammi-Keefe found that infants with higher amounts of DHA in their bodies have quieter sleep patterns than other babies. Quieter sleep patterns indicate a more mature central nervous system and brain, and have been correlated with a baby's motor and mental scores. Based on her findings, Lammi-Keefe recommends that pregnant and nursing mothers eat fish at least three times a week.

MEMORY LOSS. An experimental drug under study at **Yale** was able to improve short-term memory loss by stimulating D1 receptors in brain neurons to make them more active. With a D1 stimulator, ABT-431, **Stacy Castner**, of the **Yale School of Medicine**, and her team were able to reverse memory loss in six primates. The improvement has continued for more than a year after the final treatment, indicating that the brain circuitry involved has been permanently or semi-permanently changed. The research grew from past findings, which suggested that antipsychotic medications such as those used for schizophrenia could decrease the amount of D1 receptors in cortical neurons. However, short-term memory loss also results from aging and diseases such as Parkinson's. This study may eventually lead to new treatments for those who struggle with this problem. Other members of the Yale team included **Patricia Goldman-Rakic** and **Graham V. Williams**.

BRAIN DAMAGE. An anti-inflammatory medicine intended to treat arthritis also prevents brain damage in premature babies, according to a study led by Yale researchers. By the age of 8, only 31% of the children given the non-steroidal drug indomethacin needed special services, compared with 58% of those given a placebo. The drug diminishes intraventricular hemorrhage, or bleeding into the brain, a condition associated with later developmental problems, and it helps prevent brain atrophy. It also protects language systems, which are located in the temporal and sensory motor regions of the brain. "Almost all other studies of protective agents in the newborn period do not have long lasting effects," said Yale pediatric neurologist **Laura Ment**, the study's chief investigator. "This drug does, in fact, appear to protect the developing brain."

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 CASE at (860) 527-2161, write the editors at 179 Allyn St., Suite 512, Hartford, CT 06103-1422, or e-mail us at ctcase@tiac.net.



Energy

CENTRAL SAVINGS. A computerized energy management system recently installed at the **University of Connecticut** helps promote efficient energy use. The system allows facilities staff to monitor building temperatures from a central location; the employees can adjust temperatures as needed without bothering to travel to the outlying buildings. Other energy-saving measures included the installation of lighting controls at **Gampel Pavilion** and the upgrading of heating and cooling technology throughout the campus. These improvements are expected to result in lower operating costs and a reduction of 1.4 million kilowatt hours of electricity use per year.

ELECTRIC CAR. In the American Tour de Sol, an eight day rally of alternatively powered vehicles, a team of students from **Bolton High School** set a world record with their electric-powered Solar Bolt. The car, a converted Fiat, was able to travel an unmatched 164.53 miles on a single charge of its lead acid batteries. The Bolton team also took first place in the battery electric category, winning the most points for testing, vehicle reliability, energy efficiency, and presentation. Originally built in 1993, the Solar Bolt was modified by this year's team to improve aerodynamics and achieve better mileage. The students, who drove the car from New York City to Washington, DC, were able to average the equivalent of 65 miles per gallon of gasoline.

MARINE FUEL CELLS. **FuelCell Energy Inc.**, of Danbury, has been awarded a \$16.5 US Navy contract to build and test a fuel cell that can produce electricity for ships. The diesel-fired fuel cell is being adapted from technology developed by the company for its stationary power plants; it can produce 0.625 megawatts of electricity, which is enough power to light 625 US houses. The contract is part of a Navy program to develop 2.5 megawatt fuel-cell power plants.

BIG SWITCH. If summer heat makes the demand for electricity jump, a new 23,000-volt circuit should prevent power outages in the **East River** area of **Guilford** and **Madison**. The \$1.9 million Connecticut Power and Light upgrade can redistribute electrical loads with the new circuit, which will connect East River customers to a line that can be fed from two directions. If an outage occurs, power can be redirected automatically. This will allow CL&P to restore electricity to customers "in less than a minute," said company circuit zone manager **Harshad Sheth**. CL&P plans to spend about \$8 million this year to improve reliability throughout southeastern Connecticut, said a company spokeswoman.



Environment

FOREST SOIL. The mix of trees in the Northeast forests has changed repeatedly, in part because of harvesting, industrialization, and blights. With a \$350,000 Andrew W. Mellon Foundation grant, **University of Connecticut** ecology and evolutionary biology professor **Zoe Cardon** will study the ways these changes affect the forest soil. In one of a series of experiments, Cardon and her assistants will monitor the soil around oak and poplar saplings, measuring chemical changes that occur seasonally as well as during shorter growth cycles, and tracking how microbes respond to these fluctuations. In another, they will work with microbes that have been bioengineered to show when plants release sugars through their roots.

SITE CLEANUP. Cleaning up the contamination at an old textile mill in **Vernon** by traditional pump-and-treat methods might have cost between \$2.1 and \$3.3 million, and taken up to 30 years. But Vernon town officials have gotten conditional acceptance from the federal Environmental Protection Agency to restore the site using a

new process developed by researchers at the **University of Connecticut (UConn)** and **United Technologies Corp.** The procedure, which is currently being tested at sites in California and Indiana, requires injecting two oxidants, sodium persulfate and potassium permanganate into the contaminated ground. The chemicals react with the contaminants, breaking them down and rendering them harmless within just a few years, according to CASE member **George E. Hoag**, director of **UConn's Environmental Research Institute**, and one of the developers of the process. If successful, the process could be used at other locations.

FOREST FIRES. The state **Department of Environmental Protection (DEP)** has been setting fire to Connecticut's forests for nearly 10 years—and the results are encouraging, says **Emery Gluck**, of the DEP's forestry division. Prescribed burns are considered necessary to create healthier forests: certain plant species, explained Gluck, need disturbances like fire and hurricanes to thrive. But he notes that the DEP is also using this technique to create certain ecosystems. In **Nehantic State Forest**, in Lyme, for example, prescribed burns are being used to bring back the type of oak savanna that was common before European settlers arrived, and, elsewhere in the state, burning is being used to restore grasslands, and to control invasive exotic plants such as bittersweet.

DISTANT VISIONS. With state-of-the-art satellite imagery and a \$571,000 NASA grant, **Yale** researchers will study the impact of land use changes in the savannas and rainforests of west and central Africa. The scientists will use remote sensing technology to characterize and quantify such alterations as forest loss from logging and slash-and-burn agriculture, said principal investigator **Mark Ashton**, a professor at the **Yale School of Forestry and Environmental Studies**. The information will be used, in part, to build carbon sequestration models, which attempt to predict how much carbon is being lost from forest clearance, and can help decipher the effect of land use alterations on global climate change.

NEW FISHWAY. Alewives and herring from the Long Island Sound can now reach their natural spawning grounds on the Oyster River, thanks to a new fishway at **Chalker Mill Pond**, in **Old Saybrook**. Recently unveiled by the state **Department of Environmental Protection (DEP)**, the fishway provides passage over an existing dam. It was funded by a grant from the Long Island Sound Fund, which raises money through the sale of license plates. The fishway is a step toward the DEP's 10-year goal of restoring 100 miles of river habitat for anadromous fish, which live in the ocean, but must return to fresh water in order to spawn.



Food & Agriculture

BIOENGINEERED FISH. With a \$2.5 million grant from the state **Department of Agriculture**, CASE member **Thomas Chen**, director of the **Biotechnology Center** at the **University of Connecticut**, has begun a five-year project that will use gene transfer technology to develop improved breeds of trout. These commercially valuable fish have been difficult to raise on a large scale because they grow slowly, and because they are susceptible to attack by bacteria, viruses, and fungi. Chen hopes to achieve faster growth by building on previous research in which he used transgenic methods to enhance fish growth by 60 to 600%. He hopes to make the fish hardier in much the same way, by providing the trout with a silkworm gene that produces a peptide that kills pathogens. Chen hopes that results from the project can be applied to other fish species.

HARVESTING LIGHT. Plants can modify their own development in order to use light more efficiently—and scientists at **Yale** are figuring out how. According to a research team led by **Xing-Wang Deng**, a

professor in the Department of Molecular, Cell, and Developmental Biology, photoreceptors in seedlings send information about light signals to two protein components, which then regulate seedling development. Plants alter their growth, says Deng, depending on the direction, light-dark period, intensity, and the color of the light. "They don't necessarily grow faster or slower," said Deng. "They just grow in the best way possible to harvest whatever sunlight is provided to them." Farmers can use these findings to alter crops so that they can thrive in less favorable light conditions, or to improve plants grown in greenhouses in early spring, when light is less abundant.

GREENER GRASS. Research at the **University of Connecticut (UConn)** shows that leaving grass clippings on a lawn can reduce the need for fertilizer by 25 to 30%. According to **Stephen Olsen**, manager of UConn's **Research Farm**, the clippings serve as a slow-release fertilizer, in which nutrients return to the soil gradually, at a rate that grass roots can absorb. One advantage to this method is that fewer nutrients are lost to runoff. By comparison, commercial fertilizers, which are immediately available to roots, tend to be washed away if plants do not absorb them quickly. Fertilizer runoff can increase pollution.

GARDENING SKILLS. Thanks to a new partnership with the **New Haven Department of Parks, Recreation, and Trees**, agricultural students at the city's **Sound School** can use the local **Pardee Rose Garden** greenhouse to get hands-on experience in gardening skills. The youngsters participate in projects that include cultivating 10,000 flowering plants for transplantation to city streets as part of New Haven's beautification program. The high school students work in the greenhouse three times a week, as part of the school's requirement of 200 hours of supervised occupational experience.



Health

ARRHYTHMIAS. Although irregular heartbeats are often found in fetuses, these arrhythmias do not usually indicate any serious problem, according to a recent **Yale** study. **Joshua Copel**, an expert in high-risk pregnancies at the **Yale School of Medicine**, says that extra or skipped heartbeats were reported in about 14% of normal newborns. But, his work shows, "there is only a 1-2% chance of finding a problem in the rhythm of the heart that needs to be attended to before or after birth." The study, which looked at echocardiograms from 4,838 fetuses, is the largest review conducted of fetuses with heart rhythm irregularities.

COCAINE VACCINE. A recent **Yale** study found promising results for a cocaine vaccine undergoing preliminary trials. In a test that involved administration of the vaccine, TA-CD, to 34 former cocaine addicts, psychiatry professor **Thomas Kosten** and his team found that the medicine was safe, did not seem to produce major side effects, and did produce cocaine-specific antibodies. The antibodies bind to the cocaine, and prevent it from traveling to the brain. While the treatment does not eliminate the desire for the drug, it does block its effect. The vaccine would be used, said Kosten, in conjunction with behavioral therapy.

HEART CHECK FOR DIABETICS. Researchers at **Hartford Hospital** have found that a non-invasive test can accurately determine the risk of heart disease in diabetics. Led by **Gary V. Heller**, director of nuclear cardiology, a team examined the results for 929 diabetics who had undergone myocardial perfusion imaging (MPI) at Hartford Hospital and four other medical centers. The technique involves injecting patients with a small amount of radioactive substance, which allows doctors to scan the heart through the use of a special camera. Dark spots indicate blockages, where blood flow is weak. Currently, diabetics are checked for heart disease by catheterization,

an invasive procedure that involves having a tiny cable threaded through an artery from the groin to the heart.

DEHYDRATION TEST. Checking the color of urine against a chart created by **University of Connecticut** kinesiology professor **Larry Armstrong** provides a simple and inexpensive way to test for dehydration. The chart was created through a series of four studies that examined urine color and hydration status of 63 college students and athletes, and it can be used, says Armstrong, by hospitals, nursing homes, and those who work and exercise in extreme environments. The US Forest Service hopes to produce a pocket-size version for distribution to 20,000 wildland firefighters. "Heat stress injuries occur all the time and occasionally, so do fatalities. Anything we can do to keep firefighters aware of their hydration status is critical," said a Forest Service physiologist. Copies also will be included in a book on military medicine.

PAIN STUDY. The neuropeptide galanin increases the effects of morphine in the spine, at the same time decreasing its addictive qualities, according to a study recently done at **Yale**. These findings could have implications not only for the treatment of pain, but for the diet industry as well. "In the spinal cord, galanin makes morphine a better pain drug. It actually can increase its potency up to 10 times," said **Marina Picciotto**, an assistant professor at the **Yale School of Medicine**. But galanin also stimulates appetite, and many drug companies are looking at galanin blockers as appetite suppressants, said Picciotto. One implication of the study, she says, is that galanin blockers may increase the addictive nature of opiates in the brain.



High Technology

COMPUTER TELEPATHY. Patients at **Gaylord Hospital** in Wallingford can control computers using only their brainwaves, thanks to a device known as a **Cyberlink MindMouse**. The gadget uses sensors in a headband to detect electrical activity from the forehead and subtle facial muscle and eye movements. "You have to learn to control your brain waves to use it, but the waves are quantified on the computer screen, so you instantly know whether you have to intensify or quiet them," said **Brianna Murratti**, a Gaylord therapist. Gaylord is the only rehabilitative facility in the state that offers **MindMouse**, according to Murratti.

VIRAL CONTAINMENT. The West Nile virus isn't likely to escape from the laboratories at **The Connecticut Agricultural Experiment Station** in New Haven any time soon. The Station recently upgraded one of its laboratories to a level 3 safety rating, the same status as the animal disease lab on **Plum Island**. The Station already maintains negative air pressure to prevent microbes from leaving, and any air that does get out is passed through a high-efficiency filter. Improvements include adding a monitor to the filter, adding foot pedals to a sink so that researchers can wash without touching faucets, and installing alarms, locks, and signs. The level 3 lab will be able to receive shipped samples containing the virus, and it will be able to use research techniques that require secure containment.

HELICAL WIRES. Researchers at the **University of Connecticut (UConn)** have found a way to produce unusual spiral wires from manganese oxide, an inorganic material. "Most inorganic materials don't take this helical structure," said UConn chemistry professor **Steven Suib**, who reported the discovery. The wires, which are also excellent semiconductors, have many potential uses, for example, in computers, where researchers are vigorously seeking new types of conducting wires that can improve computing speed and storage density. The wires, which are produced by heating capillary tubes filled with a fluid colloidal solution, have other unusual qualities: they can alter their structure while preserving their shape, they're

porous, and they have excellent optical transparency. "There is nothing like this currently known," said Sulb.

LIE DETECTION. Whenever you speak, you produce not only sound, but also inaudible sound waves. In most people, the stress of lying alters the "shape," or frequency modulation, of that inaudible sound in a way that can be detected by machines, though not people. **Detective John Brunetti** of the **West Haven Police Department** is the first police officer in Connecticut to gain certification in computerized voice stress analysis, a new method of truth verification that relies on changes in the frequency modulation of sound waves. "One of the things most affected by stress is the vocal chords," explains Brunetti. The change shows up as a sharp spike on a computer screen.

MOLECULAR COMPUTERS. Yale electrical engineering professor and CASE member **Mark Reed** has co-founded a company that will create computing devices using a unique process in which computer circuits use chemical processes to assemble themselves out of individual molecules. Such molecular systems can be produced less expensively than conventional circuits and are expected to offer ultra-high capacity computer memories, as well as other capabilities. Reed has been involved in developing key components of the self-assembling devices, including on-off switches that consist of single molecules. Executives at the new company, **Molecular Electronics**, have said that they believe they have solved all the difficult research obstacles, and that they expect to create working models in 18 to 24 months. News of the company's formation surprised many in the industry, who believed commercialization of such devices to be five to ten years away.



Industry

NEW COATINGS. Researchers at the **University of Connecticut** and at **Inframat Corp.**, of North Haven, have developed super-durable coatings that can prevent wear on the moving parts of ships. The nanostructured alumina-titanium coatings possess unique structural features: they're made of particles that are 100 to 1,000 times smaller than those found in standard coatings. The extra fineness offers superior wear, impact, toughness and adhesive properties. The coatings, which are being developed under a \$4 million contract with the Office of Naval Research, are applied with a plasma spray flame that operates at temperatures hotter than 15,000 degrees Kelvin—more than three times the temperature of the sun.

WORKING PAPERS. A Yale study concluded that older workers who lose their jobs suffer increased physical disability and poorer mental health, compared to those who remain employed. The research was the first to focus on the health consequences of job loss in a broad cross-section of older workers. Yale professor **Elizabeth Bradley**, an investigator in the study, said the study contradicts a belief held by some that job loss is less significant to the elderly because they are nearing retirement. One reason job loss has such a significant effect on seniors may be that American workers accumulate a significant proportion of the capital that will finance their retirements in the decade that precedes it. That means that involuntary job loss during this period may have "a particularly devastating impact on economic well being and consequently on emotional and physical health," the researchers said.

POLLUTANTS DROP. Between 1988 and 1998, Connecticut manufacturers reduced by 84% the amount of toxic pollutants released into the environment, according to the federal Environmental Protection Agency. Nationally during that time, said the agency, that figure dropped only by 45%. At the Groton

research facilities of **Pfizer, Inc.**, for example, 5.8 million pounds of toxic pollutants were released into the environment in 1988. By 1998, that amount had fallen to 602,000 pounds. According to a Pfizer spokeswoman, the decrease was due to the company's shift from commodities to high-tech medicine. The company also installed a state-of-the-art water treatment plant that has cut the amount of pollutants released into the Thames River by 95%.

BANDWIDTH SOLUTION. **Sirocco Systems**, in Wallingford, which started in 1999, had 65 employees earlier in the year. By the end of the year, it hopes to have 200. The rapidly expanding company produces high-speed networking products that can help large telecommunications companies and smaller businesses send data across fiber-optic cables. The amount of data sent over the Internet is soaring, and many believe that, because fiber-optic cables carry so much more information than traditional copper wire, optical networking will be "the wave of the future," according to one consulting firm. Sirocco's recently released suite of products, which range in price from \$25,000 to about \$250,000, help companies make better use of existing fiber-optic networks, and extend fiber-optic connections into new areas.



Transportation

SAFETY FIRST. A refurbished **Department of Transportation (DOT) Traffic Command Center**, featuring 30 cameras set to scan the major state highways every three seconds, will help keep highway workers safe this summer. Control center employees use the cameras, which have zoom lenses and are mounted on 40-foot poles, to monitor traffic conditions; they use that information to issue the advisories on computerized "variable message boards" posted on roads throughout the state. Command center upgrades allow the center to dispatch messages to the boards within seconds, according to **Jim Mona**, of the DOT. The new Traffic Command Center is the first of its kind in the nation, according to consultant **Liz Sussman**.

ELECTRIC DRIVE. A revolutionary electric drive to power ships, now under development at **Electric Boat** in New London, "is arguably as significant [a change] as the Navy's transition from sail to steam power, or the advent of nuclear power," said Ronald O'Rourke, a military analyst with the Congressional Research Service. The new system is less expensive, more efficient, and less bulky than the one now in use. While current technology requires a long, rigid shaft and a complicated series of gears to turn the propeller that moves the ship forward, an electric drive uses only a flexible cable to send power from the generator to the motor. This saves space by eliminating the gears and allowing for a much shorter propeller shaft. An electric drive also provides enough extra power to run auxiliary equipment such as computers and electronic weapons; currently, ships must carry a second generator to operate these devices. The Navy plans to put an electric system into its new class of destroyers, the DD-21, which is scheduled to go into production in 2004.

BRADLEY EXPANSION **Bradley International Airport** is expected to have its biggest growth spurt ever this year, with passenger usage increasing by 22%, according to the **Louis Berger Group**, a consultant hired by the state **Department of Transportation**. The increase is due to the low-fare airline Southwest, which, in addition to bringing in new passengers, has forced other airlines to meet its prices, bringing down fares to many destinations. A record 6.3 million passengers used Bradley in 1999; this year, the Berger Group predicts, that number will leap to 7,724,000, with over 12 million passengers expected by 2030.

— *Compiled and Edited by Karen Miller*

CONFERENCE FOCUSES ON TECHNOLOGY IN THE CLASSROOM

New educational technologies could dramatically increase the skills of Connecticut's students, according to speakers at a CASE-sponsored conference on "The Impact of Computers and Technology on Learning." However, participants cautioned, in order to take advantage of this opportunity, Connecticut schools must provide youngsters with access to state-of-the-art computers and software, and teachers must be offered the training and technical support they need to use these tools effectively.

The June 7 conference was also sponsored by the Connecticut Technology Council and the Connecticut Capitol Region Growth Council. It took place at the Connecticut Exposition Center.

CASE president Dr. John Cagnetta and Kevin B. Sullivan, President Pro Tempore of the State Senate offered welcoming remarks. Conference speakers included Dr. Ray Perez, Director of K-12 Education in the Office of the Secretary of Defense, Dr. Richard Schwab, Dean of the Neag School of Education at the University of Connecticut, Clark Aldrich, research director at the Gartner Group in Stamford, Janice Gruendel, Executive Director of Connecticut Voices for Children, and Riberia Jones, Program Manager for the MetroHartford Millennium Project. Laura Kent, President of the Connecticut Technology Council, moderated the discussion panel.

Conference participants agreed that new technologies, including simulators, intelligent tutoring systems, and higher-order learning software, have the potential to powerfully transform the way students learn. They cited studies showing that these new methods can dramatically improve student performance: one 1994 meta-analysis of 300 studies found that students using computer-based instruction learned more quickly, and scored higher on achievement tests.

Technology-based learning, said Perez, is approaching the 'Holy Grail' effectiveness of one-to-one tutoring, which can raise the average student's test results from the 50th to the 98th percentile. Studies also show that students in technology-rich environments enjoy their studies more, developing more positive attitudes toward learning, according to research cited by Gruendel.

The new technologies, emphasized the speakers, allow students to learn in entirely new ways. Computers can be used simply for drills and applications like word processing, which mimic tasks that can be done with ink-and-paper—and, in fact, teachers report that these applications comprise the bulk of classroom assignments. But the new technologies also allow for entirely new curricula which lead youngsters to explore and develop the kind of reasoning skills that are in high demand.

Dean Schwab, for example, reported on a series of programs that he regards as paradigms of the opportunities that educational technologies provide. In one program, high schoolers in Casper, Wyoming, near Yellowstone National Park, developed a partnership with medical schools in Illinois, Georgia, and Mississippi. As part of a study of the disease *Brucellosis*, the children dissected buffalo, and sent the information to the medical schools. Work done at the high school led to changes in state laws—and the students helped write the new legislation.

Youngsters need, both for their own future and for the future of the economy as a whole, two competencies. They need the

skills that come from having a high comfort level with the technology itself, and they need the ability to perform the higher-order thinking that the new technologies can help them learn.

For the children, information technology skills mean brighter futures and better jobs. For the economy as whole, it provides a source of continued prosperity. Information technology accounted for one-third of the country's total real growth between 1994 and 1998, said Gruendel, and its importance continues to grow.

Companies, said Clark Aldrich, of the Gartner Group, want to hire e-learners—employees who are comfortable learning via technology. Increasingly, he says, companies are turning to techniques like virtual classrooms and Learning Management Systems, which assess the automated learning process.

Yet, despite the critical importance of placing information technology in the classroom, Connecticut, the speakers agreed, has lagged seriously behind other states. While Connecticut ranks fifth among states in measures of the new economy, it tumbles to forty-second when it comes to providing its youngsters with the technology-rich environment they need.

One obstacle is financing. While 98% of Connecticut school districts have a plan to put technology into the schools, 78% report that their plans are not funded, reported Gruendel. Despite this gap, technology funding as a proportion of school budget has not increased in most of the state's school districts. Half of the school districts have no hardware replacement policy, and teacher access to tech support is meager.

Just as critical is the need for teacher training. Most teachers do not yet feel comfortable with these new technologies, and they are not yet sure how to use them to their best advantage. According to Perez, only one-third of teachers support the new technology, while another third oppose it. Training, he says, is the key to converting these teachers. Gruendel cited research showing that even teachers who do use technology in the classroom often fail to take advantage of its full potential. Only 17% of those that use technology assign students work that fosters higher order skills.

Even though the state has a long way to go, it is moving in the right direction, said Sullivan, noting that the past legislative session was unparalleled in its interest in education technology. He cited increases in the state's most recent budget that provide "substantial new funding" for hardware, software, and teacher training. Funding will also be provided for a new digital library that allows all school districts to make use of previously inaccessible databases. Technology, he says, has historically been key to Connecticut's identity, a link, he believes, that continues today. "The challenge, whether in education or in the economy, is how to find that new social paradigm that can assure us that we become something more than the sum of our bytes," he said.

The explosion of technology, said Dr. Gruendel, has created a "sea change." We must, she said, convey to the public that this is a different world than the one they grew up in. And, she points out, we can't go back. Connecticut, says Gruendel, can't afford not to invest in its schools, and in technology.—*Karen Miller, science writer.*

Laboratory Safety (from page 1)

goal: university-wide compliance with safe practices and safety regulations. However, Environmental Health and Safety (EHS) administrators at the state's three major research institutions—Yale University, the University of Connecticut (UConn) at Storrs, and the UConn Health Center at Farmington—all agree that government regulation of hazardous waste has tightened in the last several years, as rules that were originally written for industry have been rigorously imposed on the academic community. Storrs and Yale are particularly sensitive to this change, as they received hefty fines in 1994 after unannounced inspections by the state Department of Environmental Protection (DEP) and the Environmental Protection Agency (EPA), respectively. As a result, the EHS Offices have needed to find ways to encourage compliance with the regulations and to handle a much greater burden of in-house inspections.

Partially as a result, laboratory safety has become big business. Yale, Storrs, and Farmington have research safety budgets of \$4 million, \$1.5 million, and \$900,000, respectively. Although the safety offices at all three universities are currently organized so that separate staffs, such as Radiation Safety and Chemical Safety, handle the different safety concerns, the offices at Storrs and Yale have expanded considerably, and Yale is completely restructuring its approach to lab safety.

At Storrs, which once relied on student employees, the new staff includes more specialists dedicated to inspections. Says EHS Director Frank Labato, "Part of our reorganization was to eliminate undergraduate student employees and promote continuity. We've hired a full-time lab inspector—a year ago we had a part-time graduate student doing that job." Five other safety positions were filled this spring, and the full-time staff now numbers about 18. Labato and Stefan Wawzyniecki, the Chemical Health and Safety Manager, feel that their team is—and appears—more professional now, and is in a good position to provide better service. "The University looks at us as the buffer with the EPA and other government agencies," says Labato.

Yale is planning even bigger changes. Its large EHS office of about 40 employees will be completely reorganized, according to its director, Dr. Elan Gandsman. "The traditional situation," he says, "is not the most suitable to help [research scientists] meet compliance." Under the current system, the component branches of EHS independently conduct laboratory training and inspection, which results in "a whole series of audits which cause a big disturbance to labs," he says. Furthermore, because "different [EHS staff members] have snapshots of what is happening in a laboratory" it can be hard to have a handle on the whole situation. From the perspective of the researchers, adds Gandsman, it can be frustrating to have to figure out whom to call with questions about safety.

To resolve these problems, Gandsman is importing an organizational plan that is already in place at Rutgers, where he worked previously, and that is also used in Great Britain. Under the new plan, says Gandsman, the Yale campus "will be divided into regional areas, and a safety advisor will be assigned to each area to provide all of the services" for every lab in the area. The safety advisors will function as "generalists" and "will be the only contact person for the EHS office," says Gandsman. "This will create a much better interface between the PI [the principal investigator who heads a research laboratory] and this office, and also provides personal service. I expect the safety advisors to spend 70% of their time in the field and become part of laboratory activities."

Services provided by the new safety advisors will include checking compliance, helping PIs to complete forms, identifying people who need training, and providing on-site training when necessary. Gandsman acknowledges that "cross-training [of the safety advisors] is an enormous investment and will go on for years." But he adds that the reorganization plan "has been accepted by the administration and accepted in principal by Human Resources." He hopes to have the new system operating by July 1. "At the end of the process," says Gandsman, "I think

we will have a much more efficient department."

The offices at Farmington are smaller, with a total of 11 full-time employees in the Office of Radiation Safety and Environmental Health and Safety—the two staffs that work in the Research Safety Office. This small workforce handles all of the occupational exposure safety issues for the entire research and clinical community at the Health Center. To complement their small staff, says William Pickett, Director of Research Safety, they work in close cooperation with other departments, including Facilities Management and the Fire and Police Departments, who provide around-the-clock support for emergencies.

A Culture of Service

The reorganizations at Yale and Storrs seem to reflect a general "change in the culture of safety," as Gandsman puts it. At all three universities, the Safety Officers interviewed describe their work as a service and see themselves as helping the scientists they serve, not as enforcers. Storrs' Wawzyniecki describes safety officers as "on-site consultants," adding, "my approach is not heavy handed. You'd much rather see me coming into your laboratory than the actual EPA." Tom Ouimet, Project Management Officer at the EHS Office at Yale, agrees, "We never want to be enforcers, because then they won't call you when they need you." On the contrary, the Safety Officers express considerable sympathy with investigators, "They see training as a disruption," says Ouimet, "Our job is to provide the training researchers need to stay in compliance without being overly burdensome." William Pickett concurs, and feels that they have won the battle of perception at Farmington, "We are seen here as support and services to the investigator."

Although they speak softly, the safety offices carry a big stick. "We have the clear written authority from the provost [to close down laboratories] if we perceive immediate danger," says Gandsman. And, in the past, laboratories have been "closed down" (that is, their right to use radioactive compounds

revoked) for up to two years for failure to comply with radiation safety regulations. Gandsman even recalls one instance where someone who repeatedly violated biosafety standards was forced to leave the University. Indeed, notes Ken Price, Director of the Office of Radiation Safety at Farmington, "you cannot run an effective safety office without strong institutional support." Nonetheless, in the collegial climate being fostered by all of the Safety Offices, the stick has been put aside as much as possible in favor of carrots. Everyone interviewed indicated that they were able to resolve almost all safety issues through discussions alone. One "carrot" that every office mentioned was that none of the services provided by the Safety Offices, from training to waste disposal to the calibration of radioactivity monitors, is charged directly to the labs. "If you don't charge [the researchers]," says Gandsman, "they don't have an incentive to do things they shouldn't."

Innovations in Safety

In their quest to serve the research community most effectively, the safety offices are actively engaged in developing innovative ways to train individuals, communicate information, and support efforts at compliance.

At Yale, Tom Ouimet is pioneering the use of on-line training vehicles for laboratory safety. Ouimet feels that "we have to improve our ability to train and provide tools to do it the right way." He notes that his office does safety training for three entirely different populations: laboratory researchers, service and maintenance workers, and administration and office personnel. "These different populations require different services," he says. "Service and maintenance are best trained through live training," and administrative personnel already have ergonomic training available, but "lab folks really like training that is delivered to them in an on-line format."

In 1995, Ouimet spearheaded a collaboration between the EHS office and Yale's Center for Advanced Instructional Media, which, according to Ouimet, "has been working on on-line training for physicians since the 1980's." Together they have developed on-line

courses in bloodborne pathogens, laboratory chemical safety, and laboratory chemical hazardous waste management. As a learning tool, says Ouimet, these courses work very well, "People do at least as well if not better on internet as on live training." Ouimet is also working on making "safety shorts," brief videos that will demonstrate specific safe laboratory techniques, like "how to use a fume hood." "Video is most useful for demonstrating behavior," says Ouimet. He and his collaborators are currently working out the technology to stream the videos over the internet so they can be viewed as needed by laboratory personnel. Ouimet notes that the development of on-line courses is very expensive, because of the cost of good programmers, but as a pioneer in the field, Yale is in a position to market some of its courses to other universities. Says Ouimet, "we are hoping to generate money to put back into the development [of these tools]."

Farmington has also developed one on-line course, which has been very well received, according to William Pickett, who foresees increased reliance on on-line training in the future.

At Storrs, Labato and Wawzyniecki have focused on on-line and high-tech solutions to information management. Wawzyniecki has developed a useful web site as an information source (<http://www.ehs.uconn.edu/index.html>). As an example, in response to a tragic incident at Dartmouth where a senior scientist died because her gloves were permeable to a small drop of a toxic compound, Wawzyniecki created a web page with information about different types of gloves and their appropriate use. Also on his site are brief summaries of policies, hazardous waste disposal procedures, and a how-to page called "Surviving an OSHA/EPA/DEP Inspection."

To make laboratory inspections efficient and unintrusive, Wawzyniecki uses a hand-held barcode reader. Every lab is bar-coded and the bar-code reader has an interface where he can mark off items on a compliance checklist. "I just read the bar code on the lab door, run through the checklist, and download the data for each lab into the computer back

in the office" says Wawzyniecki. The investigators receive a written report about how their lab did in the inspection and can make the necessary corrections.

Changes in Hazardous Waste Regulations

One source of frustration for the EHS offices has been the EPA's reinterpretation of its regulations as they apply to academic settings. Before 1994, according to Gandsman, the waste "generator" was considered to be Yale, and the DEP confined its inspection to the EHS waste facility, which was kept in compliance with state requirements. The 1994 change defined the waste "generator" as the individual investigator, which meant that as an investigator generated waste, the investigator had to store it in the laboratory in accordance with EPA regulations. According to UConn's Wawzyniecki, this means that hazardous wastes must be stored in closed bottles, clearly labeled "Hazardous Waste" with the full name of the chemical spelled out—no abbreviations allowed. If a bottle is labeled "Waste" but someone forgets to write "Hazardous," that is a violation, and merits a fine. If a scientist writes HCl instead of "hydrochloric acid" another fine is added. If a scientist has left a funnel in the bottle so that more waste can be conveniently added to it, instead of capping the bottle, that merits a third fine. According to Gandsman, "these fines can add up to \$1000 per bottle." With 10-15 bottles of waste in an average laboratory, and hundreds of laboratories on campus, it is easy to see how the fines could quickly add up and why compliance is so important to the university. However, even the safety officers feel that "there is not a lot of overlap between the regulations and health and safety risks," as Tom Ouimet puts it. Nonetheless, as Ouimet and others hasten to add, while they may share researchers' dissatisfaction with the regulations, they are still required to enforce them.

One way the EHS offices and their universities have approached this problem is to open discussions with the EPA about the possibility of changing the regulations so that they better reflect the circumstances of the universities. According to Wawzyniecki, "Ten years ago OSHA

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promulgated laboratory standards" that were different from industry standards, setting a precedent that the EPA could follow. Although "the EPA was unrelenting" at first, says Frank Labato, the talks have begun to move forward. Says Yale's Tom Ouimet, "The EPA is starting to understand. The fact that dialogues are continuing is a good thing. They have committed to producing a document summarizing the regulations and describing how they apply to a university setting. They need to acknowledge that labs are different and require their own set of regulations."

If hazardous waste regulations are in flux, Radiation Safety is an area where the application and enforcement of government regulations has become routine. The Nuclear Regulatory Commission (NRC) licenses the use of radioactivity at universities and requires adherence to the provisions of the licenses. Each university negotiates its license separately, so the details of the way radioactivity use is managed differ a bit from place to place. Nonetheless, its use is always tightly enforced. For example, because researchers cannot order radioactive compounds directly, but must order them through the Office of Radiation Safety, it is easy for Radiation Safety to identify investigators using radioactivity, and to insist on appropriate training. In addition, laboratories are routinely monitored for contamination, which helps in quickly discovering problems where additional training or compliance enforcement need to be addressed. Ken Price estimates that there is better than 99% compliance with radiation safety training at Farmington.

Safety Ultimately Lies with the Individual

Even when the procedures for following safety regulations are well-established, safety officers worry about compliance. Despite their resourcefulness and strong commitment to safety, almost everyone interviewed expressed some concern that achieving compliance was ultimately out of their hands. As Farmington's Bill Pickett puts it, "the scary thing is, it's not just us: it takes an institution and all the individuals within it [to maintain compliance and a safe environment]—the weakest link is always one individual." —*Grace E. Gray, science writer*



**CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING
179 ALLYN STREET • HARTFORD, CT 06103**

From the Academy (from page 2)

- There are many pollutants introduced into the air of schools, but studies in Connecticut and other states show that the most important indoor-generated contaminants are biological in nature (molds, spores and bacteria). Such materials produce allergic responses and often affect the immune system. They are usually produced by wet indoor surfaces, the most common causes of which are leaky roofs on schools.
- There are no legally enforceable standards for indoor air quality similar to outdoor air quality standards. But engineering standards are available that specify the quantities of fresh air ventilation necessary to achieve good indoor air quality. However, cost constraints in school districts often preclude the application of the engineering and equipment necessary to meet these standards.
- While several agencies in the state are concerned about indoor air quality in schools and make evaluations of certain aspects of these problems, there is no formal organization in Connecticut with the overall responsibility for indoor air quality issues. However, an *ad hoc* group with representation from the agencies mentioned above has been formed in an attempt to coordinate indoor air quality activities. The primary role of this group in addressing problems in schools is to encourage the use of EPA's "Tools for Schools", an excellent self help guide for achieving good indoor air quality in schools.
- Except for some funding made available to a limited number of school districts, Connecticut laws permit state grant reimbursement only for code corrections, new construction, or for new features added to existing facilities. Costs for repair and maintenance of existing facilities are not eligible for reimbursement at this time.

The CASE Committee recommended that the General Assembly establish a formal organization to improve and coordinate all of the indoor quality activities currently being carried out by a number of State agencies and provide the funding necessary to establish and maintain an effective program. The report provides a list of the responsibilities for this organization. The Committee also recommended that the General Assembly empower and provide funding to the Department of Education to make indoor air quality improvements and provide maintenance in both new and existing schools. —*John Yocom, Chair*

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