

Bulletin of the

CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING



1976

Volume 25,3 / Fall 2010

Connecticut's Laser Industry: A Proud Past, A Brilliant Future

In a high-bay facility of the Laser Applications Laboratory (LAL), an initiative of the CT Center for Advanced Technology (CCAT) located in East Hartford, Bobby Wright, a Laser Researcher for CCAT, is drilling a hole into a section of an engine turbine blade made of nickel, but he isn't using a drill bit in the conventional sense. He is using pulses of high energy light produced by a Nd:YAG laser, and with each loud "pop" of the laser, a bit of the nickel is vaporized at the focus point of the beam. Each pulse lasts less than a millisecond but reaches a peak power of 25 kW; the hole, one of more than 1.5 million per engine, is drilled in a matter of seconds. Connecticut's reputation for precision manufacturing is now focused on lasers.



*Ceramic scribing with a Coherent Diamond K250
CO₂ Laser. [Photo courtesy of Coherent]*

Early History of the Laser

What made this fantastic technology possible? Many agree that it started with the submission of a manuscript by Charles Townes and Arthur Schawlow, then at Bell Labs, to the journal *Physical Review* in 1958 describing their theoretical calculations of a concept originally termed an optical "maser." At about the same time at Columbia University, graduate student Gordon Gould was working on a doctoral thesis involving measurement of the energy levels of thallium atoms excited to higher energy states by "pumping" with suitable light. His laboratory notebook contained the phrase, "Some rough calculations on the feasibility of laser light amplification by stimulated emission of radiation," the first known use of the acronym "LASER." Gould filed for and was denied a patent in 1959—the patent instead went to Bell Labs in 1960 and sparked a twenty-eight year lawsuit on the part of Gould which was not resolved until 1987, when Gould finally was awarded a patent for an optically pumped laser. However, the

(See Lasers, page 2)

The Eli Whitney Museum: A Learning Experience

Many remember Eli Whitney as an inventor or a manufacturer. He thought of himself as an educator. His workshop was a laboratory. His workers—trained in the practical art of learning by experiment—launched the Industrial Revolution in America.

The Eli Whitney Museum is a workshop for experimental learning in that tradition. The museum designs, produces and teaches projects through laboratory experiences, which complement state science and math elementary school standards. This year, the museum has designed and produced 60 different projects that it will teach to 48,000 students.

Where do the ideas come from? Some are derived from the standard curricula for electricity, force and motion, or earth science. Many are proposed by teachers. An English scientist named Neil Downie published three volumes entitled *Saturday Science Projects*, for college students or

(See Eli Whitney, page 7)

News from the National Academies

The following is excerpted from press releases and other news reports from the National Academies (www.national-academies.org).

◆ New Reports Contain Calls to Action on Climate Change

NRC Report Urges National Response 'Informed by Reliable Data'

A comprehensive national response to climate change should be informed by reliable data coordinated through climate services and a greenhouse gas monitoring and management system to provide timely information tailored to decision makers at all levels, says a report by the National Research Council. The report recommends several mechanisms for improving communication about climate science and responses and calls for a systematic framework for making and evaluating decisions about how to effectively manage the risks posed by climate change.

Although the report does not specify a particular agency to lead federal efforts, it emphasizes the importance of coordination across the federal government and with state, local and private sector decision makers. The report is part of a congressionally requested suite of studies known as *America's Climate Choices*, which also includes three other recently released reports. A report to be released later this year will build on all four reports and other materials to offer a scientific framework for shaping the policy choices underlying the nation's efforts to confront climate change.

[\[http://americasclimatechoices.org\]](http://americasclimatechoices.org)

Today's CO₂ Emissions Choices Will Impact Climate for Centuries to Come

Choices made now about carbon dioxide emissions reductions will affect climate change impacts experienced not just over the next few decades but also in coming centuries and millennia, says a new report from the National Research Council. Because CO₂ in the atmosphere is long

(See National Academies, page 7)

controversy over who actually invented the laser continues to this day. It should be noted that Bell Labs made significant contributions to laser technology throughout its early history.

Still, no one had a working model of a laser until 1960, when Theodore H. Maiman constructed the first functioning laser at Hughes Research Laboratories in California. Maiman's first laser, using ruby as the lasing medium, did not produce a continuous beam of visible laser light—in fact, there was no bright output beam. But in a paper published in the journal *Nature* later that year, Maiman showed that the spectrum of emitted light was characterized by a marked narrowing of the range of frequencies contained within. Maiman used a pulsed light source lasting only a few milliseconds as the “pump,” therefore only a short pulse of emitted light was generated by the laser rather than a continuous wave. Because a substantial amount of energy was released in a short period of time, much more power was produced by the laser than was predicted by theory for a continuous output wave. The first continuous operation of a laser was achieved at Bell Labs in 1961.

Our Thanks to Academy Sponsors

The Academy wishes to express its sincere thanks to its sponsors, whose support makes the important work of the Academy, including this publication, possible.

◆ Leading Patrons ◆

The Connecticut Light and Power Company

The Connecticut Academy of Science and Engineering

The purpose of the Academy is to “provide guidance to the people and the government of the State of Connecticut ... in the application of science and engineering to the economic and social welfare.”

OFFICERS OF THE ACADEMY

Gale F. Hoffnagle, President
TRC Environmental Corporation, Inc

Louis Manzione, Vice President/President Elect
University of Hartford

Sandra K. Weller, Secretary
University of Connecticut Health Center

Frederick J. Leonberger, Treasurer
JDS Uniphase Corporation (ret.)

EXECUTIVE DIRECTOR
Richard H. Strauss

ASSISTANT DIRECTOR FOR PROGRAMS
Ann G. Bertini

EDITORS
Phillip Gardner, Executive Editor - Engineering
Coherent, Inc. (ret.)

Edward Monahan, Executive Editor - Science
Director, Connecticut Sea Grant College Program (ret.)
Professor emeritus, Marine Sciences & Resource Economics
University of Connecticut

MANAGING EDITOR
Martha Sherman

The *BULLETIN* of the Connecticut Academy of Science and Engineering is published by the Connecticut Academy of Science and Engineering, Inc., 179 Allyn Street, Suite 512, Hartford, CT 06103-1422. Telephone and fax: (860) 527-2161. E-mail: acad@ctcase.org. Web site: www.ctcase.org. To subscribe to the Bulletin, contact us by phone or email or subscribe on our web site. The Connecticut Academy of Science and Engineering is a private, nonprofit public-service organization established by Special Act No. 76-53 of the Connecticut General Assembly.

COPYING PERMITTED, WITH ATTRIBUTION

Lasers and Einstein

Light emitted from a laser has the properties of being monochromatic (light of a single wavelength or a very narrow spectral range), coherent (individual waves of light are in phase, i.e., moving together through space with coinciding peaks and valleys) and often is highly collimated (individual beams are parallel, able to travel long distances with little divergence). Laser light is produced by exciting or “pumping” the electrons in an atom or molecule from their ground state to an excited state. When one of these energetic electrons spontaneously returns to the ground state, a photon of light is produced. When the pumping rate is sufficiently high, the number of excited electrons exceeds the number of ground-state electrons and a so called “population inversion” occurs. Also, an excited atom may be induced by an emitted photon to produce a photon of light of equal frequency and phase to the first, and the two resulting photons are termed coherent in the phenomenon of stimulated radiation first described by Albert Einstein in 1917. It is this work by Einstein, along with his earlier description of the photoelectric effect, which laid the foundation for the advent of lasers.

Some of the coherent photons produced by pumping the lasing medium will move in a direction parallel to the axis of the lasing container, and will bounce back and forth between a reflective and a partially reflective surface, stimulating other atoms to produce photons with each trip in a process described as optical amplification. What eventually escapes through the partially-reflective mirror is coherent, monochromatic, collimated laser light now used in hundreds of applications.

The Connecticut Laser Story

If Einstein is the grandfather and Townes, Schawlow, Gould and Maiman the fathers of the laser revolution, then Anthony DeMaria is the great uncle of the Connecticut branch of the family. DeMaria, a former CASE president and currently Chief Scientist with Coherent in Bloomfield, worked from 1958–1994 at the United Technologies Research Center. While at UTRC, he conducted “pioneering research in picosecond [10^{-12} second] laser pulse physics which profoundly influenced the study of molecular and atomic dynamics, non-linear optics, and plasma physics” (National Academy of Sciences citation). He is also a member of LaserFest, an international commemoration of the 50th anniversary of the demonstration of laser technology.

When asked to describe the atmosphere within the engineering and scientific community in the post-Sputnik era as it related to the development of the laser, DeMaria replied, “It was an exciting time. As soon as Maiman demonstrated a working ruby laser, industry took the lead in its development and it was a time when industrial labs were flush with money.”

There are literally dozens of companies in Connecticut devoted to lasers, including JDS-Uniphase, TRUMPF, Inc. (a major international player), applications specialist Lasercut Technologies, and instrument repair provider Evergreen Laser Corp. Martin Seifert is president of Nufern in East Granby, which among other activities designs and manufactures fiber laser systems. “Laser technology is at the edge of science, with new problems being solved every day.”

Elliot Ginsberg, president & CEO of CCAT, says, “Lasers are used in every aspect of manufacturing: precision cutting, welding, marking (where the entire manufacturing history of a work piece can be etched onto its surface in an area no larger than a dime), drilling, and measurement are all done with lasers. Lasers are revolutionary and evolutionary.”

JDS-Uniphase, located in Bloomfield, is a leading provider of high speed optical modulators used with laser diodes for the fiber optic telecommunications industry. CASE member Fred Leonberger was

(See *Lasers*, page 8)

IN BRIEF

Science and Engineering Notes from Around Connecticut



Biomedical Research

CANCER'S 'ADDICTION' SPURS NEW TREATMENT HOPES. Yale researchers show (*Nature*, online Aug. 8) that cancer, in a mouse model system, can become dependent upon a tiny gene that allows the tumor to adapt and proliferate. Researchers looked specifically at the action of a particular microRNA, one of a class of small RNAs that has been shown to regulate the expression of genes. In laboratory tests, the microRNA called miR-21 has been found to be highly expressed in nearly every form of cancer tested. However, its effect on tumor growth in living organisms had not been determined. The study found that mice bred to overexpress miR-21 developed a form of lymphoma. However, when the gene was inactivated in the mice, tumors completely regressed within days.

NEWS IN STEM CELL FUNDING. A US District court judge in Washington issued a preliminary injunction on Aug. 23 prohibiting use of federal funds for research involving human embryonic stem cells. Repercussions for federally-funded Connecticut researchers are not clear but the ruling may have major impacts, according to CASE member **Laura Grabel**, a professor and researcher at **Wesleyan University**. Connecticut researchers await guidance from the US Department of Justice and the National Institutes of Health. The injunction will not affect \$10 million in state grants recently awarded to 22 stem cell research projects at **Yale University** and the **University of Connecticut**, spanning areas such as Huntington's disease, leukemia, Parkinson's disease and osteoarthritis. Obama administration officials say they will appeal the injunction.

ENDOMETRIAL STEM CELLS COULD REPAIR PARKINSON'S DAMAGE. Stem cells derived from the endometrium (uterine lining) and transplanted into the brains of laboratory mice with Parkinson's disease appear to restore functioning of brain cells damaged by the disease, according to a **Yale School of Medicine** study (*Journal of Cellular and Molecular Medicine*, online Apr. 7). The preliminary findings increase the likelihood that endometrial tissue could be harvested from women with Parkinson's disease and used to re-grow brain areas that have been damaged by the disease, according to lead author **Hugh S. Taylor**, professor in the Department of Obstetrics, Gynecology & Reproductive Sciences at Yale.

MIRADX OVARIAN CANCER GENETIC MARKER TEST. **MiraDx Inc.**, of New Haven has launched its PreOvar test, which screens women for the KRAS-variant, a genetic marker associated with ovarian cancer risk. Using microRNA (miRNA) discoveries licensed from **Yale University**, MiraDx works to develop gene-based laboratory tests that will provide individualized information on the likelihood of disease occurrence and response to certain types of therapy. **Connecticut Innovations**, the state's quasi-public technology investment arm, invested \$1 million—part of \$4 million involving individual investors—in MiraDx.

DRUG COMPANIES SHARE ALZHEIMER'S DATA. A dozen competing drug companies—including **Pfizer Inc.**, with research operations in Groton—have agreed to share data on thousands of Alzheimer's patients in the hope of sparking new ideas for treatments. Called the Coalition Against Major Diseases, the collaboration is led by the Critical Path Institute, a nonprofit partnership with the FDA that aims to speed discovery of new drugs. The Alzheimer's

database covers more than 4,000 patients. It is also available to brain researchers not affiliated with drug companies and eventually will address other neurodegenerative diseases.



Business & Industry

ROTHBERG A 3RD TIME TECH PIONEER. CASE member and 2010 Connecticut Medal of Technology winner **Jonathan M. Rothberg** is the only person to have three companies that he founded earn the distinction of Technology Pioneer from the World Economic Forum. Rothberg's company **Ion Torrent** of Guilford was named among 31 Technology Pioneers for 2011 by the Geneva, Switzerland-based organization. Two other companies Rothberg founded, **RainDance Technologies** and **454 Life Sciences**, also earned the distinction. Through Ion Torrent, Rothberg has revolutionized DNA sequencing, enabling a direct connection between chemical and digital information on a semi-conductor chip.

CT INNOVATIONS, BIOMED NEWS. California therapeutics giant Gilead Sciences Inc. offered up to \$120 million for Branford-based, development-stage drug company **CGI Pharmaceuticals**. Most of the offering will be paid upfront, with the remainder based on clinical development progress, Gilead said. **Connecticut Innovations Inc. (CI)**, which had invested \$4.7 million in CGI, will effectively cash out, with proceeds going into its Connecticut technology portfolio. CI lured Virginia-based **EpiEP** to New Haven with a \$1 million investment, hoping for a payoff from EpiEP Inc.'s device to make heart surgeries less invasive.

COMMITMENT TO SUSTAINABILITY. According to a survey by the **Connecticut Business & Industry Association**, nearly three-quarters of all Connecticut businesses have embraced a strategy for responsible uses of energy and the environment, an all-time record for the state. The April sampling of 391 companies showed 74% of the respondents are committed to sustainability, with the main reasons being reducing costs and environmental responsibility.

FUEL CELL CONTRACTS. Danbury-based **FuelCell Energy Inc.** was awarded a \$12.6 million contract by a unit of Pacific Gas & Electric Co. (PG&E) to install two 1.4 megawatt power plants at two university campuses—California State University East Bay and San Francisco State University. The contracts include engineering, procurement and construction services, the company said. In addition, the Navy signed a three-year contract to supply energy for its **Groton** attack submarine base from chemical power generators built by FuelCell Energy. Terms were not disclosed.

GERBER TOLLAND MOVE. **Gerber Scientific Inc.** is moving from its longtime headquarters in South Windsor to its Gerber Technology building in Tolland. The company also plans to move its **Gerber Innovations** division, located outside Boston, to the Tolland site. Gerber owns the Tolland facility and will save money in the move since it currently leases the South Windsor site. The \$1.1 million cost of moving Gerber Innovations from Wilmington, MA, will be recouped in just over a year, the company said.

ARCOR BUILDS NEAR BRADLEY. Windsor-based **Arcor Laser Services** is building a 12,000 square foot headquarters in Suffield. Arcor President **Gary Francoeur** said the new facility will centralize production, administrative offices, shipping/receiving and

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 CASE Bulletin, 179 Allyn St., Suite 512, Hartford, CT 06103-1422, or email us at acad@ctcase.org

IN BRIEF

Science and Engineering Notes from Around Connecticut

warehouse, and will provide a separate assembly area for sensitive medical devices. Francoeur said the company chose the site because of its proximity to **Bradley International Airport**.

GOOGLE'S IMPACT. Search-engine giant Google published a report assessing its state-by-state economic impact in 2009. For Connecticut, the report notes that 18,100 businesses generated \$741 million in economic activity from ads placed on its search engine. Google says it donated \$1.5 million in free advertising to Connecticut nonprofits. See the full report at www.google.com/economicimpact.

EB BUYING PFIZER SITE. Groton-based submarine maker **Electric Boat (EB)** completed its purchase of **Pfizer's** former New London research and development complex. EB has moved more than 300 engineers and designers into the building and will continue to relocate employees there over the next 18 months as Pfizer completes its phased withdrawal by the end of 2011. EB said the total number of employees to be located at the site depends on the volume of work from the Navy, primarily for a next-generation submarine and Virginia-class submarine redesign work.



Communication

SOCIAL MEDIA PILOT. **Northeast Utilities** chose **South Windsor, Ledyard** and the **Capitol Region Council of Governments** for a pilot project utilizing social media to enhance marketing outreach and two-way communications with the public. The participants were among 16 applicants that participated in a competitive selection process. Each will receive \$8,000 in consulting services over the next year paid for by NU's **Connecticut Light & Power & Co.** and **Yankee Gas** divisions. At the end of the 12-month pilot, participants will share their project experiences with other Connecticut communities via Twitter, Facebook and other social media.

WIFI FOR METRO-NORTH. The Metropolitan Transportation Authority (MTA) is seeking to provide Wi-Fi network access on some 2,264 Metro-North and Long Island Railroad passenger cars. Six companies have submitted proposals to the MTA, which expects to award the contract by year's end.

UI'S NEW SOFTWARE. **United Illuminating Co.** in New Haven is using software from Ohio-based Arcos Inc., for an automated system that calls out repair crews after normal business hours. According to Arcos, the software will be used to replace a system in which supervisors telephone electric substations and line workers about after-hours outages. The new system is designed to reduce the time it takes to send workers out on repair, with the ability to send voice or text messages to hundreds of employees in seconds.

H-FOSS SOFTWARE PROVEN. A web-based communications tool called Collabbit, developed via the **Humanitarian Free and Open Software (H-FOSS) Summer Institute** based at **Trinity College**, was used with success by the Red Cross of Greater New York during a full-scale disaster exercise. Developed in 2009, Collabbit is a virtual emergency operations center that assists relief agencies in coordinating efforts during a disaster. H-FOSS also involves students and professors from **Connecticut College** and **Wesleyan University**. The program's goal is to reach out to academic computing departments, information technology corporations, and local and global humanitarian and community organizations that are dedicated to building and using FOSS to benefit humanity. H-FOSS has since expanded to include students at the **University of Hartford** and several out-of-state colleges.



Education & Cognition

PRESIDENTIAL AWARD. In June, President Obama named 103 teachers from across the country as recipients of the prestigious Presidential Award for Excellence in Mathematics and Science Teaching. Connecticut's winners are **Edward DePeau III**, Newington High School (math) and **Kristen Record**, Bunnell High School Stratford (science). DePeau, who teaches grades 9 through 12, says he believes students need to be active learners and tries to build a conceptual understanding of mathematics so that students can discover math on their own. Record teaches 11th and 12 grade physics. Elected a CT Academy for Education fellow in 2010 and recently named Stratford Public Schools' Teacher of the Year 2011, Record said she tries to make physics relevant to her students' lives.

ELECTRICAL FIELDS INFLUENCE BRAIN ACTIVITY. Most scientists have viewed electrical fields within the brain as the simple byproducts of neuronal activity. A **Yale** study (*Neuron*, July 15) reports that electrical fields can also influence the activity of brain cells. The finding helps explain why techniques such as transcranial magnetic stimulation and deep brain stimulation are effective for the treatment of various neurological disorders. Senior author **David McCormick**, the Dorys McConnell Duberg Professor of Neurobiology at **Yale School of Medicine**, says the finding raises questions about possible effects of electrical fields humans are exposed to daily. McCormick and **Flavio Frohlich**, a postdoctoral researcher, introduced slow oscillation signals into brain tissue and found that the signal created a sort of feedback loop, with changes in electrical field guiding neural activity, which in turn strengthened the electrical field.

UCONN MED SCHOOL ACCREDITATION. The Liaison Committee on Medical Education gave a probation warning to the **University of Connecticut School of Medicine** after finding that the school failed to fully comply with 15 out of 132 standards. Concerns cited were the school's economic future, a potentially inadequate number of faculty, vacant department chairmanships, possible problems with student evaluations and inadequate financial aid services and debt counseling. UConn officials say none of the citations is about the quality of education at the medical school. The school remains accredited and will submit a plan to correct the problems by the end of the year. A report by the Liaison Committee also praised the school's programs and student body.

NSF GRANT FOR UCONN FIFE PROGRAM. The **University of Connecticut School of Engineering** will receive nearly \$600,000 from the National Science Foundation for its innovative **First in Family Energy (FIFE)** scholarship program that targets students of the Connecticut technical high schools from economically disadvantaged families. FIFE focuses on students that are the first in their families to attend college and who are interested in careers in energy engineering. The five-year project will fund an estimated 20 scholarships of \$6,500 each.

GREEN SCHOOLING. **Gov. M. Jodi Rell** signed into law the Green Technology Education Act, requiring the state's public colleges, universities, community-technical colleges and vocational-technical high schools to coordinate a green technology curriculum. The legislation takes effect Oct. 1. Schools are required to develop career ladders for the green technology industry, publicize their green jobs training, and work with employers to identify additional necessary training for future green employees. The **Departments of Education** and **Higher Education** will create a list of green technology courses and programs.

IN BRIEF

Science and Engineering Notes from Around Connecticut



Energy

W. HARTFORD CO-GEN FACILITIES. In June, **Hughes Health & Rehabilitation** started its 75-kilowatt co-generation plant, which provides up to 53% of the facility's electricity at a rate below grid market prices. In addition, **Hebrew Health Care** inaugurated its 150-kilowatt co-generation plant—to provide up to 70% of that facility's electricity. Co-generation, or Combined Heat and Power, is the simultaneous production of usable heat and electricity from one fuel source—in this case, natural gas. Both projects were developed and installed by Aegis Energy Services of Holyoke, MA.

CL&P RATE CASE. The **Department of Public Utility Control (DPUC)** trimmed a revenue increase request from **Connecticut Light & Power (CL&P)** by nearly \$76 million, effectively cutting customers' bills. The DPUC approved a smaller-than-requested increase of \$63.4 million this year and \$38.5 million next year. State regulators say customer bills will likely decline from an average of \$141 to \$130 monthly in January 2011 due to the lower-than-requested increase combined with the expiration of an assessment and changes in other rates.

KLEEN ENERGY INVESTIGATION. One of two blue-ribbon panels investigating the deadly gas explosion at the **Kleen Energy** power plant in Middletown urged regulatory and other changes to avoid repeating the Feb. 7 disaster. One recommendation is for the state to designate a single agency to regulate the "gas blow" process for clearing debris from natural-gas piping. The panel, led by **Judge Alan H. Nevas**, submitted its findings and recommendations to the governor and to a second investigative panel, the Thomas Commission. Nevas' panel also urged the **Connecticut Siting Council** to impose safety guidelines on plants that plan to use the procedure, and advocated that the Council include some of its recommendations in any new construction permit issued to Kleen Energy. The current permit expires Nov. 30, 2010.

NEW ENGLAND RELIABILITY VENTURE. **Connecticut Light & Power Co. (CL&P)** and **United Illuminating** will share ownership of a \$1.4 billion transmission project meant to increase delivery reliability over the next five years for the state and New England. The **New England East-West Solution** is a joint venture between **Northeast Utilities (NU)** and National Grid to install four 345-kilovolt lines between Connecticut, Massachusetts and Rhode Island. The project also includes lower kilovolt lines meant to deliver power more cost-effectively by giving utilities access at multiple points. UI is contributing \$60 million, or 8.4%, of NU's \$711 million cost for Connecticut's portion of the lines. In return, UI will own 8.4% of the poles and transmission lines. CL&P, owned by NU, will maintain the system's Connecticut leg.

PRICE OF WIND TURBINES DROPPING. Contract prices for wind turbines dropped 15% from 2008, a reduction that could make the renewable technology cost competitive with other forms of electricity generation. The Wind Turbine Price Index, published by Bloomberg New Energy Finance, showed oversupply in the global market led to the drop.



Environment

REAL-TIME AIR QUALITY. To encourage energy conservation, especially during times of poor air quality and peak electrical demand, the **Department of Public Utility Control (DPUC)** contracted with CASE to design and implement a comprehensive Real-Time Air Quality Report for the web and TV. The new

report will supplement DPUC's Real-Time Energy Report. A CASE committee worked with **Sonalysts, Inc.**, of Waterford to develop the report, interactive map and FAQ available at www.ctenergyinfo.com. Custom versions of the report have also been made available to several Connecticut TV news stations for web and broadcast use.

CLEAN WATER FUND PROJECTS BONDED. The state bond commission recently authorized \$145 million of state grants and loans for the **Connecticut Clean Water Fund**, to supplement \$25 million provided to Connecticut by the US Environmental Protection Agency. Projects to be undertaken include wastewater de-nitrification and combined sewer overflow repairs in several municipalities. See further details at http://www.ct.gov/dep/lib/dep/water/municipal_wastewater/final_cwf_priority_2011.pdf.

EMERALD ASH BORER IN SAUGERTIES, NY. Federal agricultural officials confirmed the presence of the Emerald Ash Borer (EAB) in nearby Saugerties, NY. The pest is responsible for the death and decline of over 25 million ash trees in the United States since 2002. The **Connecticut Agricultural Experiment Station (CAES)** is surveying for EAB, the Asian longhorned beetle, and other pests; the Station has intensified the survey in northwestern Connecticut. Affected trees include White, Black and Green Ash. Residents should report suspected EAB infestations to CAES at (203) 974-8474 or (203) 974-8485, or at CAES.StateEntomologist@ct.gov.

FOREST RESOURCE AND ASSESSMENT STRATEGY. The **Department of Environmental Protection (DEP)** announced the completion of Connecticut's first **Forest Resource Assessment and Strategy**, designed to document the condition of Connecticut's forests, engage the public in discussions about the state's forestlands, and develop strategies to focus federal, state and local partner efforts in protecting, conserving, and managing Connecticut's forestlands. The development of the strategy was authorized by the federal Food, Conservation, and Energy Act of 2008 (the 2008 Farm Bill).

EB CITED FOR POLLUTION. During the past eight months, the **Department of Environmental Protection (DEP)** has cited Groton submarine maker **Electric Boat** for three environmental violations, including the release of 4 million gallons of polluted water from EB's graving dock into the **Thames River**. DEP says Electric Boat violated water discharge permits, state regulations and the federal Clean Water Act. In a statement, EB said the violations were self-reported and steps were immediately taken to prevent them from being repeated. DEP is negotiating a resolution that could include a fine or other enforcement action.



Food & Agriculture

EXPERIMENT STATION TESTS GULF SEAFOOD. The **Connecticut Agricultural Experiment Station (CAES)** in New Haven is collaborating with the US Food and Drug Administration (FDA) and other states to test shrimp and finfish from the oil spill in the Gulf of Mexico. A new, highly sensitive and specific method using liquid chromatography with fluorescence detection is being utilized to analyze samples for chemicals associated with petroleum. The CAES and the FDA Forensic Chemistry Center in Cincinnati found that potentially harmful oil-residue contaminants in shrimp and finfish from sampled areas were below levels that would cause a health concern, allowing a portion of commercial fishing waters in the Gulf to reopen. Analyses will continue for several months.

\$200,000 IN FARM REINVESTMENT GRANTS. The state bond commission approved \$200,000 of grants for Connecticut farmers to

IN BRIEF

Science and Engineering Notes from Around Connecticut

make long-term improvements. Grants are provided through the state **Department of Agriculture's Farm Reinvestment Grant Program**. Farmers who have sound long-range programs and will complete them within one year are awarded matching grants up to \$40,000. Approved projects have included greenhouse construction, new dairy and cheese production facilities, commercial kitchens, wine processing and fruit and vegetable packing facilities.

DISASTER RELIEF FOR MAPLE PRODUCERS. Unseasonably warm nights from February 15 through April 9 reduced sap production about 30% in **Litchfield, Middlesex, New Haven** and **Windham** counties, prompting a disaster declaration from the US Department of Agriculture (USDA). Federal disaster loans are available for maple syrup producers and small farm-related businesses in the affected counties. Eligible producers can apply for the low-interest loans through the USDA's Farm Service Agency. Small agriculture-related businesses that suffered direct financial losses from the weather are also eligible for Small Business Administration low-interest loans. March 8, 2011 is the application deadline for both programs.



Health

TYPE 1 DIABETES TRIAL RESULTS. A year-long clinical trial by **Yale University** and other institutions showed that treatment with sensor-augmented insulin pumps, which include continuous glucose monitoring, leads to significantly greater control of type 1 diabetes than a daily regimen of insulin injections (*New England Journal of Medicine*, online). The multicenter, randomized and controlled trial compared the efficacy of both methods in 485 adult and child patients. At one year, average plasma glucose concentrations—which indicate blood sugar control in type 1 diabetes—were significantly lower for both adults and children in the pump-therapy group, compared with the injection-therapy group.

REMOTE HEART CARE. Hartford health insurer **Aetna Inc.** and microchip-maker Intel Corp. shared initial findings from an 18-month study, saying that it is possible for care providers to remotely intervene to treat elderly Americans with chronic heart ailments in their home, reducing their need for costly hospital visits. The study is based on 364 Aetna members on Medicare who suffer chronic heart problems. Subjects were given blood-pressure monitors and weight scales to monitor their vital signs, which they entered mostly daily onto home computers. Nurse case managers monitored the information online using Intel's Health Guide system. When signs indicated that a patient's heart conditions were unstable, care providers intervened with an online video reminder about taking medication on schedule or other proactive health advice.

ASSISTANCE FOR NEW PATIENT RECORD RULES.

EHealthConnecticut is one of 60 regional extension centers designated by the federal Department of Health and Human Services to coordinate with Connecticut health providers in satisfying new patient-record rules aimed at improving care and curbing costs. The new federal guidelines for collecting and securing patient records are designed as a first step in creating a national health information exchange. EHealthConnecticut comprises volunteers representing care providers, health insurers, patients, business, academia and quality organizations.



High Technology

A STAR IS BORN. Astronomers have glimpsed what could be the youngest known star at the very moment it is being born. Not yet

a fully developed star, the object is in the earliest stages of star formation and has just begun pulling in matter from a surrounding envelope of gas and dust, according to a new study (*Astrophysical Journal*, June). **Xuepeng Chen**, a postdoctoral associate at **Yale**, is lead author of the paper. Researchers found the object using the Submillimeter Array in Hawaii and the Spitzer Space Telescope. Known as L1448-IRS2E, the star is located in the Perseus star-forming region, about 800 light years away within the Milky Way galaxy.

UCONN/DUKE DISCOVER NEW METHOD OF MICROCHIP TESTING.

University of Connecticut (UConn) and Duke University researchers found a more effective way to screen ever-shrinking microcircuits for small delay defects (SDDs). SDDs are a type of timing defect that are difficult to fully and efficiently target with current testing methods, which assume that SDDs appear as physical defects. Team leaders **Mohammad Tehranipoor**, UConn associate professor of electrical and computer engineering, and Krishnendu Chakrabarty of Duke University, say their methodology will dramatically improve the quality of the test process and reduce costs.



Transportation

BONDING APPROVED FOR RAIL IMPROVEMENTS. In August, the **State Bond Commission** approved borrowing \$260 million for improvements on the **New Haven-Hartford-Springfield** rail corridor, with the prospect of obtaining an additional \$220 million in federal funding. The rail corridor has already received \$40 million in federal funding to double-track the 10-mile stretch between **Newington** and **Berlin**. Improvements in the corridor will include fixing existing stations, building new ones, and increasing the efficiency and frequency of freight and passenger service.

SIKORSKY DEBUTS FIREFLY. Stratford-based **Sikorsky Aircraft Co.** unveiled "Project Firefly"—the company's prototype electric helicopter—at the AirVenture exhibition in Oshkosh, WI, this summer. **Chris Van Buiten**, director of **Sikorsky Innovations**, the company's technology development division, said Firefly's objectives "are to validate the benefits of an electrically powered rotorcraft; to develop the technologies to enable the manned flight of that technology, and to drive future development of improved, state-of-the-art 'green' technologies and practices."

FAA GREEN GRANTS. The Federal Aviation Administration awarded \$125 million in contracts to five companies, including East Hartford-based **Pratt & Whitney**, and Fairfield-based **General Electric Co.**, to work on aviation technologies to make the aviation industry more environmentally friendly. Each of the companies (the others are Honeywell International, Boeing and Rolls-Royce-America) will be paid \$25 million over five years, and each company will match or exceed the investment, the FAA said. The companies will develop technologies for alternative fuels, lighter engines, optimizing flight trajectories and others.

PROTON ENERGY HELPS FUEL CA BUSES. Wallingford-based **Proton Energy Systems** will provide the electrolyzer that produces gaseous hydrogen for buses in the Alameda-Contra Costa transit district of San Francisco. As the largest electrolyzer Proton Energy has ever put in the field, it produces 65 kilograms of hydrogen per day, compared with smaller units that produce 12 kilograms per day. Developed in partnership with Windsor Locks-based **Hamilton Sundstrand**, the electrolyzer is part of a refueling station that fuels the buses in 3-6 minutes.

— *Compiled and edited by Ann G. Bertini, Asst. Dir. for Programs*

From the National Academies *(from page 1)*

lived, it can effectively lock the Earth and future generations into a range of impacts, some of which could become very severe.

Policy choices about emissions can be informed by recent advances in climate research that quantify the relationships between atmospheric CO₂ and warming levels, and between warming levels and future impacts. Drawing upon this research, the report estimates changes in precipitation, streamflow, wildfires, crop yields, and sea level rise that can be expected with different degrees of warming. It also estimates the average temperature increases that would be likely if CO₂ were stabilized in the atmosphere at various target levels. However, the report does not recommend any particular stabilization target, noting that choosing among different targets is a policy choice rather than strictly a scientific one because of questions of values regarding how much risk or damage to people or to nature might be considered too much.

[http://www.nap.edu/catalog.php?record_id=12877]

◆ New Rule Simplifies PTSD Disability Claims

A new rule announced by the government in July makes it easier for veterans with post-traumatic stress disorder to receive disability benefits. This change could affect hundreds of thousands of veterans who served in Iraq, Afghanistan, and Vietnam. Under the new regulation, the VA will grant disability benefits to all veterans who can prove they served in a war zone, performing a job consistent with the traumatic events that allegedly triggered the PTSD. Veterans are no longer required to corroborate traumatic events related to hostile military activity, such as coming under fire or watching a friend die. According to the US Department of Veterans Affairs, the new regulations on PTSD claims will apply to claims received by the VA on or after July 13, 2010, as well as to claims received or appealed before this date, which have not yet been resolved by the Board or by VA regional offices. The rule applies to veterans who served in any US war.

Several Institute of Medicine committees have studied the issue of PTSD, written reports, and provided congressional testimony on the needs of veterans with post-traumatic stress. Some notable, recent reports from the National Academies include *Returning Home From Iraq and Afghanistan: Preliminary Assessment of Readjustment Needs of Veterans, Service Members, and Their Families* (2010), *Gulf War and Health, Vol. 8: Update of Health Effects of Serving in the Gulf War* (2010), *PTSD Compensation and Military Service* (2007), and *Treatment of Post-traumatic Stress Disorder: An Assessment of the Evidence* (2008).

[<http://www.nationalacademies.org/headlines/20100714.html>]

◆ New Book Examines Language Diversity, School Learning and Closing the Achievement Gap

A new book, *Language Diversity, School Learning, and Closing Achievement Gaps: A Workshop Summary*, from the National Academies Press, summarizes and synthesizes two days of workshop presentations and discussion from the Workshop on the Role of Language in School Learning: Implications for Closing the Achievement Gap. Participants in the workshop, which was sponsored by the William and Flora Hewlett Foundation, included members of the National Research Council (NRC) planning committee and other invited content experts and guests. It was held to explore three questions: What is known about the conditions that affect language development? What are the effects of early language development on school achievement? What instructional approaches help students meet school demands for language and reading comprehension? Of particular interest was the degree to which group differences in school achievement might be attributed to language differences, and whether language-related instruction might help to close gaps in achievement by helping students cope with language-

Eli Whitney Museum *(from page 1)*

At the Eli Whitney Museum, children observe the outcome of a Downie experiment that places small motors on brushes, causing them to vibrate.

[Photo: Eli Whitney Museum]



precocious high school students. However, Downie's eye for the essential and exciting is so keen that his projects intrigue and reward 9-year-olds. In early 2010, Downie gave the museum permission to adapt his designs for American students. This fall, the museum will introduce a handful of projects from Downie's book entitled, *Vacuum Bazookas, Electric Rainbow Jelly & 27 Other Saturday Science Projects* (2001, Princeton University Press, <http://press.princeton.edu/titles/7129.html>). Museum participants will be immersed in Downie's fresh and artful perspective on the pure pleasures of experiment.

Where will the museum turn next? Perhaps to your special enthusiasm. It's a Whitney principle: minds open to experiment never want for fresh challenges. Visit www.eliwhitney.org or email sh@eliwhitney.org with questions or requests.

intensive subject matter especially after the 3rd grade. The aim of the meeting was not to reach consensus or provide recommendations, but rather to offer expert insight into the issues that surround the study of language, academic learning, and achievement gaps, and to gather varied viewpoints on what available research findings might imply for future research and practice, workshop presentations and discussion.

[http://www.nap.edu/catalog.php?record_id=12907]

◆ Continued Focus on Hydrogen Technologies Urged

The public-private partnership to develop vehicles that require less petroleum-based fuel and emit fewer greenhouse gases should continue to include fuel cells and other hydrogen technologies in its research and development portfolio, according to a new report by the National Research Council. The third volume in the FreedomCAR series states that, although the partnership's recent shift of focus toward technologies that could be ready for use in the nearer term—such as advanced combustion engines and plug-in electric vehicles—is warranted, R&D on hydrogen and fuel cells is also needed given the high costs and challenges that many of the technologies must overcome before widespread use.

The FreedomCAR (Cooperative Automotive Research) and Fuel Partnership is a research collaboration among the US Department of Energy, the United States Council for Automotive Research, five major energy companies, and two electric utility companies.

[http://www.nap.edu/catalog.php?record_id=12939]

Visit our web site at www.ctcase.org

Lasers *(from page 2)*

general manager at JDS since its inception as a spin-off from UTRC, later becoming the CTO when JDS merged with Uniphase. "State-of-the-art laser encoding of information and transmission by fiber optics is currently at a speed of 40 gigabits per second. That is like transmitting the Encyclopedia Britannica in less than 100 milliseconds. The next breakthrough will be in speeds of more than 100 gigabits per second," says Leonberger.

Lasers are a big factor in Connecticut's economy, representing millions of dollars in business revenue. According to Burke Doar, VP of Sales and Marketing at TRUMPF in Farmington, "The manufacture of lasers requires a number of different components and subassemblies, and many of these are sourced to Connecticut companies." And why would a company like TRUMPF locate in Connecticut? For the same reasons that many, including Giovanni Tomasi of RSL Fiber Systems, cite: Connecticut has a wealth of talent, a long history of precision manufacturing, and is a great place to live. RSL is developing state-of-the-art laser fiber optic lighting systems for military applications.

CCAT's Ginsberg says, "Connecticut was traditionally a machine tool state. Lasers and optics are the next generation of machine tools, which will manufacture the

next generation of products. Lasers will become even more ubiquitous and every company that works in materials processing should have lasers in their toolbox."

Connecticut's Lasers: The Next Fifty Years

When DeMaria was asked where he thought the technology will go in the next fifty years, he replied, "If I knew that, I would be a millionaire." After reflecting for a moment, he added, "Lasers have not reached their full potential in the computing sector. Telecommunications, lighting industries, and advances in materials processing will all be major fields of advancement for the laser." Seifert thinks that the emphasis on Homeland Security will drive the development of directed energy weapons. Leonberger sees fiber cable reaching individual homes and schools, allowing for the transmission of tremendous amounts of information with huge implications for education. Others see the medical field, the ability to zap single cancer cells for instance, as the next breakthrough technology. It is interesting to note that, now that lasers are 50 years old, the early instruments can be considered antiques and have become items sought after by collectors. Watch for them on coming editions of the Antiques Roadshow. In any case, the laser is no longer a solution looking for a problem. — **Robert Vieth, science writer**

Latest Academy Studies

DESIGN-BUILD STUDY

A study by the Connecticut Academy of Science and Engineering entitled, *The Design-Build Contracting Methodology for Transportation Projects: A Review of Practice and Evaluation for Connecticut Applications* finds that the Connecticut Department of Transportation (ConnDOT) should be legislatively enabled to make use of the design-build contracting methodology. View the full report at http://www.ctcase.org/reports/Design_Build.pdf

PEER REVIEW OF ARTIFICIAL TURF STUDY

The Connecticut Department of Public Health (DPH), Connecticut Department of Environmental Protection (DEP), University of Connecticut Health Center (UCHC) and The Connecticut Agricultural Station (CAES) conducted a study entitled *Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields*, which included air sampling and laboratory analysis. On behalf of those state agencies, the Academy performed a peer review of their final report. View both the state and CASE Peer Review reports at www.ct.gov/dep/artificialturf.