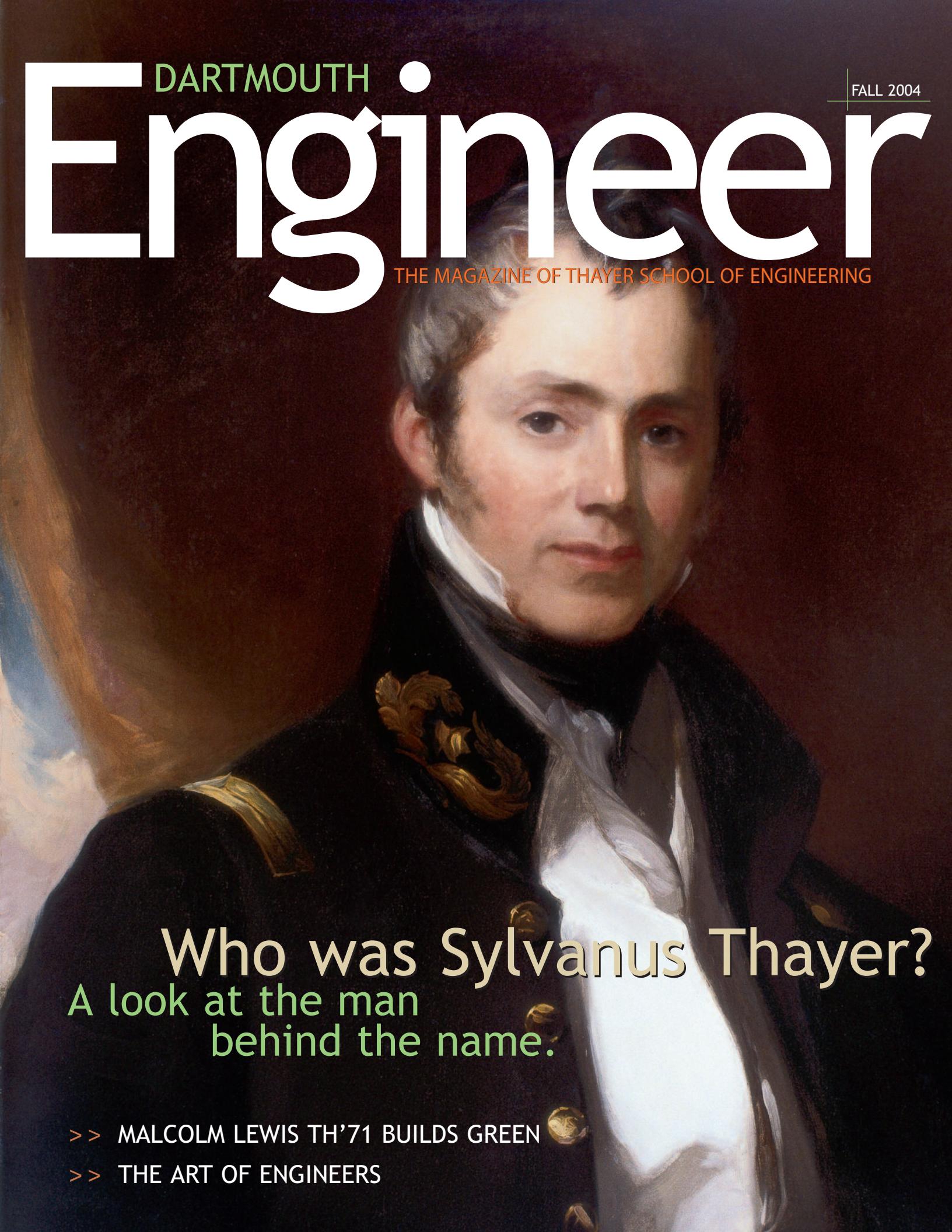


DARTMOUTH

FALL 2004

Engineer

THE MAGAZINE OF THAYER SCHOOL OF ENGINEERING

A portrait painting of Sylvanus Thayer, a man with dark hair and a high forehead, wearing a dark military-style uniform with gold epaulettes and a white cravat. He is looking slightly to his left.

Who was Sylvanus Thayer?
A look at the man
behind the name.

>> MALCOLM LEWIS TH'71 BUILDS GREEN

>> THE ART OF ENGINEERS

OPENING NOTES

WELCOME TO DARTMOUTH ENGINEER, the new magazine of Thayer School of Engineering. *Dartmouth Engineer* takes up the mantle from *Directions in Dartmouth Engineering*, the magazine Lois Wood created in 1986 and ably edited until her recent retirement. Our mission remains the same—to bring news and information about Thayer School to all members of the Thayer School community and strengthen lines of communication among Thayer School's students, faculty, alumni/ae, and friends.

Recognizing Thayer School's ongoing presence in the lives of all who walk through its doors, *Dartmouth Engineer* will feature stories about the research and teaching taking place at the school and document the accomplishments of alumni/ae. To enhance communication among former Thayer School students, *Dartmouth Engineer* introduces Alumni/ae News as a regular department. Whether you remained in engineering or headed in another direction, if you attended Thayer School, we encourage you to write or e-mail us about your passions, your career, your life. We hope all readers will use *Dartmouth Engineer* to renew old friendships, make new contacts, and take collective pride in the achievements and interests of the entire Thayer School community.

We also extend an invitation to readers to write or e-mail us with your comments about *Dartmouth Engineer*. Tell us what you'd like to read about in future issues. Let us know your thoughts about the work and research being done at Thayer School and about the broader world of engineering.

In serving you, our readers, *Dartmouth Engineer* aims to be as wide-ranging as engineering itself. After all, engineering isn't merely a profession. It's a way of life.

KAREN ENDICOTT
Editor

DARTMOUTH ENGINEER

VOLUME 1 / NUMBER 1

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General Sylvanus Thayer, Class of 1807, by Thomas Sully. Hood Museum of Art, Dartmouth College, Hanover, New Hampshire; Gift of General Sylvanus Thayer, Class of 1807.

BACK COVER
Cummings Hall photograph by Douglas Fraser.

THE Great Hall

>>NEWS FROM AROUND THAYER SCHOOL



GROUNDBREAKING

Construction Begins on MacLean Engineering Sciences Center

Big Dig
(Above) Rendering of MacLean Engineering Sciences Center. (Top) Left to right, Overseer chair John Ballard, Dean Lewis M Duncan, donors Mary Ann and Barry MacLean, and President James Wright; (bottom) Barry MacLean.

GROUNDBREAKING CEREMONIES were held May 8 for the new MacLean Engineering Sciences Center, with construction launched in August. The building, which will house innovative instructional and research spaces, will adjoin the south side of Cummings Hall.

Barry MacLean '60, Th'61 and his wife, Mary Ann, donated \$15 million toward the new Engineering Sciences Center. President and chief executive officer of MacLean-Fogg Co., a diversified company specializing in high-performance fastener

and component manufacturing, MacLean has served on Thayer School's Board of Overseers since 1972 and was a Dartmouth College Trustee from 1991 to 2001. "It brings me satisfaction to see the College prosper as one of the nation's select institutions. To sustain that, you need to reinvest," says MacLean, a Sylvanus Thayer Fellow who received the Robert Fletcher Award in 1989 and an honorary master of arts degree from Dartmouth in 1991. Mary Ann MacLean is a trustee of Union College and serves on a number of boards in their home city, Chicago.

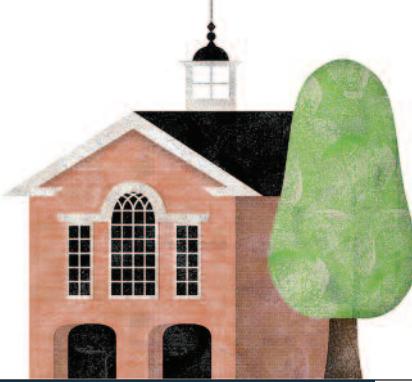
Designed by Koetter/Kim and Associates of Boston, the

four-level, 64,300-square-foot MacLean Engineering Sciences Center will feature interconnected spaces for undergraduate and graduate research and integrated project rooms for design, fabrication, and instruction.

According to interim Dean William Lotko, the new facility will free up space in Cummings Hall for ongoing research in biomedical engineering, computer engineering, dynamics and controls, lasers and optics, and nanomaterials, as well as accommodating the planned expansion of biotech research.

The MacLean Engineering Sciences Center is scheduled to open during spring of 2006.

Interim Dean William Lotko on outgoing Dean Lewis M. Duncan: "He believes that students are Thayer School's most valued asset."



LEADERSHIP

Changing of the Dean

DEAN LEWIS M. DUNCAN took his leave of Thayer School in July to become president of Rollins College in Winter Park, Florida. "Leaving Dartmouth is bittersweet," said Duncan at his farewell gathering in June. "I'm excited about the new opportunities and challenges awaiting at Rollins, but saddened by leaving the exceptional Dartmouth academic community."

During his six-year tenure, Duncan oversaw a tripling of Thayer School's research activity, added breadth and depth to the school's interdisciplinary focus, increased technology education for liberal arts students, expanded information technology initiatives with the College, and fostered entrepreneurial activities. Duncan also provided the leadership to bring the plans for the new MacLean Engineering Sciences Center to fruition.

As Thayer School conducts a national search for Duncan's successor, Professor William Lotko is serving as interim dean and Professor Charles Wyman as interim senior associate dean for academic affairs.

Lotko joined the faculty in 1984 and served as senior associate dean for academic affairs for the past five years. During that time he organized a coalition of faculty to improve and expand Thayer School's signature interdisciplinary systems approach to the Dartmouth undergraduate engineering core curriculum. "In today's world, the emphasis is increasingly on interdisciplinary research and teaching," he observes. "We can lead the way."

Lotko also worked closely with Duncan to advance Thayer School's academic and research programs and to develop new facilities. "As interim dean," he says, "I am committed to working with our faculty, staff, and overseers, together with colleagues across Dartmouth, to ensure that the School remains on this forward trajectory during the transition period."

An expert on space plasma physics, Lotko is principal investigator on Dartmouth's Sun-Earth Connection Theory program and a co-investigator for the Center for Integrated Space Weather Modeling.

Professor Wyman, the Paul E. and Joan H.



Queneau Distinguished Professor in Environmental Engineering Design, joined the faculty in 1998 after a long career in industry. His investigations into technologies for converting cellulosic biomass into fuels and other materials include analyses of economic and industrial challenges inherent in making cellulosic ethanol a commercial reality.

"The combination of Bill Lotko's extensive service to Thayer School and Charlie Wyman's previous administrative experience will provide strong leadership during the interim period," says Dartmouth Provost Barry Scherr. Thayer School hopes to name a new dean by next spring.

Farewell
Outgoing Dean Lewis M. Duncan presided over his last Thayer School Investiture in June before taking up the presidency of Rollins College.

kudos

>> George Cybenko, Dorothy and Walter Gramm Professor of Engineering Sciences, recently received a new award honoring outstanding mentoring of graduate students by faculty advisors. Nominations for the award, presented by Dartmouth's Graduate Student Council and Office of Graduate Studies, came from two of the highest authorities on mentoring—Cybenko's students. "He motivates via high expectations instead of pedantic correction or humiliation. He brings out the best in us and knows how to make us push ourselves as far as possible," says doctoral candidate Glenn Nofsinger.

"He is much more than an advisor," says doctoral candidate Annarita Giani. "He leads his students with a sincere interest in their success, not only professionally but in all of life."

"This is a great honor," says Cybenko, an expert on information systems, "because it comes from my students." —Annelise Hansen

>> The National Academy of Engineers (N.A.E.) "Frontiers of Engineering Symposium" annually exposes 100 of the country's brightest young engineers to ideas outside their specialties. Professor Laura Ray presented one of those ideas— solar-powered robots for scientific exploration in Antarctica—at this year's symposium, held in Irvine, California, in September. She illustrated the discussion with a prototype designed and built by a team of her ENGS 190: "Engineering Design and Methodology" students.

EXTRACURRICULARS

Junkyard Wars

SPLAT WAS THE SOUND OF SCIENCE at the second annual Junkyard Wars held by the Society of Women Engineers in May. The event challenged students to build water-balloon launchers from a mountain of donated junk. Eleven teams—ranging from non-engineers to Thayer School grad students—had four hours to design and construct catapults, trebuchets, and slingshots. “The Weapons of Mass Construction,” a team of engineering majors, built a trebuchet in three hours, leaving a full hour for testing and adjustments. It was a winning strategy: They scored the farthest launch of the day.

The event attracted some 100 observers. “The main idea is to show people that engineering isn’t just about sitting inside doing problem sets all day,” says organizer Amanda Plagge ’03. —*Sara Vogel*

Heave Ho
Students test the power of their slingshot during Thayer School’s second annual Junkyard Wars competition.



FORMULA RACING

Lighter, Sleeker, Faster

FOR THE DARTMOUTH Formula Racing team, the most striking difference between its 2004 and 2003 cars was weight.

The team built a car this year that weighed in at 489 pounds—nearly 100 pounds less than last year’s and the first-ever sub-500-pound car in the eight years that the team has been competing. The drive to shed extra weight affected nearly every element of the design, leading to a smaller, sleeker, faster car, team members said. “It couldn’t just be functional,” says co-captain Scott Lish ’03, Th’04. “It had to be light, and it had to be somewhat revolutionized across the board if we were going to do well, because the other teams at the competition were getting better.” That mindset paid off when the team’s car finished eighth out of 140 entered vehicles at the annual Formula SAE (Society of Automotive Engineers) competition for college students in May. The ranking was an improvement over last year, when the team placed 18th, and just shy of this year’s

goal of finishing in the top five.

But their second-ever top-10 ranking was only one of the team’s accomplishments. For the first time Dartmouth was among some 20 teams selected for the semi-finals of the design event, in which judges grill students for five hours on all aspects of the car’s design and manufacture. In addition, the DFR car was the first one to pass a technical inspection required before it could be driven in competition. And the car’s design was a finalist in a separate competition sponsored by Parametric Technologies Co., which makes the software that the team used to help design this year’s car.

“This is one of the largest and best organized teams we’ve had, and they’ve taken on the most ambitious project that any of our teams ever have,” says Douglas Fraser, a Thayer School research engineer who has advised DFR since its inception. “They really impress me. It was very professionally run.”

This year’s achievements are especially impressive given that the five-day Formula SAE competition, which takes place in the parking lot of the Silverdome in Pontiac, Michigan, attracts teams

DFR 2004 Fast Facts

Top speed in competition: 80 m.p.h.
Zero-to-60 acceleration: about four seconds

from around the world. Unlike Dartmouth, many schools represented at the event have programs in automotive engineering and faculty whose sole job is to advise the racing team. In Michigan the team competed in seven events both on and off the track. The four driving events tested the car's acceleration, braking and cornering ability, performance, fuel economy, and reliability; the three non-driving events evaluated the car's design, cost, marketability, and the team's presentation skills.

To create this year's DFR car, some 30 undergraduate and graduate students put in thousands of hours. The 11-month process began almost as soon as last year's competition had ended and involved continually redesigning components in a quest to come up with an overall design that balanced sometimes conflicting design goals: lightness, speed, reliability and driver comfort. "Right from the get-go, we were committed to change in leaps and bounds, and by doing that, ensured that pretty much nothing on the car would be the same," says team captain Ariel Diaz '02, Th'04. For instance, last year the team bought an aluminum seat from a third-party racing company. This year, the team decided it could do better by making its own fiberglass seat using the aluminum one as a mold. The new seat wasn't stiff or supportive enough, however, so the team tried making one out of carbon fiber instead. The team finally realized it could incorporate the seat into the required "driver close-out," a barrier between the driver and the road

that prevents stones and other debris from flying into the vehicle. "It ended up being lighter than we could ever have imagined and better integrated with the car itself," Diaz says.

By having one part serve two functions, the team saved 8 1/2 pounds—not an insignificant amount given that even tiny weight reductions can have a big overall impact.

The team also worked to improve the aesthetics of the car. In addition to giving the car a leaner look by trimming inches from its height, length and width, the team used polyester-based aircraft fabric, which conformed to the angular shape of the frame, rather than rounded fiberglass body panels. "We wanted to get a stealthy look to the car—show off the angles," says team co-captain Dave Blindheim '03, Th'04.

Downsizing the frame wasn't merely about appearances: The frame weighed 67 pounds, more than 10 pounds less than last year. And a smaller frame meant that other parts could be lighter as well.

Another goal was to create a car that could be driven by different-sized team members. "There's an emphasis that the team places on allowing everyone to be able to drive," says Emilie Fetscher '03, Th'04, who worked on driver controls. "It's kind of the team's philosophy." The pedal package—clutch, brake and throttle pedal—is more easily adjustable than last

year's, sliding along the car's frame and locking into place with pins, Fetscher says. The new system allows a single person to adjust the pedals in less than 15 seconds, while last year's required two people and took nearly a minute.

Team members got some help designing the car from engineering software programs Pro/ENGINEER and Pro/MECHANICA. Although last year students used the programs to analyze individual parts, this year the team used the software to get a preview of how different parts would work together and how they would fit into the car, Lish said.

The team did run into a few snags at the competition. The car had fuel-delivery problems that resulted in reduced power during the 22-lap endurance event, which makes up the biggest portion of a team's total score. In addition, the rear wheels started coming loose because of worn-down aluminum hubs that were splined onto steel shafts. But the DFR team finished the race, beating the odds in an event in which roughly two-thirds of the teams are compelled to drop out because of such problems as spilled fluids, engine fires, and electrical failures.

Brian Mason '03, Th'04, the fundraising and public relations chair, said the team strives to include anyone who's interested, and above all, to have fun. "It's one of the best real-world engineering experience that Thayer school has to offer," he says.

—Sonia Scherr

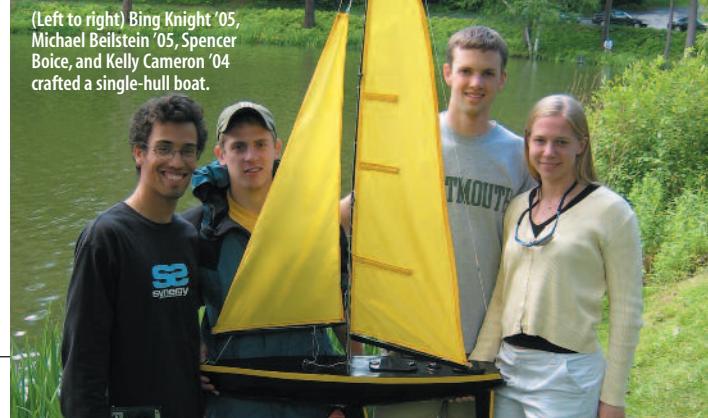
>> The Acoustical Society of America presented its Best Student Paper Award to M.S. candidate Alexander Streeter Th'04 at its annual meeting in New York City in May. The paper described a portable headset for the hearing impaired that uses an active-noise-reduction (ANR) algorithm to provide real-time attenuation over a broad spectrum of noise sources. Streeter modified an ANR headset by replacing the simple analog feeder control with a digital system combining feedforward and feedback elements. Streeter designed the feedback circuitry; David Cartes Th'01 designed the feedforward element. The project was part of ENGG 291: "Engineering Design and Methodology."

>> G. Ayorkor Mills-Tettey '01, Th'03 is one of 35 young engineers selected for a Tau Beta Pi graduate fellowship for 2004–2005. A doctoral student at Carnegie Mellon University, she is studying sustainability and robotics technology. The Ghana native says her ultimate goal is to help developing countries "join the ranks of the producers and developers, not just consumers, of technology."

>> ENGS 190/ENGG 290 students Jonathan den Hartog '03, Spencer Boice, and Scott Wisniewski '03 won the 2004 American Society of Mechanical Engineers (ASME) Student Safety Design Contest with their paper, "Helicopter Blade Emergency Detachment System." The system uses an explosive to detach the helicopter blades. The team will travel to this year's ASME International Congress and Exposition in Anaheim, California, to accept the award.

>> The *Chronicle of Higher Education* quoted Professor Edmond S. Cooley in a recent article about colleges switching to Internet-based telephones: "You don't get a bunch of middle-aged IT directors to use it. You get a bunch of 17- to 18-year-olds." For other examples of Thayer School in the news, see <http://engineering.dartmouth.edu/thayer/news/>.

(Left to right) Bing Knight '05, Michael Beilstein '05, Spencer Boice, and Kelly Cameron '04 crafted a single-hull boat.



STUDENT PROJECTS

I Want One of Those!

Just Right ▶

Coffee was always too hot or too cold—until now. The sealed interior of the Sip-by-Sip mug keeps beverages piping hot, while a valve releases liquid into the outer chamber one sip at a time. By the time it reaches your lips, it's cooled to the perfect temperature.

Designed by **Emilie Fetscher '03, Th'04**



Grip and Slip ▼

The Gliding Snowshoe combines traction for climbing with ski-like descents. A professional version features a rotating crampon and smooth underside, while a recreational model uses angled ridges to grip uphill or glide down.

Designed by **Kelly Cameron '04 and Brian Mason '03** for Erik Brine Tu'04 and Eric Darnell of Lakota Investments, Etna, New Hampshire



CLASSROOM

Sailing through Design

A FLOTILLA OF MODEL SAILBOATS chased by land-bound students with radio controllers took over Hanover's Occom Pond at the end of spring term. This was no mere afternoon frolic. It was the ENGS 146 regatta, a demonstration of what students learned from a shop-based approach to computer-aided mechanical engineering design.

The premise of ENGS 146: "Computer-Aided Mechanical Engineering Design," taught by Professor Laura Ray, is that the most important aspects of design aren't found in a textbook. Students in this class head straight to the shop, where they work with software, handle tools and materials, and develop an intuitive feel for the process of designing and manufacturing a product.

"It gives them experience in things that are hard to learn except by doing," Ray explains. "You can't teach them the impact of the planning stage on the final fit of the pieces. They have to see it."

Each boat had to meet the following requirements: a length of 1 meter or less; a hull manufactured either by Rapid Prototyping, thermoforming or composite layout; one vacuum-cast piece; and one injection-molded piece.

Software instructor Paula Berg, who taught design and modeling techniques, says she "pushed the students to think about their choice of materials, and about accommodating their designs to their chosen manufacturing and assembly processes." Students discovered, for example, that large composite hulls are harder to manufacture than small ones and that structural protrusions don't thermoform well. "They had to experiment," Ray said, "They had to redo things. But I like experimentation, and I was really pleased with the quality of the parts they produced."

Ray organized the regatta in lieu of formal project presentations. After all, she points out, the true test of a sailboat is how well it sails. Some boats struggled just to reach the starting gate, while others skimmed through with ease. A scaled-down 1901 America's Cup craft, Shamrock II, finished the course three times before others were halfway through. Shamrock II co-builders Nathaniel Merrill Th'04, John McCall-Taylor '03, and Nicholas Schaut '05 think they know why: Their boat was the only one with an integrated keel, which required fewer parts, lightening the hull. "It was amazing to watch her heeling over in the wind, just like a real sailboat," says Schaut.

Students made several other discoveries: Boats with larger rudders tacked more successfully than those with small ones. Boats with tightly bound rudders had difficulty coming about. Hull weight affected performance more than the number of hulls per boat.

Ray is eager to assign sailboats again. She'd like to improve the matching of parts to processes and have students spend more time designing the sails. Then it will be back to Occom Pond.

—Annelise Hansen

sports

Big Wheel

FOR MOST COLLEGIATE athletes their sporting careers end the day they collect their undergraduate diplomas. If that were the case in collegiate cycling, however, then Mike Barton Th'04 wouldn't have been able to win two national championships for Dartmouth at this year's National Collegiate Cycling Association Championships. Barton won both the criterium and road race events at the May NCCA championships in Madison, Wisconsin.

Sports governed by the National Collegiate Athletic Association (NCAA) allow athletes five years in which to complete four years of eligibility, but since collegiate cycling operates outside the NCAA umbrella no such eligibility rules apply. As long as you're enrolled in a college or university, no matter your status, you can race. Having raced as an undergrad at the University of New Hampshire, Barton enrolled in Thayer School's M.E.M. program in the fall of 2003 knowing cycling would remain part of the academic experience. And racing and training while in grad school turned into an altogether better experience than his undergrad racing.

"Racing as an undergrad was way harder because you were forced to do five classes or more each term and you had really short timelines," says Barton, "As a grad student you have bigger objectives and longer timelines so you can make your own schedule. You don't have as



NCCA champ
Mike Barton
Th'04

many quizzes and exams to get in the way, so I actually had more time [to train] as a grad student."

Barton took a circuitous route to college in the first place, not starting UNH until he was 25. By the time he enrolled for his first semester in Durham he'd already packed a lifetime's worth of excitement into his early-20s, and cycling was just the next step.

"I raced stock cars for six years semi-professionally, local speed tracks and the Star Speedway in Epping," explains Barton, a Grantham, New Hampshire, native. "It got to the point where the best driver wasn't always the guy who was winning the races, it was the people who had the most money in their car. That's why I like cycling so much: Equipment matters to a point, but you really have to bring your own motor."

Barton credits his friendship with a former Dartmouth rower, Mark Nathe, with jumpstarting

his training and allowing him to improve his cycling while in Hanover. On top of his two national titles, Barton also won the East Coast collegiate series, at one point reeling off five race wins in a row. While maintaining his research studying heat transfer of the cornea of the eye, Barton still managed to train upwards of 15 hours a week starting in January.

"I bobbed along for the first three or four years and I never trained in the winter, I'd only start training the first week of

racing in the spring. The year before last I started training in the winter with a friend of mine and he was a former crew guy so he's basically a training lunatic. We trained every night, all winter. I won a bunch of collegiate races that summer and saw the benefits of the winter labor and last winter I trained even more."

Barton faces a new race for time. Now an engineer at Creare in Hanover, he says, "It's tough to balance a full-time career and cycling at the elite level."

—Chris Milliman

On the Right Track

TWO DARTMOUTH TRACK and field stars, B.E. candidates Mustafa Abdur-Rahim '04 and Sean Furey '04, competed in the U.S. Olympics Trials in July. And though they didn't make it to Athens, they racked up competitive points and experience.

"I felt like a superhero—I felt like an animal," says Abdur-Rahim '04, a three time All-American decathlete, of his shot-put attempt.

"Track is the purest sport in the world," he says. "You don't need teams or officials to make calls. You just get out there and be an animal."

His strategy served him well at the trials, where he finished sixth out of 25 competitors. With 7,844 points, he had the highest collegiate finish at the event.

All-American javelin thrower Sean Furey '04 placed 16th overall, with a throw of 221 feet, 5 inches. "I've always wanted to compete at the highest level," says Furey. "A lot of people throwing the javelin are bigger, stronger, and more technical than me. Those guys are where I want to be soon."

Furey and Abdur-Rahim, who co-captained Dartmouth's indoor and outdoor track teams last year, will continue competing for the Big Green while they complete their B.E. degrees. Both are taking aim at a new target as well: the 2008 Olympics.



Giving It a Shot
B.E. candidate
Mustafa Abdur-
Rahim '04 placed
sixth at the shot-put
trials for the 2004
Olympics.

lab updates

SOLAR WINDTRAPS

Scientists are closer to understanding how high-energy particles from the sun—the solar wind—enter Earth's magnetic field. Thayer School Research Associate Hiroshi Hasegawa and an international team of colleagues have for the first time observed giant space vortices that trap plasma and energy from the solar wind. The finding, published in the August 12 issue of *Nature*, may help explain how Earth's magnetic field lets in the solar plasma when it should be acting as a barrier.

The newly discovered vortices, known as products of Kelvin-Helmholtz instabilities, resemble curled ocean waves. "These vortices were really huge structures, about six earth radii across," says Hasegawa, who has been analyzing the data collected by four satellites dubbed the Cluster. "This is the first time rolled-up Kelvin-Helmholtz vortices have been detected unambiguously. Past observations, which were based on single-spacecraft measurements, could not tell with certainty whether the waves along the magnetopause—the edge of Earth's magnetic field—were large rolled-up vortices or only small ripples that do not trap the solar wind."

One reason space physicists and engineers want to understand how the solar wind gets through the magnetopause is because the solar wind causes geomagnetic storms that can disable satellites, disrupt radio and radar systems, and create electrical surges in power transmission lines and telephone wires.

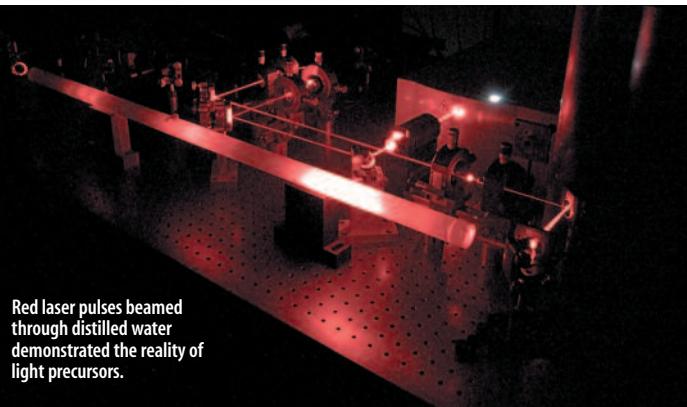
Hasegawa's research, funded by NASA, is part of the International Living with a Star collaborative program investigating how variations in the sun affect the environments of Earth and other planets.

SPEEDS OF LIGHT

Ninety years after the phenomenon was first predicted, Thayer researchers have observed an elusive property of light: in some media, a flash of light breaks into constituent frequencies that travel further and faster than the flash as a whole. Called precursors, these strong, fast constituents have defied detection since 1914. But when Professor Ulf Österberg and Research Associate Seung-Ho Choi beamed 100-femtosecond (10^{-15}) pulses of red laser light into a 70-cm.-long tube of distilled water, they observed a new pulse which attenuated an order of magnitude less than a conventional pulse.

Precursors result from two phenomena: 1) light traveling through any transparent medium splinters into component frequencies; and 2) water, like many transparent materials, transmits certain frequencies of light exceptionally well. Splinters of light traveling at favored frequencies propagate efficiently, while others fade. But as the light travels, the favored frequencies change—and so do the precursors, further complicating detection. "The precursor is like soap in the bathtub," says Österberg. "It's like it's alive, it's breathing, it's moving along and changing the whole time."

Precursors, if controllable,



Red laser pulses beamed through distilled water demonstrated the reality of light precursors.

could be useful in medical imaging, underwater communications, radar, and other applications. Österberg and Choi's discovery was reported in AAAS *Science* online and in *Physical Review Letters*.

RED TIDE ALERT

Professor Daniel Lynch's ocean circulation models recently helped coastal communities in Casco Bay, Maine, gain their first-ever advance warning of red tide, the annual shellfish contamination caused by toxic algae. The early warning came from a National Ocean and Atmospheric Administration-funded project that analyzes wind, currents, and other oceanographic data collected by sensors on ships, satellites, and buoys. When data about a patch of toxic algae observed in the Gulf of Maine was fed into Lynch's computer model, the result was an accurate prediction of where and when the red tide would wash ashore. The forecast allowed Maine officials to close shellfish beds to public harvest before contamination began.

Lynch's work in Thayer School's Numerical Methods Lab involves three-dimensional coastal ocean circulation models, including a nonlinear prognostic model that allows the circulation field to evolve over time. See <http://www.nml.dartmouth.edu/>.

MICROWAVES FOR VISION

Professor Stuart Trembly is investigating a less invasive alternative to laser eye surgery: reshaping

corneas with microwave thermokeratoplasty (MTK). Microwave energy, applied around the pupil outside the field of vision, causes collagen fibers in the cornea to shrink, flattening the optical surface in the center of the eye. The procedure is fast, requires no cutting, and uses less expensive equipment than laser surgery.

Trembly has advanced the state of MTK therapy with two patented devices. One is an improved applicator with embedded sensors to measure temperature or mechanical strain of the cornea during the procedure; the other is a feedback system that analyzes the signals to determine precisely when the myopia is corrected.

The project, which received support from Thayer School Overseer Ralph Crump '66 and his wife, Marjorie, created opportunities for student input. Luke Dalton '99, Th'01 worked on the cooling system for the MTK applicator; Michael Barton Th'04 studied anisotropic thermal conductivity of the cornea; and M.S. candidate April Mohns '03, Th'04 is currently working on a finite element treatment-planning model.

Trembly is chief scientific officer of ThermalVision, Inc., which was incorporated in the fall of 2002 to bridge the gap from laboratory to market. "Human trials," says Trembly, "are scheduled to begin in about 18 months." Information about ThermalVision is at <http://www.thermalvision.net/>.

Fiscal Year 2004 Overview

Research expenditures: a record \$19 million
Proposals submitted: 100, totaling \$44.3 million
Awards received: 57, totaling \$18.7 million

TREATING PROSTATE CANCER

Thayer School and Dartmouth Medical School researchers are investigating a novel approach to using photodynamic therapy (PDT) to treat early-stage prostate cancer. Professor Brian Pogue, research associate Bin Chen, and adjunct Professor Jack Hoopes are testing their hypothesis that PDT is effective when used to consecutively target prostate cancer cells and the tumor's vascular system. PDT involves fewer side effects than prostate surgery, which can cause impotence and incontinence.

PDT is a two-step process. The subject is injected with a photosensitizer, then the tumor is treated by laser light irradiation. By adjusting the interval between drug administration and light irradiation, PDT can be directed at either tumor cells or blood vessels.

Current PDT protocols typically use either a relatively long drug-light interval to target tumor cells or a short drug-light interval to cause vascular occlusion. The Thayer School team's protocol applies the same long-interval cellular-targeting PDT but follows it immediately with short-interval vascular-targeting PDT. The researchers believe that targeting the tumor's vascular system is crucial since a single vessel supplies oxygen and nutrients for thousands of tumor cells.

Ongoing studies are focused on assessment of the anti-tumor effect in prostate cancer and the ability to spare normal surrounding tissues. The research is jointly funded by the Department of

Defense and the National Institutes of Health.

DETECTING BREAST CANCER

A team of Dartmouth engineers and medical researchers headed by Professor Keith Paulsen has released preliminary findings on how various imaging technologies can be used to detect breast cancer. Reporting in the May issue of *Radiology*, the journal of the Radiological Society of North America, the interdisciplinary team from Thayer School, Dartmouth Medical School, Norris Cotton Cancer Center, and Dartmouth-Hitchcock Medical Center, described baseline data that identify an array of tissue properties that can differentiate healthy breasts from cancerous ones.

For example, electrical impedance spectral imaging, by measuring the impedance of cell membranes, can distinguish electrical characteristics that vary from healthy to cancerous tissue. Microwave imaging spectroscopy sends microwave energy, which is sensitive to water, through the breast, while near infrared spectral imaging sends infrared light, which is sensitive to blood. Both techniques can distinguish between healthy cells and cancerous cells, which tend to have more water and blood than regular tissue.

Phase 1 of the study concentrated on 23 healthy women. The second phase focuses on women who have had abnormal mammograms. "We're just now getting into the really exciting part," says Paulsen. "We've started to get some information on what the normal breast is like, and

now we have some information on the abnormal tissue."

The project is at least 10 years away from providing commercial versions of the tests. "There's a lot of ways we can improve the instrumentation," Paulsen says, "and we're still trying to understand what these images mean. These are new types of images that no one has ever looked at before." Ideally, the imaging techniques will be combined into a single medical procedure.

Paulsen, with Professor Paul Meaney and Larry Gilman Th'95, has edited *Alternative Breast Imaging: Four Model-Based Approaches*, to be published this November by Springer.

DE-ICING PLANES AND BRIDGES

Professor Victor Petrenko's thin-film, pulse electro-thermal de-icing (PETD) method for airplanes had its first in-flight testing this year. The Goodrich Corp., which holds the license for PETD aerospace applications, bonded a thin titanium-alloy skin onto the outboard wings of a twin-engine plane and tested it in an icing wind tunnel, then in flight behind an icing tanker (an aircraft with a tail-mounted icing spray boom), and finally on several cross-country flights under natural icing conditions.

"The test pilots were quite pleased with the system," says Dave Sweet, director of research and development at Goodrich. "All the ice was removed instantly with very little runback ice generated." Testing on a business jet is scheduled for this winter.

"The beauty of the method,"

says Petrenko, "is that only a very thin layer of ice directly at the ice-material interface is heated." A single pulse of electricity melts the interfacial ice, and any ice build-up slides right off. Regular pulsing keeps surfaces ice-free while maintaining low overall power consumption.

Another PETD test is taking place on Sweden's four-year-old Uddevalla Bridge, which has to be closed each winter because ice falls from its towers and cables. In August Petrenko traveled to Sweden to meet with the Swedish Road Administration and several companies involved in the de-icing project. The process involves heating a stainless-steel foil coating on the bridge towers and cables with a second-long electrical pulse. Full-scale implementation of a PETD system for the bridge will begin next year.

See <http://engineering.dartmouth.edu/thayer/research/ice-engg.html> and <http://www.iceengineering.com>.



investiture

Class of 2004

TO THE APPLAUSE of their professors and families, 109 Thayer School students received hoods, caps, and honors at the 2004 Investiture on June 12.

Presiding over his last Investiture, outgoing Dean Lewis M. Duncan told the graduates, "We have provided for your education here to the very best of our abilities, but as we're sure you recognize, your education is not yet complete, but only transitioning to a new stage."

Robert Fletcher Award winner and Investiture speaker Rita R. Colwell, Distinguished Professor at the University of Maryland and Johns Hopkins University Bloomberg School of Public Health, welcomed the new engineers to the profession. "In our science-, engineering-, and technology-powered world of ever-increasing complexity," she said, "there is a growing need for your knowledge and very special know-how, steeped in interdisciplinary education and social conscience—so very important as we try to understand each other in order to live in harmony and build a sustainable future."

Engineers have social responsibilities, Colwell stated. "It is no longer enough for scientists and engineers to generate the new knowledge. We, as scientists and engineers, must be active in the support of, and debate about, the use of that knowledge. Science and engineering are strong and valuable forces for finding solutions to problems and for changing the world in positive ways. But, the task for all of us is to



understand the issues that science and engineering raise and to be informed partners with the public in the debate about how knowledge is used."

Dean Duncan urged the graduates to use their education to the fullest. "In adherence to the founding charge of Sylvanus Thayer," he said, "we believe that you are indeed today the most capable and faithful, well prepared for the most responsible positions and the most difficult service. Of those to whom much is given, much is expected. And so we expect much of you. Through your choices and your deeds, through your professional careers and the lives that you lead, stand tall and proud, now and always the men and women of Thayer School."

BY THE NUMBERS Engineering Graduates

4	Doctor of Philosophy
18	Master of Science
30	Master of Engineering Management
57	Bachelor of Engineering
60	Bachelor of Arts, Engineering Sciences Majors

Degree Recipients

BACHELOR OF ENGINEERING

*denotes group project

- *Nii Moi Addo
BlitzMail Application/Website for Pocket PC 2003
- *Hans Albee '03
Dartmouth Formula Racing: Engine Tuning and Dynamometer Installation
- *Benjamin Annino '03
Instrumented Bat for On-Field Measurement of Swing Dynamics
- Sara Atwood '03
Application of Diamond-Like Carbon Coatings on Artificial Knee Materials
- *David Blindheim '03
Dartmouth Formula Racing: Electronic Engine Management and Fuel System Design

“America’s scientists, engineers, inventors, and entrepreneurs have ingrained in our culture the importance of asking questions, finding answers, and challenging the status quo.”

—RITA R. COLWELL, AT INVESTITURE



***Tico Blumenthal '02**

A Head-Mounted Display for a Hearing-Impaired Surgeon

Benjamin Bollinger '04

Integration of a Clinical Ultrasound Machine with the Create Dual Frequency Instrument

***Michele Casey**

Crank Generator for Emergency Battery Charging

Janelle Chang '03

The Mechanical Properties of L₂1-structured Fe₂MnAl at High Temperatures

Jeremiah Connolly '04

Increasing the Efficiency of Residential Electricity Use

***Keith Dennis '03**

Wine Preservation Product Development

***Eli Diament '02**

Design of a Dynamic Response Sensor System for Green Design in Office Buildings

***Ariel Diaz '02**

Dartmouth Formula Racing: Independent Rear Suspension

***Ryan Dunn**

Crank Generator for Emergency Battery Charging

***Philip Engelhardt**

URACCAN Water Project

***Katherine Farmer**

Vocera VoIP Interface

***Emilie Fettscher '03**

Dartmouth Formula Racing: Driver Controls and Ergonomics

***Elisse Gaynor '03**

Design Multi-terrain Rescue Litter System

***Aaron Goss '03**

Dartmouth Formula Racing: Driver Controls

***Hritik Govardhan**

Vocera VoIP Interface

***Adam Han '03**

Ethanol as Fuel for Recreational Boating

***Edward Hopkins '92**

Low-Cost Inertial Smart Sensor

***Alex Jordan '03**

Johnson & Johnson Handheld Wireless Proof of Concept

***Samuel Kasdon**

Cool Robots

***Russell King-Jones '02**

Stir Cycle

***Hannah Köppen**

Dartmouth Formula Racing: Air Induction and Exhaust Systems Development

***Brian Lehrman '03**

Johnson & Johnson Handheld Wireless Proof of Concept

***Kenneth Leon '04**

Prototype Circumaural Feedforward Active Noise Reduction Headset-B

***Scott Lish '03**

Dartmouth Formula Racing: Driver Controls

***W. Riley Lochridge '02**

A Head-Mounted Display for a Hearing-Impaired Surgeon

***Gustav Löfholm**

Dartmouth Formula Racing: Driver Controls and Ergonomics

Kathryn Lundquist '03

Optimization of Building Ventilation

***Brian Mason '03**

Dartmouth Formula Racing: Driver Controls

***Julie Matteini '03**

Switch-Adapted Kid Car

***Nathaniel Merrill**

Dartmouth Formula Racing: Design of an Independent Rear Suspension

April Mohns '03

Magnetic Resonance Imaging as a Noninvasive Measure of the Biomechanical Properties of Articular Cartilage

***David Neundorfer '03**

Articulating Head for a Hand-Held Plasma-Arc Cutter

***Hans J. Nilsson**

Dartmouth Formula Racing: Engine Tuning and Dynamometer Installation

Peter Ostendorp '03

Solar Greenhouse Design for the Dartmouth Organic Farm

Natalie Ostrander '03

Redesign of Waste Streams

***Amanda Plagge '03**

Vertical Axis Wind Turbine Electrical Generator Design

***Craig Rashkow**

Crank Generator for Emergency Battery Charging

***Raymond Ring '04**

Dartmouth Formula Racing: Investigation of High Performance Hybrid Drive System for Race Cars

***Scott Sadlon '03**

Dartmouth Formula Racing: Electronic Engine Management and Fuel System Design

***Neil Sherer '03**

Low-Cost Inertial Smart Sensor

William Shields '03

The Design of a Simulator to Determine the Cause, Mechanism, and Ways to Prevent Backside Wear on Fixed-Bearing Total Knee Replacements

***Katherine Sinclair**

Virtual Server to Virtual Server Conversion Tool Development

***Kevin Stevenson**

Dartmouth Formula Racing: Design of Differential Drivetrain

DEGREE RECIPIENTS continued on page 31

honors

>> **Brianna S. Weinstein** Engineering Design Prize: Brian M. Foley '06, Albert M. Kang '06, Andrew P. Argoski '06, Zachary E. Pierce '06—Combined existing technologies with their own Java-based graphical user interface to create a touch-sensitive remote-control screen for turning household appliances on and off. The device increases independence for people lacking fine motor skills or confined to wheelchairs.

>> **Thayer School of Engineering Corporate Collaboration Council Engineering Design Prize:** Curt A. Monaco '04, R. John Ring Th'04—Designed a hybrid drive system for Dartmouth's formula race car.

>> **Special Faculty Award for Engineering and Service to Humanity:** Matthew K. Sueoka '04—Designed new buildings for an orphanage in Bangladesh.

>> **Thayer School Faculty Award for Academic Excellence:** Alexander D. Streeter '03, Th'04 (B.E.)—Obtained the highest academic record in coursework required for the Bachelor of Engineering degree.

>> **Charles F. and Ruth D. Goodrich Prize:** Hai Sun Th'04 (Ph.D.)—Designed an intraoperative stereovision system to track brain shape and motion in near-real time during surgery.

>> **Caroline Henderson Prize:** Ashly K. Downey Th'04 (M.E.M.)—Streamlined recruitment process for the H. Lee Moffitt Cancer Center.

>> **John C. Woodhouse Engineering Design Prize:** William H. Shields '03, Th'04 (B.E.)—Developed and used a simulator to investigate the importance of component congruency to the integrity of knee replacements.

>> **John C. Woodhouse Environmental Engineering Prize:** Zhiliang Fan Th'04 (Ph.D.)—Developed a process using enzymatic hydrolysis to convert paper sludge, the refuse from the paper industry, to ethanol, a renewable fuel source.

>> **The Dartmouth Society of Engineers Prize:** Alexander D. Streeter Th'04 (B.E.)—Developed a portable headset to execute a new hybrid Active Noise Reduction algorithm that provides real-time attenuation for many different noise sources.

Benjamin R. Bollinger Th'04 (B.E.)—Integrated two existing methods of detecting and monitoring bubbles during decompression sickness to produce a new system with increased effectiveness.

>> **The Phillip R. Jackson Engineering Sciences Prize:** Michael Martin '06, Jon Groetzinger '07, Ashley Levack '07, and Eben Sargent '05—Designed a shower system that saves water and energy by cycling water through a reservoir until it is hot enough for use.

>> **Excellence in Teaching Award:** Francis E. Kennedy

>> **Outstanding Service Award for Staff:** Barbara E. Crawford, Philip D. Tacy



WHO WAS SYLVANUS THAYER?

HE WAS MORE THAN THE MAN WHO GAVE
ENGINEERING TO AMERICA.
FROM WEST POINT TO THAYER SCHOOL,
HE WAS MY HERO. BY NARDI REEDER CAMPION

I FELL IN LOVE WITH SYLVANUS THAYER THE FIRST TIME I SAW HIM. An Army family, my parents had taken me to West Point, the United States Military Academy, for the graduation of my brother Red. I was nine. We stayed at the old Thayer Hotel—now long gone—a rambling Victorian structure with porches and spittoons. I remember sitting in a rocking chair, gazing up the wide, blue Hudson River, and wondering who Thayer was. I loved his hotel.

Then I saw him. So stylish in his uniform: high-button, long-skirted jacket, tasseled sash at his waist. So handsome: sharp features, wavy hair, erect posture. And so cold—he was chiseled granite. His statue says in bold letters: Colonel Thayer, Father of the Military Academy. No wonder he looked serious.

That night at dinner, I asked Red, “Who was the Mother of the Military Academy?” He threw back his head and laughed. “Colonel Thayer never married,” Red told me, “but he raised hundreds of sons while he was Superintendent.”

I wanted to know more. I made my way to the West Point library, where the librarian gave me a book about Sylvanus Thayer. It was slow going. I learned that he graduated from Dartmouth College in 1807 and one year later from West Point. Only one year? I wondered. And why two colleges?

I also read that after Thayer left West Point, he founded the Thayer School of Engineering at Dartmouth. “What makes a man into a founder?” I asked Red.

He shrugged. “All I know is Sylvanus Thayer was hipped on engineering and on training young men. He drilled into all his cadets the essentials for a military man: discipline, precision, reliability, and honor. The West Point motto, ‘Duty, Honor, Country,’ came from him.”

I trotted across the Plain for another look at the statue. I asked my

brother, “Do you think Sylvanus Thayer had a sense of humor?”

“Not a chance. You can tell by looking at him that he wasn’t a laugher. Maybe that’s why he accomplished so much.”

I studied Thayer’s strong face and said to myself, “I bet he had a sense of humor but nobody wrote about it.”

SYLVANUS THAYER WAS BORN IN BRAINTREE, MASSACHUSETTS, June 9, 1785, the fifth of seven children. His mother, Dorcas, and father, Nathaniel, a sturdy New England farmer whose family had been there for generations, had little money, so they sent their brilliant son to live with his uncle Azariah Faxon and attend school in Washington, New Hampshire. Sylvanus earned his way by helping in his uncle’s store, where, fortuitously, he met General Benjamin Pierce, father of future President Franklin Pierce. Both General Pierce and Sylvanus’ Uncle Azaria, who had fought in the Revolutionary War, fed Sylvanus’ growing fascination with military matters, including the dazzling campaigns of Napoleon Bonaparte.

At 16, Sylvanus was teaching school in Washington and preparing for college. What he wanted was a technical education that would prepare him to be an engineer, but at the time no such institution existed in this country. So he pursued the next-best thing: a college that offered advanced mathematics as well as a classical education. In 1803 he entered 34-year-old Dartmouth College.

He quickly distinguished himself on the Hanover Plain as a top student and man of high ideals. He was invited to join United Fraternity, one of Dartmouth’s two literary societies, which only opened its ranks to students who displayed “respectability of talents and acquirements, and a fair moral character.” His interest in world affairs and his passion for Napoleon stood out, too. He was well-known for being the only stu-

dent on campus to subscribe to the *National Intelligencer*, a Washington, D.C., paper that covered foreign events, including the latest news of Napoleon's exploits.

Dartmouth left its mark on Thayer. The College's small classes, daily recitations, and prescribed curriculum—including the humanities— influenced his ideas of what education ought to be. Thayer was exposed to the formal bearing and austere educational leadership of Dartmouth President John Wheelock, a former military officer—and son of College founder Eleazar Wheelock. And like thousands of Dartmouth students who came after him, Thayer developed lifelong friendships with his classmates, including his best friend and roommate George Ticknor, who went on to become a leader in American liberal arts education.

ONE DAY IN 1807 THAYER RECEIVED TWO letters, one telling him he was valedictorian of his class; the other saying his old friend General Pierce had persuaded President James Madison to appoint Thayer to be a cadet at the five-year-old United States Military Academy.

Sylvanus Thayer, 22, never gave his valedictory speech. Instead, with his Dartmouth degree and Phi Beta Kappa key, he left for West Point. Ticknor thought his friend was relieved to forfeit the valedictory address. "He was always modest and shy and would have had difficulty facing an audience composed mostly of ladies," Ticknor explained.

Arriving at West Point, Thayer was surprised at the laxness of the academy. There was no fixed curriculum. Cadets were graduated whenever the professors felt they were ready. Some cadets had been there since the academy opened in 1802. With his classical Dartmouth education, aptitude in math, and natural diligence, Cadet Thayer was graduated in one year.

During the War of 1812, Thayer, a second lieutenant in the Corps of Engineers, planned and directed the defense of Norfolk, Virginia. Though the British captured many of our coastal fortifications, they were unable to take this one. For this achievement, Thayer was made brevet major. (Brevet means an officer receives higher rank without higher pay. No wonder it's obsolete.)

Despite America's victory, President Madison and Secretary of War



ENDURING VISION Sylvanus Thayer keeps watch over his beloved West Point, where engineering education in America began.

James Monroe were alarmed at the educational deficiencies of the Army's officer corps. When Major Thayer expressed interest in spending time abroad expanding his knowledge of military and technical studies, Madison and Monroe provided him with \$5,000 to buy books, maps, and "other learning materials" for the nation's struggling young military academy.

Thayer arrived in Europe on June 12, 1815, just three weeks after his hero Napoleon, whom he hoped to see, lost the Battle of Waterloo. Thayer spent two years studying at the French West Point, Ecole Polytechnique, and traveling through Europe collecting military texts. His old Dartmouth friend George Ticknor was also in Europe at the time, studying German educational systems for Harvard. Ticknor was impressed with German liberalism and freedom. Thayer was impressed with Ecole Polytechnique's strict discipline and academic requirements. This led to lively arguments, the kind that cement relationships.

In 1817 President Monroe ordered Thayer to return to West Point to take over as Superintendent to bring order out of the academy's chaos. Thayer began by weeding out loafers, establishing standards for admission, applying military discipline, creating a student-enforced honor system, and developing a rigorous curriculum centered on engineering. Drawing on his Dartmouth education, studies at Ecole Polytechnique, experience in the Corps of Engineers, and discussions with George Ticknor, Thayer insisted that America's military engineers be educated in the sciences and the humanities. Between 1817 and 1833 he turned West Point into the world's finest military academy and the country's first college of engineering. Carried by West Point graduates to other colleges and universities, Thayer's curriculum became the springboard for technological instruction throughout the country.

IN THE EARLY 19TH CENTURY, A COLLEGE HEAD DID IT ALL— appointing trustees and faculty, deciding on courses of study. Thayer also was treasurer, disciplinarian, even director of architectural projects. The Superintendent's quarters he built in 1820 attest to his sense of beauty and keen foresight. Still in use today, the capacious rooms,

A Man for All Times The Life of Sylvanus Thayer



1785	1799	1800	1802	1803	1807	1808
1785 Born June 9 in Braintree, Massachusetts.			1802 Teaches at Washington District School.		1807 Named valedictorian, but departs before Commencement to take up appointment to United States Military Academy (USMA) at West Point.	
	1799 Moves to Washington, New Hampshire, to live with and work for his uncle Azariah Faxon, a veteran of the American Revolution.		1803 Enters Dartmouth College. Studies the classics and higher mathematics. Develops lifelong friendship with George Ticknor, future distinguished author and Harvard educator.			1808 Graduates from USMA as second lieutenant in U.S. Army Corps of Engineers.
		1800 Develops interest in military campaigns of Napoleon Bonaparte.				

with fireplaces for heating, are large enough for Superintendents and their families yet to come.

Thayer himself was a kind of military monk. He lived in solitude, attended only by an orderly. He was famous for punctuality, arriving at his office on the stroke of the bell and at parties on the precise moment of the invitation. He was equally stringent with the cadets, who received demerits for every instance of tardiness. Nevertheless, the cadets admired him extravagantly.

Thayer had an uncanny memory and knew every cadet by name. He took an interest in each one and amazed them with his knowledge of their activities. Thayer's desk helped in this regard. Large and high in front, the back was built with pigeon holes where Thayer filed each cadet's weekly grades, financial standings, and demerits. When cadets reported to the Superintendent, they were surprised to find their every flaw on the tip of his tongue. Because they could not see behind the partition, they would leave convinced that he knew everything about them. (I say that a man who could dream up such a clever desk must have had a sense of humor.)

During the 16 years Thayer was Superintendent of West Point, he earned the respect and admiration of the cadets, sometimes by being unpredictable. One night the "Supe" ferried across the Hudson to attend a party in Garrison. He was shocked to run into one of his cadets, off-limits. Thayer conversed pleasantly with the illegal visitor. The stunned sinner knew he would be severely punished. Instead, it was the commandant of cadets who received a severe rebuke for permitting such an infraction to occur. The story spread among the cadets like wildfire, increasing their awe of the Superintendent.

He also earned their respect by running West Point as a meritocracy, a revolutionary idea in education at the time. Thayer insisted that privileged students should never be accepted over more talented plebeians. He made continuance at the academy conditional on performance. He dismissed cadets who failed academically or breached the academy's rules. And he avoided favoritism of any sort. When his nephew was admitted to the academy, Thayer called him in to his office. "Sir, your relationship to me is known and I am liable to be suspected of partiality to a relative," Thayer informed him, "therefore, I have prepared your resignation, which you are to sign now. If at any time you commit a serious offense, this resignation will be published by the adjutant at evening parade and you will cease to be a member of the Corps of cadets."

The most famous of the Superintendent's student failures was a cadet named Edgar Allan Poe. Orphaned young, a poet, dreamer, gambler, drinker, Cadet Poe was the worst possible misfit. However, the

strict Superintendent granted Poe permission to publish a collection of poems and deducted the 75-cent price from each cadet's pay. Poe lasted seven months before being court-martialed for failure to attend classes, disobedience of orders, and gross neglect of duty. The only good thing the poet ever had to say about West Point was to express admiration for Thayer.

Superintendent Thayer had always demanded a free hand in discharging cadets he believed unsuited to the ideals he had established. When Andrew Jackson became President, everything changed. Thayer would dismiss a man for good reason; then Jackson, for political reasons, would return him by presidential order. Finally, not wanting Jackson's apparent personal animosity toward him to wreak further havoc on the military academy, Thayer resigned as Superintendent. Stunned, every cadet and professor shook his hand in farewell. Then the man who had educated 711 "sons" boarded a boat on the Hudson and quietly took his leave. He never returned.

SYLVANUS THAYER RETURNED TO ACTIVE DUTY IN THE U.S. ARMY
Corps of Engineers constructing harbor defenses for New England. During the next 30 years his educational and organizational expertise was tapped by several institutions, including Harvard and the University of Virginia. Harvard, Dartmouth, and other colleges awarded him honorary degrees. By 1860 his influence had spread throughout the nation. Seventy-eight West Point graduates were on the faculties of the country's 203 colleges, 40 as math professors and 16 as professors of civil engineering.

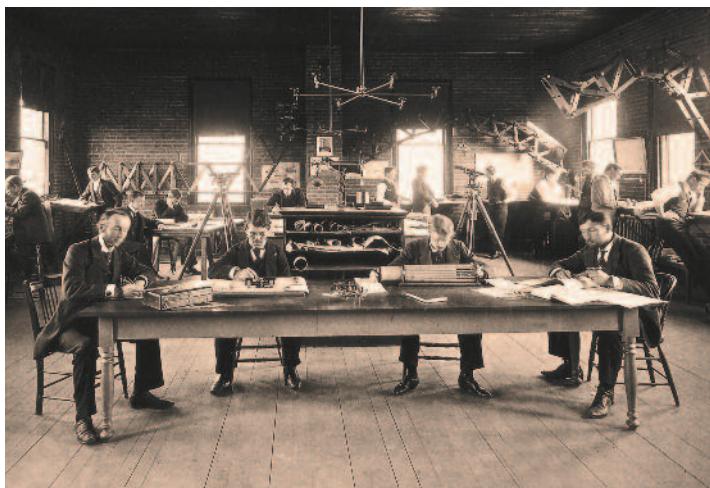
When failing health finally induced Thayer to retire from active service in 1863, at the rank of brevet of brigadier general, he returned to his home in Braintree. There he drew up plans for a new addition to education at Dartmouth.

THAYER WANTED TO ESTABLISH A CIVILIAN SCHOOL TO TRAIN
engineers, desperately needed in our young country. On April 4, 1867, he wrote to Dartmouth President Rev. Asa Smith: "I hope to be prepared to place in the hands of trustees thirty thousand dollars...to be applied to the establishment and maintenance of a Department or School of Architecture and Civil Engineering connected with Dartmouth College, the institution in which I was educated and in the prosperity of which as my Alma Mater I feel the deepest interest."

President Smith and Dartmouth's trustees welcomed the proposal, and Thayer proceeded with his plans for a mainly postgraduate engineering program. One of his greatest challenges was finding the right man to lead the new school. Naturally, he turned to a West Point graduate—

1809	1810	1812	1814	1815	1817	1821	1823	1825	1826
1809 Teaches mathematics at West Point.			1814 Awarded Brevet Major (promotion without pay increase) for design and erection of Norfolk Harbor.		1817 Appointed Superintendent of West Point by President James Monroe. Within first two years, establishes discipline, standards, and nation's first engineering curriculum and technical library.	1821 Professor George Ticknor, classmate and friend from Dartmouth, requests Thayer's advice on revamping curriculum at Harvard College.		1825 Awarded Master of Arts degree by Harvard College.	
1810 Awarded Master of Arts degree by Dartmouth College.			1815 Travels to Europe to study military operations, works, and schools, particularly France's Ecole Polytechnique.			1823 Awarded Brevet of Lieutenant Colonel.		1826 President Monroe consults Thayer on administration of the University of Virginia.	
1812 Fights in War of 1812.									

Dennis Mahan—for help. Mahan, who taught civil and military engineering at the Academy, suggested several qualified Army officers, but none could be persuaded to resign his commission for the smaller salary Thayer's nascent school could offer. Finally in 1870, Mahan suggested a young officer just two years out of West Point: Lieutenant Robert Fletcher. "He is a pious and pure man, one who would harmonize, on all points, with the society at Dartmouth," Mahan wrote Thayer. After meeting Fletcher, Thayer wrote a note of approval to President Smith: "I have sounded him on all points to the best of my ability, resulting in the conviction that he will prove himself to be 'the right man in the right place.' His disposition, morals, principles, & intellectual powers seem to me all we could wish."



DARTMOUTH ENGINEERS Members of Thayer School's classes of 1894 and 1895 work alongside Dean Robert Fletcher, left.

Steeped in the education system Thayer had established at West Point, Fletcher understood perfectly the curricular goals and standards Thayer set for his school of civil engineering. The two conferred constantly on the evolving program of study. They developed a preparatory program for prospective students and persuaded President Smith to allow Dartmouth undergraduates to forego German so they would have time to study the advanced mathematics they would need to pass Thayer School's stringent entrance examinations. In 1871 Thayer School admitted its first three students. The sole professor, Fletcher taught every course, a load that should have been shared by three or four instructors. For the next 47 years Fletcher

directed Thayer School with the care, devotion, and fortitude worthy of its founder.

ON SEPTEMBER 7, 1872, GENERAL THAYER DIED AT AGE 87. HE WAS buried in Old North Braintree Cemetery, near his father's grave. President Smith and other illustrious men came for his funeral. Braintree had never seen anything like it: the parade from the church to the cemetery, the somber martial music, the honorary guard firing a salute over the grave. A local boy had brought world renown to their small New England village. Thayer gave the town a generous legacy, too: funds to build a Thayer Public Library and Thayer Academy, a secondary school on the grounds of his own home. Thayer wanted the school to "offer to youth the opportunity to rise, through the pursuit of duty, industry, and honor, from small beginnings to honorable achievements." Once again he was creating a meritocracy, this time one that was coeducational from the beginning.

OVER THE YEARS SYLVANUS THAYER HAS CONTINUED TO BE PART OF my life. In the late 1960s my husband, Tom, and I took our children to see the Hall of Fame for Great Americans at New York University. The curving colonnade overlooking the Hudson contained bronze busts of winning candidates. At the time only 93 Americans had been selected for this huge honor. And there, in the Hall of Fame, was my old friend. The handsome bronze bust carried the words: "Sylvanus Thayer, 1785–1872, Duty, Honor, Country." Years later, after Tom and I moved to Hanover, I walked past Dartmouth's engineering school; suddenly I stopped short. There, carved in stone on the front of Cummings Hall was a quote from Sylvanus stating the purpose of the school: "To prepare the most capable and faithful for the most responsible positions and the most difficult service." As I read those words—the civilian equivalent of Duty, Honor, Country—I felt I was back at West Point.

Immersed in Sylvanus Thayer lore for this article, I decided to make a pilgrimage to his grave. I envisioned myself putting flowers on his grave and offering a prayer of thanks to him. When I consulted the Internet for directions to Braintree, I got a shock. Sylvanus Thayer had moved. In 1877, five years after his death, he was disinterred and reburied in the West Point Cemetery (where my brother Red now lies). I took a virtual tour of the cemetery via the website www.usma.edu. The General's tombstone is a disappointing oblong block of marble.

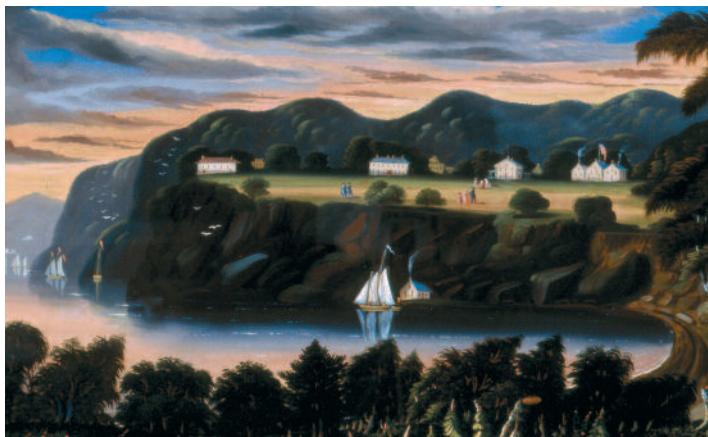
I prefer his statue.

—Nardi Reeder Campion's eighth book, a memoir, *Everyday Matters: A Love Story*, has just been published by University Press of New England.

1833	1833 -36	1838	1846	1857	1860	1864	1867
1833 Resigns superintendency to prevent President Andrew Jackson's rivalry with him from eroding USMA's standards.	1833-36 Constructs Boston harbor defenses. Forts Warren and Independence are models of engineering skill, economy, and construction.	1846 Awarded LL. D. by Dartmouth College.	1860 Thayer's influence on education felt nationally through the success of his cadets: Seventy-eight USMA graduates teach at the nation's 203 colleges.	1867 Donates \$40,000 to the Trustees of Dartmouth College "for the purpose of establishing ... a School or Department of Architecture and Civil Engineering." Outlines a rigorous curriculum for a mainly post-graduate education in civil engineering.			
	1838 President Martin Van Buren's secretary of war invites Thayer to resume charge of USMA. Thayer declines.	1857 Awarded LL. D. by Harvard College	1864 Retires from active duty and returns to family home in Braintree.				

THE DARTMOUTH FACTOR

ECOLE POLYTECHNIQUE WAS NOT THAYER'S ONLY EDUCATIONAL MODEL.



ALMA MATER Thayer gave West Point (left, circa 1835) elements of the rigorous education he received at Dartmouth (right, circa 1803).

Many historians point to Sylvanus Thayer's two-year study of French military schools as the inspiration for his instrumental changes to instruction and administration at West Point, including rigid entrance standards and daily graded recitations. But his decision to round out the curriculum with courses in advanced mathematics and humanities may have been influenced by his own alma mater, Dartmouth.

By 1803, when Thayer entered the College, Dartmouth had established itself as an institution with a rigorous four-year liberal arts education. The class day began at 5 o'clock in the morning and ran until 6 o'clock in the evening. There were three classes per day, with breaks for meals, study periods, and prayers. Recitation was the most widely used form of instruction. Instructors asked questions about the assigned reading and students recited what they remembered. With no pre-selected courses of study or majors, all students received a comprehensive education, taking classes in a wide range of subjects. For the first

three years, students focused on the Classics: from Greek they learned about art, literature, and science, and from Latin they learned about law. Grammar, logic, and geography were also a part of their studies. In their fourth year, students took courses in metaphysics, theology, natural philosophy, and French, the language in which most scientific texts were published.

Thayer chose Dartmouth in large part because it offered several courses in higher mathematics that were not yet available at other colleges, even Harvard. At Dartmouth Thayer was able to study algebra, trigonometry, and calculus. When he graduated in 1807, as class valedictorian, Thayer was the consummate scholar. He excelled not only in the scientific subjects that would lead to his military calling, but in the humanities as well. His accomplishments demonstrated a belief that a complete education would show him how best to serve his country.

This high regard for a liberal arts education followed him through his successful

careers as mathematics professor, soldier, engineer, and ultimately as academic administrator and benefactor. During his 16 years as superintendent of West Point, he encouraged his students to master French so they could translate the foreign texts, giving this country its first books on engineering. Students also studied history, art, moral philosophy, law, and geography to give context to their campaign planning and building projects.

As founder of Thayer School, Thayer wrote out requirements for admission that again emphasized the importance of grammar, geography, and history, along with the requisite background in mathematics and science. He understood that a good education was more than a study of discrete subjects. The ideal curriculum mixed philosophy and theory with skills and practical application. By challenging students to understand the necessary interaction between the two, he hoped "to prepare the most capable and faithful for the most responsible positions and the most difficult service."

—Genevieve Chan

1871	1872	1876	1877	1883	1958	1966	1967	1985	2004
1871 Thayer School of Civil Engineering opens its doors, with Robert Fletcher as sole professor, a Board of Overseers, a program of admission requirements, a curriculum, an endowment, a drawing room, a recitation room, and three students.	1872 Dies September 7 in Braintree.			1883 Thayer statue unveiled at West Point.		1966 Thayer elected to New York University's Hall of Fame for Great Americans as the "Father of Technology in the United States."		1985 U.S. Postal Service issues nine-cent Sylvanus Thayer stamp. Massachusetts Governor Michael Dukakis declares June 9 Sylvanus Thayer Day.	
		1876 Thayer Academy, a coed secondary school, established in Braintree from funds bequeathed by Thayer.		1958 West Point presents first annual Sylvanus Thayer Award to recognize outstanding citizens. Future recipients include Bob Hope and astronaut Neil Armstrong.		1967 Thayer School of Engineering celebrates centennial with publication of school's history and Thayer's school-related correspondence.			2004 Furthering Thayer's goals, expansion of Thayer School of Engineering begins.
		1877 Thayer's remains reinterred at West Point.							—Genevieve Chan

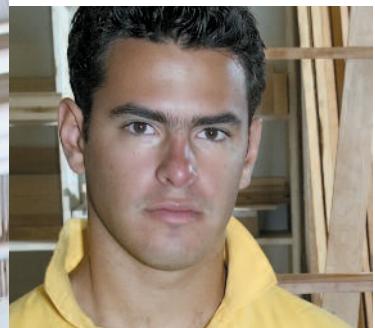
The Art of Engineers

A gallery of
students' creations
erases the line
between analytical
and artistic expression.

BY CHRIS MILLIMAN

Visit any of Dartmouth's art studios at the Hopkins Center, and you're likely to find an engineering student at work. Every year a suite of drawing, photography, sculpture, painting, and architecture courses entice Dartmouth undergraduates to combine studio art and engineering as a double major, minor, or modified major. More Dartmouth engineering students modify the major with studio art than with any other subject. Last year studio art accounted for a third of all modified engineering majors. **>> For the five students** featured here, studio art has been both an outlet and a haven, a complement to engineering and a refrain from it. Whatever the medium, their work shows what engineering and art display in common: the beauty of the creative mind.

PHOTOGRAPHS BY CHRIS MILLIMAN



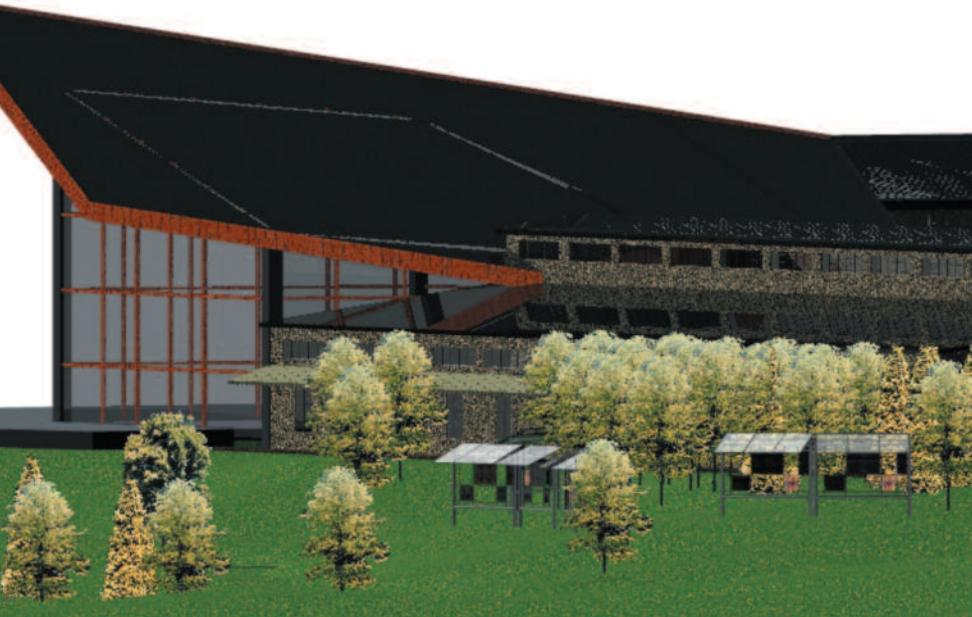
Ariel Diaz '02, B.E.'03

Bookcase: Wood

The woodshop was my creative outlet. As an undergraduate I was spending a lot of time doing crew and a lot of time at Thayer School, and I needed to balance that out. A lot of my early woodwork designs were inspired by crew. This bookcase was based on the shape of the bow of the boat, then became a little more abstract and functional. Visually it's really light, but it's a lot more stable than you'd think because of the cantilevered shelves.

In wood you work with the limitations of the wood and the grain. I've seen a progression in my designs—in woodworking and engineering—where I start thinking more about the end product and the manufacturing. How I'm going to make it becomes an integral part of the design.





Austin Lord '06
Ledge Gallery:
CAD Rendering

As a Dartmouth student and a resident of a relatively small hometown, I find myself continually frustrated with the lack of artistic forums in everyday spaces. Both on campus and at home, art is often confined to a certain delegated space. The goal of my Ledge Gallery is to create an outdoor public forum for art. I try to marry the aesthetic and the structural, creating something modular and simple, yet complementary to the landscape. The initial design was sited on a specific ledge along the Connecticut River, but the gallery's adjustable components and skeletal design allow the structures to be arranged in various tessellations across a landscape. The idea is as much one in landscape architecture as in product design.





Emilie Fetscher '03, B.E.'04
World Trade Center Tower: CAD Rendering

I worked on this project the fall of 2001 in an Architecture 2 class. Our topic was to suggest a redesign for the World Trade Center site following the attack. We created both a physical and CAD (using FormZ) model of the southern portion of Manhattan to understand the greater landscape this site was a part of. My design involved one prominent building based on a contracting and expanding spiral as well as several smaller buildings. Central to this design was a memorial/reflection space depressed under the building itself. The building functioned as a gigantic funnel, open to the air above. Water continually flowed spiraling down the inner windows and into a suspended pool at the center of an underground dome room—a memorial space—where it was then circulated back out to the site. I felt water was appropriate for the memorial and had hoped the design would allude to the convergence and divergence of world cultures and our shared knowledge.

I find art, the creative process, and engineering closely related; each is an exercise in problem solving. Both engineering and creative design are ways in which you train your mind to think. In my work within the studio art department, I find the emphasis is placed on the creative process and the ideas behind the end result. Often in engineering, students place the emphasis on the result, and the process becomes secondary. We learn skills and techniques in order to analyze or create a component or system correctly. My richest experiences have involved bringing the two fields together—the aesthetic details and conceptual ideas of the art world as well as the analysis, systems integration, and real-world application of the engineering world. Although I don't see myself continuing in a traditional engineering field, I do hope to bring perspective to my creative work from engineering.



Narissa Chang '05
Sculpture: Beanbags
and Coffee Grinds

When it comes to studio art and engineering, I prefer to keep each subject independent of the other. I am not overly concerned with integrating the two. People often ask if I am planning to study architecture; my answer is most likely not, although I do believe that art and science do go hand in hand. For me, one is more of an escape from the other. If I need time away from problem sets, a visit to the studio allows me to clear my mind. If a sculpture has me stumped, engineering work pushes my mind to think more analytically, and my mind shifts to problem-solving mode. Working as both a studio art and engineering student seems only natural at times; together, they form a dynamic balance.

Inspiration for this sculpture, as is often the case for my work, was the material itself. After playing with the basic materials—nylons and cotton stuffing—the size of each part of the piece became apparent. The soft materials asked to be sewn. The sewn pieces asked to be held in the palm of a hand. Altogether, there are four rows of seven. Each object is labeled with a number, 1 through 28, with one mound left unoccupied, in order to keep the eye moving throughout the work. Each component, while set on its own plot of ground and given its own number, serves to create a definite space. The numbers are meant to imply some sort of order, the color a sense of history, the texture, rawness, and collectively, time. It intimates being, at once present and absent, while also suggesting a happening, an event of marked significance.





Roy Small '04
Sculpture: Wood and Metal

I like making things that blend in with the room. I like how they're attached. It's a good break from engineering.

This sculpture is a bleeding piece of metal being beaten by wooden mallets that can't even reach it. I don't know what it means; I just thought it was a funny idea. Some people could probably read more into that than I can. The enjoyment is in creating and not overthinking.



BUILDING GREEN

SUSTAINABLE DESIGN EXPERT

MALCOLM LEWIS TH'71

WORKS TO REMAKE HOW THE WORLD BUILDS.

FOR PEOPLE WHOSE EXPERIENCE OF ENVIRONMENTALLY RESPONSIBLE building consists of rustic yurts and hay-bale homes, Malcolm Lewis has good news: going “green” doesn’t have to mean giving up style or comfort. And, better yet, it doesn’t have to cost a small fortune, either.

Lewis, an expert in sustainable building design, is president of CTG Energetics Inc., an Irvine, California-based firm that helps clients create structures that are both comfortable and good for the environment. Since the early 1990s, the company has completed more than 100 green projects for clients ranging from automakers Ford and Toyota to the cities of Sacramento and Los Angeles. Several projects under Lewis’ leadership have earned professional awards for their design or environmental features. One of the most recent, the Department of the Navy’s Public Works Building 850 at Port Hueneme, California, was named one of the Top Ten Green Projects in 2002 by the American Institute of Architects Committee on the Environment.

“There tends to be this perception that a green building has to be either ugly or uncomfortable or it won’t last well,” says Lewis, who received his doctoral degree from Thayer School in 1971. Misconceptions like these, common among building professionals and consumers alike, often are the result of bad experiences with early green technology, he says.

Lewis, however, is doing his part to spread the good news about sustainable design. A former director of the U.S. Green Building Council, he frequently writes and speaks on the topic—including at Thayer School last April—and teaches online courses through the National Society of Professional Engineers and other organizations.

In its most basic form, sustainable design is about minimizing the negative impact a building has on its surroundings. Lewis, like many engineers

BY TAMARA STEINERT



LIGHT MOTIF In the sunny showroom of Ford's new California headquarters, Malcolm Lewis extols the beauty of energy-saving buildings.

"REGENERATIVE BUILDINGS"

are actually capable of improving their environment. They might create more energy than they consume, or leave the air fresher than when it came in, or conceivably leave people healthier after spending a day there."



ON THE RIGHT ROAD: Lewis helped Ford (left) and Toyota (right) build sustainably in California.

and architects of his generation, encountered the first iteration of environmentally aware design during the Arab oil embargoes of the 1970s, when energy efficiency became a high priority. Over time, other resource issues, such as water conservation and waste generation, also came into the picture. Now, 30 years later, these issues are still significant, with buildings consuming a staggering 40 percent of the energy, 25 percent of the wood and 16 percent of the water used each year, according to the U.S. Department of Energy. But contemporary green building also encompasses new issues, such as choosing building sites with minimal impact on ecosystems, creating an interior environment that is healthy and enjoyable for the occupants, and selecting building materials that are not harmful to the environment.

One of the happy surprises for green-design pioneers such as Lewis was the realization that many of the techniques used to make a building more resource efficient, such as "daylighting"—using natural light as a pri-

mary source of illumination—often make buildings more pleasant places to be as well.

"That drove us to begin thinking more about designing buildings that people like to be in," he says. Today, Lewis and a growing number of like-minded architects and engineers believe that the comfort and satisfaction of a building's occupants should be an important criterion for evaluating how well a green building "performs." This perspective is gaining converts among construction managers and business leaders as well, thanks to case studies demonstrating that green building produces significant cost savings.

"There are lots of different metrics we use to find out how the building works for people. At the highest level are measures of satisfaction, things like productivity, turnover, rates of learning and quality control rates. Then there are a building's functional measures, like energy use and solid waste production. The tendency is to think about the secondary measures and not the first," Lewis says. "The

true economic impact of sustainable design is way higher than just the hard cost of constructing and operating the building."

In fact, design, construction, operations, and maintenance typically account for only 8 percent of the 30-year lifetime cost associated with a typical office building. The remaining 92 percent is salaries and other employee costs. "Anything a business can do to monitor and improve the health, comfort, and performance of their employees is money ahead," Lewis says. "Typical office workers cost, on a salary basis, about \$200 per square foot per year. At that rate, improving productivity by just 1 percent per year could potentially pay the entire energy cost of a building."

Numbers like this aren't just theoretical, as a growing number of industry case studies demonstrate. When VeriFone, Inc. in Costa Mesa, California, added skylights, occupancy sensors and natural-gas-fired cooling systems to its existing building, it experienced a 40 percent decrease in absenteeism and a 50 percent decrease in energy expenditures. The company's co-founder, William R. Pape, described Verifone's experience as "a rare instance in which our tools have been largely low-tech," noting that "it has done more to boost productivity than all the bandwidth in the world." Similarly, West Bend Mutual Insurance Co. in Wisconsin reported that including individual controls for temperature, air flow, lighting, and noise in its new 150,000-square-foot building accounted for 4 to 6 percent improvements in productivity. When other green features were factored in, overall productivity rose 16 percent, while energy costs fell by 40 percent. And the company was able to construct the building at a cost of \$90 per square foot in a market where the average was \$125.

A recent CTG project, the Toyota Motor Sales South Campus Headquarters in Torrance, California, hasn't been in use long

DO IT YOURSELF

The principles of sustainable design can be applied to projects of any size. Here are some suggestions from Malcolm Lewis for planning your green building:

- » Ask prospective architects, engineers, contractors and interior decorators about their approach to sustainable design. What criteria do they use to define their buildings as "green"? Have they completed other green projects? Has the organization or person been trained in LEED standards?
- » Bring design and construction professionals into a team so individual efforts don't conflict with each other. These could include engineers, architects, contractors and subcontractors, even the interior designer.
- » Don't assume that new and high-tech is better than old and low-tech. Long before there were mechanical ways to control the indoor environment, buildings were designed to work with nature to provide natural light and ventilation. "The tendency is to go with a high-tech approach on everything, but simple, elegant solutions are what you should look for first," Lewis says.
- » Pay attention to what goes inside the building. Some finishes and furnishings emit fumes that can diminish the indoor air quality.

For more information on green building, see www.ctg-net.com.

HOW GREEN IS MACLEAN?

enough to measure productivity improvements. However, in the year since it opened, the building has already exceeded the 10 percent return on investment required by company shareholders. It also has demonstrated a 94 percent reduction in potable water demand and is 60 percent more energy efficient than required by California's strict Title 24.

"It's a very mainstream building. You wouldn't necessarily be able to tell that it's a green building just by looking at it," says Michele Diener, strategic planning administrator for Process Green, an environmental initiative at Toyota. "That was part of what we wanted to accomplish. And it had to be at no additional cost," she adds.

A key to keeping costs down, says Lewis, is gathering all of the project's design and construction professionals into an integrated team from the beginning. Often excessive costs are the result of mistakes caused by poor coordination, he says. For example, a space designed to use reflected natural light for illumination will not perform like it is supposed to if the interior decorator chooses dark-colored finishes and furnishings.

Despite the impressive numbers that green buildings are chalking up, sustainable building is still far from the norm. "There's a major structural barrier in that the people who build buildings and the people who occupy them have different interests, and there is no incentive to integrate," says Lewis. Construction budgets are typically separate from personnel budgets, making it difficult to leverage the human benefits of green building, Lewis says. Also, in industries like the lease office market, "the developer doesn't get any benefit if the tenants' employees are happier," he notes.

That could change thanks to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. Created in 2000, the program establishes standards for sustainable building and certifies high-quality green practices in completed projects. Lewis, who chairs LEED's Technical and Scientific Advisory Committee, says one of the program's goals is to help educate anyone involved in a building's creation or management—from architect to facilities manager—about the benefits of green technology.

A THAYER SCHOOL QUALIFYING EXAM problem on affordable housing for northern New England first triggered Lewis' interest in building as a focus for his engineering career. His proposed solution had both a technical aspect—the use of new-at-the-time modular

housing—and a public policy aspect.

"I included a proposal for the development of a rural housing financing agency that would provide mortgage financing for people who would otherwise not qualify for it," he says. Although the policy element was a radical departure from straightforward engineering solutions, the proposal was accepted by the Thayer School faculty members reviewing Lewis' exam. "We were talking about replacing homes that were literally tarpaper shacks. That was really unbelievable in terms of the winters they have there. The faculty recognized that you can have the best technology in the world, but it doesn't matter if you don't have any mechanisms for making it happen."

This combination of public policy and engineering was also evident in the research Lewis did with Professor Alvin Converse during his Thayer School years. Converse had been hired by the Vermont attorney general to examine the environmental impact of a nuclear power plant proposed for the Brattleboro, Vermont, area on the Connecticut River. "Both the research I did with Professor Converse and the qualifying problem were a nexus of public policy and engineering issues," Lewis says. "That's what I wanted my life to be about, and it's played into my interest in green building."

Today, Lewis wants to see engineers take more leading roles in the building field.

"Frankly, I have been discouraged by the fact that the engineering community by and large hasn't stepped up to the challenge of green building," he says. In part, he believes this is the result of a gradual minimizing of the engineer's role in building construction over several decades. However, the newest trend in sustainable design, the development of so-called "regenerative" buildings, could offer opportunities for substantial innovation. "Regenerative buildings are actually capable of improving their environment. They might create more energy than they consume, or leave the air fresher than when it came in, or conceivably leave people healthier after spending a day there than they would have been otherwise," Lewis says.

His experience with sustainable design has reinforced for Lewis that good aesthetics and functionality can co-exist in the same building. "The challenge," he says, "is to do a process that honors them both, that synthesizes the left and right sides of the brain."

—*Tamara Steinert is a freelance writer who enjoys writing about environmental issues.*

Just how environmentally friendly will Thayer School's new MacLean Engineering Sciences Center be? Enough to qualify for Silver certification from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) ratings. To do so, MacLean, currently under construction, must score 33-38 out of a possible 69 LEED credit points. Green plans either in the works or under consideration for MacLean* include:

Site Sustainability

- Reduce storm water runoff by minimizing paved areas, using porous paving, and capturing rainwater for irrigation
- Landscape with native plant species
- Design outdoor building and path lighting to avoid polluting night sky
- Reduce car pollution by providing preferential parking for high-occupancy vehicles, an electric car refueling station, bike storage areas, and showers for cyclists

Water Efficiency

- Reduce outdoor use of drinking water by 50 percent through plantings with low water needs, capturing rainwater, and watering with drips instead of sprinklers
- Reduce indoor use of drinking water by 20 percent by using high efficiency faucets, toilets, and shower heads

Energy and Atmosphere

- Reduce energy use of building by 40 percent through triple-glazed windows, sprayed foam insulation, and high-efficiency heating, ventilation and air conditioning systems

Materials and Resources

- Recycling stations throughout building
- Salvage or recycle 50 percent of construction site waste
- Use recycled content in 25 percent of building materials
- Use local sources for 20 percent of building materials
- 20 percent of wood used in the building sourced from Dartmouth College Grant forests
- 50 percent of wood used in the building sourced from sustainably managed forests

Indoor Environment Quality

- Use materials that have low levels of "off-gassing," including carpets, paints, sealants, adhesives, and composite wood products
- Operable windows
- Quiet heating and cooling systems

* MacLean is not a CTG project.

Alumni/ae News

Alumni/ae News not available online



Together Again
Thayer School grads
came back to
Hanover in June for
reunions.

Alumni/ae News not available online

Your Turn

Dartmouth Engineer wants to know what you've been doing since leaving Thayer School. Whether you've continued in engineering or gone in another direction, fill the Thayer School community in on your passions, your career, your life.

E-mail: [dartmouthengineer@
dartmouth.edu](mailto:dartmouthengineer@dartmouth.edu)

Write: Dartmouth Engineer
Office of Communications
8000 Cummings Hall
Dartmouth College
Hanover, NH 03755

Dartmouth Society of Engineers

<http://engineering.dartmouth.edu/thayer/alumni-ae/DSE.html>



Alumni/ae News not available online

*Scott Stewart '03 Dartmouth Formula Racing: Design of an Independent Rear Suspension	Zhiliang Fan Design and Costing of a Process for Converting Paper Sludge to Ethanol in Nexfor Fraser Paper Gorham Cascade Paper Mill	Chad Steinglass '02 Organized Marketing for Frorer Partners, LP	Han Li Semantic Message Oriented Middleware
Alexander Streeter '03 Prototype Circumaural Feedforward Active Noise Reducing Headset	Marc Fenigstein '01 Ski Touring Adapter Plate	Christopher Vander Mey RPM: Developing an Industry Specific eBusiness Solution	W. Riley Lochridge '02 A Robust, Distributed Brokering System for the Agent-Based Environment for Linking Simulations (ABELS)
*Gail Sweeney '03 Vocera VoIP Interface	Ross Gortner III Paper Pulp Refining Process	Omen Wild '97 The Enforcer: A Linux Security Module	Sunit Mahajan A Current View of Spin
*Alexander Tee Articulating Head for a Hand-Held Plasma-Arc Cutter	*Haibing Han URACCAN Water Project	Song Xu China Ethernet Market Analysis and Strategy Development	Sarah Pendergrass Microwave Imaging Device Design and Improvement Related to Dielectric Property
*Cindy Torres '04 URACCAN Water Project	Christopher Hayen Implementation of a Product Data Management System for Stereotaxis, Inc.	MASTER OF SCIENCE	Shannon Agner '02 Spectral Analysis of the Phrenic Neurogram Before and After Vagotomy During Early Maturation
*Tomasz Tunguz-Zawislak '04 Dartmouth Formula Racing: Design of an Independent Rear Suspension	Katherine Hickey Seating Ergonomics of ForwardFace!		Tara Ryan Effects of Culture Conditions and the Replication of a Clinical Repair Technique on Articular Cartilage Explants in Vitro
*Daniel Wichmann Dartmouth Formula Racing: Engine Tuning and Dynamometer Installation	Kevin Horrigan '02 Bringing a Virtual Wind Tunnel to Market		Tuba Sahin Near Infrared Spectroscopy System for Monitoring Peripheral Vascular Disease
*Scott Wisniewski '03 Helicopter Blade Emergency Detachment System	Ryan Kane Cutting Fluid Selection at Hypertherm, Inc.		Chao Sheng Photodynamic Therapy: Assessment of Light and Photosensitizer Dosimetry and Histomorphometry
*Rena Yotsu '03 Switch-Adapted Kid Car	Russell King-Jones '02 Security Assessment and Recommendations for Masonic Hall Building in New York City		Suzanne Wendelken '01 Using a Forehead Reflectance Pulse Oximeter to Detect Changes in Sympathetic Tone
MASTER OF ENGINEERING MANAGEMENT	Craig Laskowski Collaborative Product Data Management		DOCTOR OF PHILOSOPHY
Ian Bodley Dartmouth-Hitchcock Air Response Team Helicopter Location Analysis	Xia Li Develop Basic Operating Parameters to Design a Simulated Moving Bed System for Separating Monomeric Sugars		Zhiliang Fan Conversion of Paper Sludge to Ethanol and Analysis of Selection Based Strain Improvement for Recombinant <i>Saccharomyces Cerevisiae</i> Expressing Saccharolytic Enzymes through Continuous Culture
Tamara Cooke '02 A Feasibility Study of Biodiesel Production in the Upper Valley	Thomas Nichols '02 Semi-Autonomous Robotic Soil Sampler		Karen Lunn Data Assimilation in Brain Deformation Modeling
Ryan Daugherty Lebanon Noise Monitoring System	Patrick Olsen Designing Mechanical Safety Devices for Handguns		Sriram Srinivasan A Novel High-Cell-Density Recombinant Protein Production System Based on <i>Ralstonia eutropha</i>
Eli Diament '02 Colgate Customer Profile and Data Analysis	Azmat Pasha Visual Studio Reporting iFeature		Hai Sun Stereopsis-Guided Brain Shift Compensation
Ariel Diaz '02 Analysis and Design of Next Generation Cabin Suspension for Forklifts at Still GmbH	Mandar Pendse Marketing Research and Brand Management		
Ashly Downey Recruitment Process Improvement	Saurabh Phansalkar Marketing and Pricing Structure Analysis for Leadership In Medicine, Inc.		
José Echenique Connectivity for Inter-Continental Sites	Kelly Schneiter '03 Textco BioSoftware, Inc., Market-Based Business Strategy		
Gordon Ehret '02 Design and Prototype of a User Interface for a Hot Food Appliance	Poonam Shinde Product Management and Marketing		

Be a Mentor

MentorNet, a national nonprofit e-mentoring network founded by Carol Muller '77, pairs women engineering and science students with academic and industry professionals.

- >> Advise students by e-mail about career goals, course work, etc.
- >> Join a lively online community of professionals and students.
- >> Spend just 20 minutes a week—and make a huge difference in a student's life.

Sign up at www.MentorNet.net

inventions



THE ANT HOUSE

>> INVENTOR: PROFESSOR FRANK AUSTIN

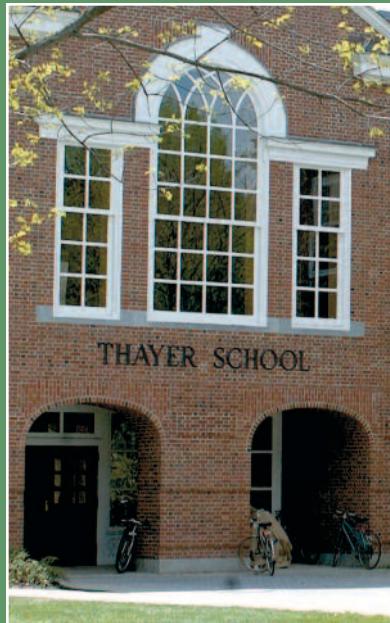
Necessity is the mother of invention, and for Frank Austin, class of 1895 and a retired professor of electrical engineering at Thayer School, his need was pretty dire. The stock market crash of 1929 left him broke. Austin, a member of the Dartmouth team that produced the first medical X-ray in 1896 and the author of numerous papers and texts on electricity, needed money. He set out to work and invented the Austin Ant House. At the peak of production in the mid-1930s, 400 ant houses a day left Hanover. Austin's economic success trickled down to the local economy. The professor paid Hanover kids \$4 a quart for the estimated 3.6 million residents he needed for his ant communities. In addition to a basic \$3.50 ant house, Austin marketed an Antville Fire House, Antville Coal Mine, an entire town called Ant Boro, and a top-of-the-line Ant Palace, which retailed for \$50. With fortune came fame. Profiles of Austin appeared in *The New Yorker*, *New York Herald Tribune*, and *Forbes*. Ant-house fever eventually cooled, but Austin's inventiveness did not. A safer hurdle he made to cut down on runners' injuries was used in the 1936 Olympics. He designed a rocket-propelled grenade and drew up plans for a bombproof airplane factory inside Mt. Washington. Austin eventually relocated to Orlando, Florida, where he ran a roadside museum until his death in 1964.

—Lee Michaelides



RANDOM WALK

When the new MacLean Engineering Sciences Center opens in 2006, a glass atrium will connect it to Cummings Hall. The sunlit corridor will be more than a beautiful space. Providing ready access and views into several of the design, fabrication, and testing facilities of Thayer School's new Unified Projects Laboratory, it will be an open window on engineering education at Dartmouth.



THAYER SCHOOL OF ENGINEERING
DARTMOUTH COLLEGE
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HANOVER, NH 03755-8000

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