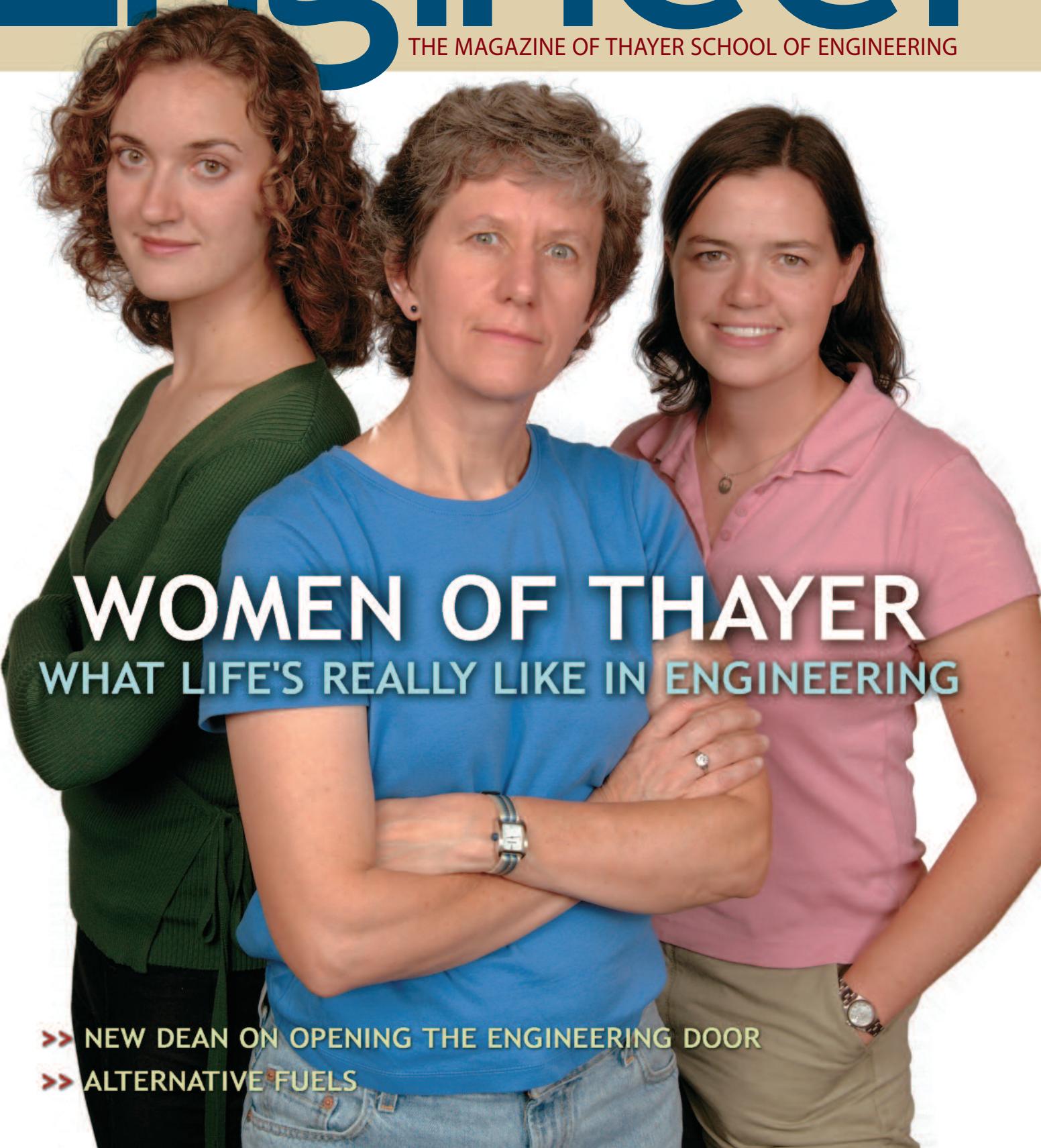


DARTMOUTH

FALL 2005

# Engineer

THE MAGAZINE OF THAYER SCHOOL OF ENGINEERING



## WOMEN OF THAYER WHAT LIFE'S REALLY LIKE IN ENGINEERING

- » NEW DEAN ON OPENING THE ENGINEERING DOOR
- » ALTERNATIVE FUELS

## In Katrina's Wake

BY DEAN JOSEPH HELBLE

HURRICANE KATRINA'S DESTRUCTION OF THE LEVEES in New Orleans painfully demonstrated to a technologically dependent nation that no engineered structure is infallible. Levees—whether in New Orleans or elsewhere—are designed and built to withstand a certain level of storm. Decisions about the protective strength of levees are not based on engineering considerations alone, but on assessments of the probabilities of potential storm damage and on funding priorities. Perhaps the public understands these cost-benefit tradeoffs at the time of construction, but as levees hold year after year through storm after storm, it becomes easy to forget their design and structural limits.

In the wake of the Katrina disaster, it is tempting to rush ahead and build a structure just like before, but bigger, stronger, and more durable—to engineer and build even better protection against the next big storm. We certainly have the technical know-how to do so.

But engineers should also be pushing society to look at the bigger picture and debate broader issues. We should be asking whether rebuilding levees is the only solution we should consider—and whether this is a sustainable solution. We should be posing questions not only about how to build, but about what to build, where to build, and how to live within the constraints imposed by the local environment. Can we, for example, mitigate the next storm by partially restoring depleted coastlines and wetlands to absorb the next onslaught?

As New Orleans is rebuilt, engineers will not be the ones charged with making many of these broad policy decisions. But engineers have the expertise to raise the questions and make sure that political leaders understand the tradeoffs. It is our responsibility to society to do so.

**FEEDBACK LOOP**

Share your thoughts on engineering, Thayer School, or Dartmouth Engineer through a letter to the editor.

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

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

**Editor**

Karen Endicott

**Assistant Editor**

Jennifer Seaton

**Design**

Wendy McMillan

**Contributing Editors**

Genevieve Chan, Theresa D'Orsi, Catha Lamm, Lee Michaelides, Courtney Peschel '99, Th'00, '01, Nancy Serrell, Tamara Steinert

**Editorial Board**

William Lotko (ex officio), Harold Frost, Elsa Garmire, Marcia Craig Jacobs, Lee Lynd, Courtney Peschel '99, Th'00, '01 Amanda Plagge '03, Ellen Stein '86, Jeanne West, Charles Wyman

**Office of Communications**Thayer School of Engineering  
8000 Cummings Hall  
Dartmouth College  
Hanover, NH 03755**E-mail:**[dartmouth.engineer@dartmouth.edu](mailto:dartmouth.engineer@dartmouth.edu)  
Telephone: (603) 646-3521  
Fax: (603) 646-9133  
[engineering.dartmouth.edu](mailto:engineering.dartmouth.edu)**Address Changes**Thayer School Development Office  
8000 Cummings Hall  
Dartmouth College  
Hanover, NH 03755  
[engineering.alumni.records@  
dartmouth.edu](mailto:engineering.alumni.records@dartmouth.edu)

DARTMOUTH ENGINEER is published twice a year for the Thayer School community.

© 2005 Trustees of Dartmouth College

thay6.5m10.05villanti

# Contents



8

## Women of Thayer School

What life's really like in engineering.

BY JENNIFER SEATON

18

## Opening the Engineering Door

New Dean Joseph Helble on why the future depends on engineers.

BY TAMARA STEINERT

22

## Power Plants

In the drive for alternative fuels, Professors Lee Lynd and Charles Wyman explain the growing role of ethanol.

BY GENEVIEVE CHAN



## DEPARTMENTS

- 2 The Great Hall**
- 26 Alumni/ae News**
- 32 Inventions**
- 33 Random Walk**

## ON THE COVER:

Left to right, Julia Ott '05, Th'05, Ursula Gibson '76, and Eleanor Alexander '04, Th'05.  
Photograph by John Sherman.

## BACK COVER

Investiture 2005.  
Photograph by Mark Washburn.

# THE Great Hall

>>NEWS FROM AROUND THAYER SCHOOL



## ROAD TRIP

### Have Vegetable Oil, Will Travel

FIFTEEN STUDENTS TOOK A VICTORY LAP AROUND the Dartmouth Green August 5 after covering more than 10,000 miles in a bus powered by vegetable oil. Eager to talk about their trip and lead tours of the “Big Green Bus,” the students stepped off their home-away-from-home and dove right into an official presentation at Thayer School.

“Driving into Hanover today was incredible,” Ariel Dowling ’05, Th’05 told an enthusiastic welcome-back crowd. “We did it!”

The cross-country bus trip originated as a way to get the College’s Ultimate Frisbee team to a tournament near Seattle but quickly morphed into an experiment in using—and spreading the word about—alternative fuels.

The students, 14 seniors and one junior, including engineering sciences majors Dowling, Mike Beilstein ’05, Dave McCune ’05, and Cliff Orvedal ’05, bought a 1992 diesel-powered school bus and converted the engine to run on waste vegetable oil.

Starting up the vehicle with diesel fuel warmed the vegetable oil enough to flow through the engine. The students refitted the interior with tables, chairs, and sleeping bunks, painted the exterior Dartmouth green, and labeled the bus as running on vegetable oil. The group pulled out of Hanover June 15, three days after graduation.

Throughout the six-week adventure, the bus and its chase car, a Mercedes converted with a commercial kit to run on vegetable oil, pulled into restaurant parking lots to fill up on old, discarded cooking oil. The team used a hose with a built-in filter to transfer the oil from the restaurants’ waste containers to the bus’ fuel tank. The 12-ton bus got a respectable seven miles per gallon on vegetable oil compared to diesel’s eight. According to Orvedal, emissions from the

**Grease Monkeys**  
The Big Green Bus team, pictured inside the vehicle, included four engineering sciences majors from the class of 2005: Mike Beilstein (second from left), Ariel Dowling (fourth from left), Dave McCune (fifth from left), and Cliff Orvedal (seventh from left).

bus were carbon neutral. The exhaust had another advantage as well: it smelled like French fries.

The aroma helped draw attention to the bus, and the group made the most of it, talking with people at every turn. The group made television news in Pittsburgh and attracted crowds at the Boston Common and the beach in San Diego. When a Hummer rolled up next to the Big Green Bus in Washington, D.C., one student jumped out and handed the driver a packet of information on alternative fuels. “We’re not forcing our views on anyone. We just wanted to get the message out,” said Dowling.

“The best audience was the 6- to 10-year-olds,” reported Orvedal. “They ate it up and were excited about everything we said. One kid even suggested using milk as an alternative fuel.”

The students raised almost \$30,000 for the trip. Sponsors included Thayer School, Dartmouth, several businesses, and singer Dar Williams, who, according to Dowling, was “thrilled” with the project.

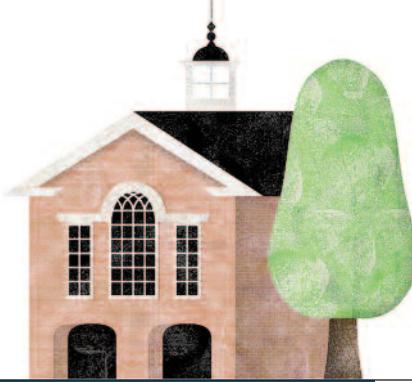
Repairs were the biggest expense. For example, two weeks into the trip the bus ground to a halt. “But it wasn’t due to veggie oil,” Dowling said. “The engine overheated.”

And how did the team fare in Ultimate Frisbee? Not so well. “Sitting on a bus for 16 hours a day is not a great way to train,” said Doug Hannah ’05.

For more information about the project—and instructions for converting vehicles to run on waste vegetable oil—drive to [engineering.dartmouth.edu/other/thebiggreenbus/](http://engineering.dartmouth.edu/other/thebiggreenbus/).

# Big Green Bus Tour

10,000 miles  
◀ 1,429 gallons of veggie oil



## CUMMINGS AND GOINGS

### Three Profs Arrive, Three Depart

>> **Reza Olfati-Saber**, an expert in systems dynamics and control, recently joined the faculty as an assistant professor of engineering sciences. He was a postdoctoral fellow at CalTech in control and dynamical systems after completing his doctoral studies in electrical engineering and computer science at MIT in 2001. He was also a visiting assistant research engineer in mechanical and aerospace engineering at UCLA, working on swarms, sensor networks and complex networks.

>> **Eugene Santos**, professor of engineering sciences, brings expertise in modern statistical and probabilistic methods with applications to intelligent systems, uncertain reasoning and decision science. He earned his M.S. and Ph.D. in computer science at Brown.

>> **Petia Vlahovska** will become an assistant professor of engineering sciences in July 2006. Interested in the dynamics of complex fluids, she is spending the 2005-06 academic year at the Max-Planck Institute of Colloids and Interfaces. Vlahovska earned M.S. and Ph.D. degrees in chemical engineering at Yale.

>> **Metin Akay**, associate professor and senior lecturer, recently became a full professor at the Fulton School of Engineering at Arizona State University, where he will help build a new department of biomedical informatics.

>> **Hamid Dehghani**, assistant professor, became a lecturer at the University of Exeter, U.K. He will also continue medical imaging research at Thayer School as an adjunct professor.

>> **Charles Wyman**, Thayer School's Paul E. and Joan H. Queneau Distinguished Professor in Environmental Engineering Design, became the Ford Professor in the Department of Chemical and Environmental Engineering at the University of California, Riverside, where he will continue his research in alternative energy and fuels. He will remain on the Thayer School faculty as an adjunct professor. To read about his work on ethanol, turn to page 22.

## STUDENT LIFE

### Club Scene

THAYER SCHOOL STUDENTS HAVE TWO NEW organizations to call their own: the International Club and Thayer Council.

Ph.D. candidate Xiongjun Shao says he founded the International Club last spring "to promote communications and make international students comfortable and also to incorporate culture into our education." One of Thayer School's 53 international students, Shao, who is studying biochemical engineering, says homesickness is a constant part of life—he and his wife have not been back to their native China since 2001. The club mixes film nights, dinners, and other social events with advice on visas, housing, and other practical matters to ease adjustment to life and studies in Hanover. You don't have to be an international student to participate, says Shao. Everyone in the Thayer community is welcome. The club's web site is: [engineering.dartmouth.edu/other/tic/](http://engineering.dartmouth.edu/other/tic/).

Thayer Council was formed last fall to foster a sense of community and serve as the student voice in communications with the Thayer School faculty, staff, and administration. Growth in the graduate student body and an increase in student diversity were the impetus for the new student council, according to its co-founders, Ph.D. candidate Doug Van Citters '99, Th'03 and assistant dean for academic and student affairs Ellen Stein '86. "We are laying the foundations for greater student representation at Thayer School," says Van Citters.

Thayer Council meets regularly with the Dean, sends a representative to faculty meetings, and organizes student focus groups for Thayer faculty and staff. The council has held school-wide functions and secured a graduate student lounge in the MacLean Engineering Sciences Center. Open to all Thayer students, the council regularly discusses academic issues, social activities, clubs, philanthropy, and joint events with the Dartmouth Society of Engineers and other Thayer groups. E-mail the council at [thayer.council@dartmouth.edu](mailto:thayer.council@dartmouth.edu).

## kudos

>> **Dean Joseph Helble** has appointed Professor **Ian Baker** as senior associate dean and Associate Professor **Brian Pogue**, who recently gained tenure, as director of the M.S. and Ph.D. programs.

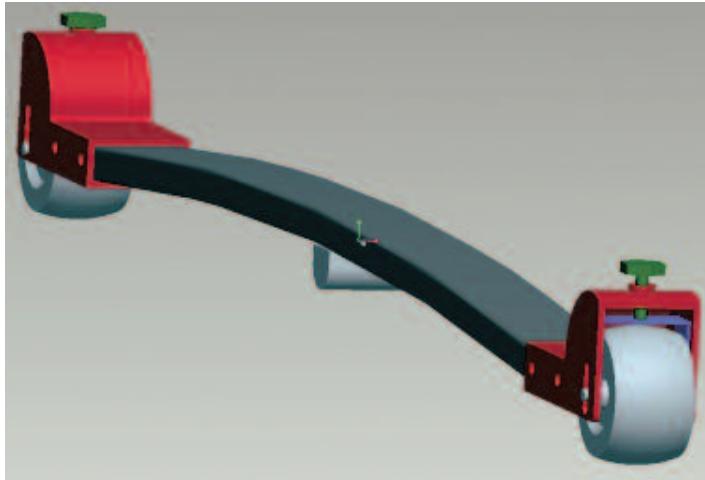
>> **George Cybenko**, Dorothy and Walter Gramm Professor of Engineering, has been appointed as a representative of the Institute of Electrical and Electronics Engineers (IEEE) Computer Society to the Computing Research Association (CRA) Board of Directors. The CRA includes more than 200 U.S. and Canadian academic departments in computer science, computer engineering and related fields, as well as member organizations from industry and government. Cybenko serves on the Board of Governors of the 90,000-member IEEE Computer Society and is currently editor-in-chief of the IEEE publication Security and Privacy.

>> Professor **Lee Lynd** was awarded the Charles D. Scott Award at the 27th Symposium on Biotechnology for Fuels and Chemicals on May 1 in Denver, Colo. The award recognizes those who have distinguished themselves through their sustained contributions to biotechnology for fuels and chemicals.

>> Professor **Bill Lotko** was named editor-in-chief of the Journal for Atmospheric and Solar Terrestrial Physics.

## STUDENT PROJECTS

### I Want One of Those!

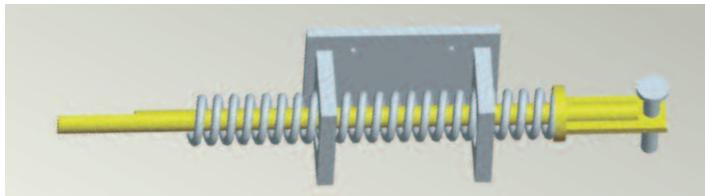


#### ▲ FlexTech Roller Ski

FlexTech improves on currently available roller skis by accurately simulating the dynamic weight shifts involved in the classic cross-country skiing stride. **Monica Martin de Bustamante '08, Ben Koons '08, Ashley Heist '08, and Patrick Biggs '06** won the Phillip R. Jackson Award for outstanding overall performance in ENGS 21 (Introduction to Engineering) last spring. They hope to bring their product to market. Their teaching assistant was **Gail Sweeney '03, Th'05**.

#### ▼ Boof Buster

Boofing, a whitewater kayaking maneuver for descending waterfalls, often leads to broken ankles as kayakers smash against their craft's bulkhead—or their kayak hits rock. So ENGS 21 students **Diede van Lamoen '05, Bennet Meyers '08, Justin Sanford '08, David Strauss '08, and Alfred Umbhau '08**, four of whom are kayakers, designed a bulkhead shock absorber that uses springs to safely suspend the kayaker at the moment of impact. Kayak manufacturer LiquidLogic has expressed interest in the product. **Erik Dambach '04, Th'05** was the team's teaching assistant.



## ENGINEERS WITHOUT BORDERS

### Travels to Kenya

DURING THE SUMMER, 10 VOLUNTEERS FROM the service organization Dartmouth Engineers Without Borders installed a solar-powered pump to provide clean water year-round to the village of Nyamilu, Kenya. The community, home of Audi Okullo '00, Th'05, previously relied on an unpredictable supply of rainfall and water collected from streams for drinking, cooking, and washing. The \$20,000 project was designed to supply clean drinking water as well as water for small-scale irrigation for fruits and vegetables that the community can sell.

According to volunteers Mike Bolger Th'05 and Katie Muse '05, D-EWB outfitted the village's new 98-meter borehole with a pump powered by 480 Watts of photovoltaics mounted on the roof of a small pump house. The villagers had begun to dig the well by hand, but the volunteers, concerned about contamination, hired a local company to drill a borehole. The students tested the water for bacteria and fluoride and briefed villagers about well maintenance. The team plans to stay in contact with the village for the next few years.

In addition to Bolger and Muse, the D-EWB team in Kenya included Ashley Carruth '05, Colby College exchange student Sandy Beauregard, Tia Hansen '05, Tietjen Hynes '06, Erin Osborn '05, Leah Skypeck '05, Allison Welsh '05, and team advisor Brian Klett '89.

To learn more about D-EWB's projects, visit [engineering.dartmouth.edu/other/dewb/](http://engineering.dartmouth.edu/other/dewb/).

**Doing Well**  
D-EWB's  
Sandy  
Beauregard  
helps residents  
of Nyamilu,  
Kenya, test a  
hand-dug  
well for  
contaminants.

## Race Car Weigh-In

2005: 454 lbs.  
2004: 489 lbs.

### FORMULA RACING

## Hot Wheels

THE DARTMOUTH FORMULA RACING TEAM roared to a 19th-place finish among 166 entries in the Formula Society of Automotive Engineers competition held in Pontiac, Mich., in May.

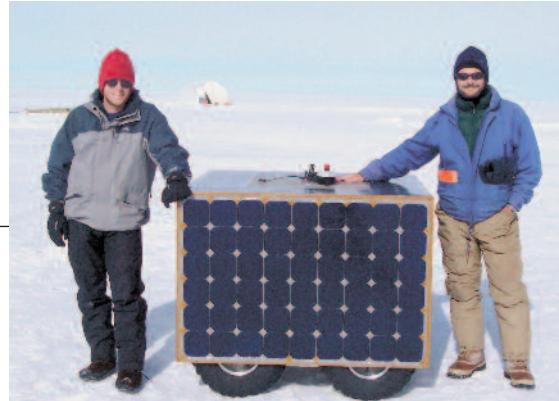
The annual contest incorporates design, presentation, and competitive driving, familiarizing students with the full range of engineering, manufacturing, and marketing considerations that go into producing a car. Dynamic events, including a white-knuckler of an endurance race over a one-kilometer road course, test the car's performance in acceleration, autocross, skid pad, and stamina.

The 454-pound entry, dubbed Vicki by the 35-member team, featured the most compact rear frame design ever built by a Dartmouth team, according to co-captains Jonathan Den Hartog '03, Th'05, Joe Horrell '04, Th'05, and Alric Lam '01, Th'05. Thirty-five pounds lighter than last year's car, Vicki achieved the team's goals for weight and ease of driving. "Most of the mass is concentrated low and in the center of the vehicle to enhance dynamic performance," Den Hartog says. "You can definitely feel it while driving—the car is really quick and nimble around tight turns."

In another innovation the team used Thayer School's new vacuum casting equipment to build a lightweight plastic—rather than aluminum—air intake system for the engine.

The team is already looking ahead. "In future competitions, the team needs to concentrate more on data collection and be ready to justify the choices that are made on each part to the judges," says Lam.

Steer to the team's web site at [engineering.dartmouth.edu/~dfr/](http://engineering.dartmouth.edu/~dfr/).



### LAB UPDATES

## Cool Robot

ALEX STREETER '03, TH'05 AND adjunct associate professor Jim Lever spent two weeks in Greenland during the summer to test Thayer School's solar-powered "Cool Robot" against the cold realities of extreme climates. Designed to be a mobile platform for conducting scientific experiments in the Arctic and Antarctic, the 165-pound robot performed well. "We demonstrated that the robot can navigate long distances autonomously following a GPS course; drive over rugged terrain and soft snow in excess of what we can expect in Antarctica; operate on solar power so long as the sun lasts; match the power from the different solar panels to the instantaneous demand; and tow more than twice its own weight," Streeter reported in an online log ([engineering.dartmouth.edu/other/crobots/](http://engineering.dartmouth.edu/other/crobots/)). The robot has been in development for two years under the leadership of Lever and associate professor Laura Ray.

**Cool Dudes**  
Streeter, left,  
Lever, and the  
Cool Robot catch  
some rays in  
Greenland.



**Trim Figure**  
The 2005 model  
featured the most  
compact rear  
frame design yet  
for a Dartmouth  
formula race car.

>> Adjunct Professor Mary Albert was recognized at Dartmouth's annual Karen E. Wetterhahn Science Symposium for 10 years of mentoring young women.

>> B.E. students Tia Hansen, Liz Hunneman, Jaime Mazilu, Sally Smith, and Diana Szczepanski, all from the Dartmouth class of 2005, received Clare Booth Luce scholarships for 2005-06. Luce scholarships are awarded to engineering-bound women whose academic achievements and other accomplishments are of the highest quality.

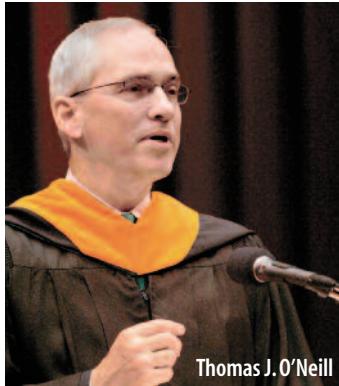
>> Johnathan Loudis '05 won a National Science Foundation Graduate Research Fellowship to pursue his M.S. at Thayer School. Working with Professor Ian Baker, he is studying the magnetic properties of the iron-cobalt-manganese-aluminum metal alloy system.

>> Lauren Padilla '05, Xiongjun Shao Th'03, and Thomas Zangle '05 won first place in the American Institute of Aeronautics and Astronautics' 2005 Northeastern Student Conference Team Competition for their paper, "Micro Air Vehicle Stability Investigation." Professor Simon Shepherd advised the team.

>> Adjunct professor Robert Dean and Joe Brown '00 won the grand prize in the 2005 Start-Up New Hampshire Business Plan Competition. Their company, NanoComp Technologies, co-founded with former adjunct professor David Lashmore, develops long carbon nanotubes for structural composites and electro-energy products. Sound Innovations, a company founded by professor Laura Ray, adjunct professor Robert Collier, and Christopher Pearson Tu'02, was one of 15 finalists out of more than 200 entrants.

>> Sean Furey '04, Th'05 was named Men's Scholar-Athlete of the Year by the U.S. Track and Field and Cross-Country Coaches Association.

# investiture



Thomas J. O'Neill

## Class of 2005

FOR THE FIRST TIME, THAYER School's Investiture, held June 11, took place in Spaulding Auditorium at the Hopkins Center, a venue large enough to accommodate record numbers of graduates and their well-wishers. With Interim Dean William Lotko presiding, 144 Thayer students received hoods, caps, awards, and an official welcome to Thayer School's alumni/ae body, the Dartmouth Society of Engineers.

Thayer School Overseer Thomas J. O'Neill '73, Th'74, chairman and CEO of Parsons Brinckerhoff Inc., received the Robert Fletcher Award for distinguished achievement and service. In his Investiture speech he outlined a formula for success, which is excerpted here:

- 1.** In the poker game of life, your technical competence is an ante. You need a differentiator.
- 2.** One of the biggest differentiators is an ability to communicate.
- 3.** You are all broad enough and talented enough that you will lead and manage and direct. That piece of advice was first given to me by Carl Long here at Thayer



COMMENCEMENT (Left to right) George Tsung, Tomasz Tsunguz-Zawislak '04, and Rena Yotsu '03, Th '04 received M.E.M.degrees.

School. We asked him to teach us about pre-stressed concrete. He told us, "I don't know why you guys want to learn about that—you'll hire people to do that for you." We didn't believe him at the time. Turns out he was right.

- 4.** Be on time.
- 5.** The three magic words in dealing with clients are scope, schedule, and budget. You have to manage client expectations—not necessarily lower them—and deliver a product that performs the desired functions within the time and budget available.
- 6.** Understand the requirements of whoever assigns work to you.
- 7.** Assignments often come down to who the client has the best relationship with.
- 8.** Personal life matters.
- 9.** Power comes from sharing knowledge—not hoarding it.

- 10.** Don't be constrained by arbitrary rules or limits.
- 11.** Get a passport. China will dominate the world economy.
- 12.** Never give up hope.

O'Neill's entire speech is at [engineering.dartmouth.edu/thayer/eve](http://engineering.dartmouth.edu/thayer/eve)

[nts/oneill05.html](http://nts/oneill05.html).

## Degree Recipients

### BACHELOR OF ENGINEERING

**Mustafa Abdur-Rahim '04**

Design Turbojavelin for Blind Disabled Athletes

**Angel Acevedo '03**

Wheelchair Foot Adaptor

**Eleanor Alexander '04**

RapidSet Gate System

**Dale Apgar '04**

DFR Driver Controls, Ergonomics and Safety

**Marcus Assefa '04**

Wheelchair Foot Adaptor

**Adam Barsky '03**

Upper Peninsula Bridge Project II

**Matthew Bell '05**

Handheld Currency Reader

**Keith "Kip" Benson IV '04**

Hybrid Race Car Phase 2

**Spencer Boice**

### BY THE NUMBERS

#### Engineering Graduates

<b>13</b>	Doctor of Philosophy
<b>29</b>	Master of Science
<b>32</b>	Master of Engineering Management
<b>70</b>	Bachelor of Engineering
<b>59</b>	Bachelor of Arts, Engineering Sciences Majors

**“One of the best parts about being an engineer  
is working on things that will benefit  
people for 50 or 100 years or more.”**

—THOMAS J. O’NEILL ’73, TH’74, AT INVESTITURE

**Michael Bolger**  
DFR Differential Drivetrain and Brake Systems Development  
**Kelly Cameron ’04**  
Gliding Snowshoes  
**Luis Carrio ’04**  
DARTSAT Spin Stabilization and Release Mechanism  
**Robert Conrado ’05**  
Switchgrass Feedstock Logistics Systems  
**Erik Dambach ’04**  
Ethanol as Fuel for Recreational Boating  
**Jonathan den Hartog ’03**  
Helicopter Blade Emergency Detachment System  
**Jordan Desroches ’03**  
Circuitry to Charge a 12-Volt Battery from a Vertical Axis Wind Turbine  
**Ariel Dowling ’05**  
Head Impact Telemetry System™ for Ice Hockey: Monitoring Real Time Impacts  
**Faisal Fazalbhoy ’04**  
Fixed-Point Implementation of Feedforward ANR  
**Brian Ferguson ’04**  
DFR Front Suspension and Steering Development  
**Andreas Fiolitakis**  
Sequencing Stardust  
**Eric Fitz**  
DFR Fluids Team  
**David Fouche**  
DFR Fluids Team  
**Philip Frost ’04**  
Turbojavelin for Blind Disabled Athletes  
**Max Funk**  
Low-Profile Robotic Vehicle for Over-snow Traverse  
**Sean Furey ’04**  
Turbo Javelin  
**Jasmine Gipson ’04**  
Virtual Server to Virtual Server Conversion Tool Development

**Ryan Goldhahn ’04**  
Low-Cost Inertial Smart Sensor  
**David Goldstein**  
DFR Front Suspension and Steering Development  
**C. Susana Guajardo ’04**  
MRI Gauss Meter Design  
**Martin Habermehl**  
Sequencing Stardust  
**Daniel Hassouni ’05**  
Turbo Javelin  
**Sarah Hatridge ’05**  
Hybrid Race Car Phase 2  
**Scott Hazard ’03**  
Articulating Head for a Hand-Held Plasma-Arc Cutter  
**Stephanie Johns ’04**  
DARTSAT Spin Stabilization and Release Mechanism  
**Jay Jung ’03**  
DFR Drivetrain Development  
**Ian Kahn**  
Cool Robots  
**Carolyn Kirchner ’04**  
Feasibility Study of Anaerobic Digestion at McNamara Dairy  
**Linden Klein ’05**  
Switchgrass Feedstock Logistics Systems  
**Yuki Konda ’05**  
Fixed-Point Implementation of Feedforward ANR  
**Jillian Ladegard ’04**  
MRI Gauss Meter Design  
**Jessica Lawrence**  
Upper Peninsula Bridge Project II  
**Ethan Levine ’03**  
Life Cycle Analysis with an Environmental Impact Redesign of Hybrid Vehicles  
**Carl Longard**  
DFR Front Suspension and Steering Development  
**Johnathan Loudis ’05**  
Characterization of Cryolite as an Optical Thin Film  
**Reginald Martin IV ’04**  
Switchgrass Feedstock Logistics Systems

**John McCall-Taylor ’03**  
DFR Drivetrain Development  
**Curt Monaco ’04**  
Investigation of High Performance Hybrid Drive System for Race Cars  
**Colin Murray ’04**  
Turbo Javelin  
**Joshua Navikonis**  
DFR Rear Suspension Development  
**Henrik Nyberg**  
DFR Engine Management Team  
**Julia Ott ’05**  
Handheld Currency Reader  
**Lauren Padilla ’05**  
Micro Air Vehicle Stability and Control  
**Joshua Peteet**  
Handheld Currency Reader  
**David Philips ’04**  
DFR Vehicle Dynamics Development Abstract  
**Alexander Price ’04**  
DARTSAT Spin Stabilization and Release Mechanism  
**Daniel Renner ’04**  
Design and Development of an Artificial Larynx  
**Peter Rice**  
RapidSet Gate System  
**Zachary Ruff ’05**  
Neuropathic Foot Alert Monitor  
**Tasha Sakaguchi**  
DFR Engine Management Team  
**Philip Taber ’04**  
Hybrid Race Car Phase 2  
**Daniel Tadesse ’03**  
A Protocol for Lead-Free Assembly and Other RoHS Issues  
**Heiyab Tessema ’04**  
A Protocol for Lead-Free Assembly and Other RoHS Issues  
**Monica Thomas**  
DFR Data Acquisition and Electronics Development

**DEGREE RECIPIENTS** continued on page 30

# honors

- >> **The Dartmouth Society of Engineers Prize** for outstanding B.E. project: Robert J. Conrado ’05, Linden T. Klein ’05, Reginald W. Martin ’04, and Amol B. Pingre
- >> **The Charles F. and Ruth D. Goodrich Prize** for outstanding achievement: Alexander D. Streeter ’03, Th’04, ’05
- >> **The Caroline Henderson Prize** for best M.E.M. project: Ryan C. Dunn ’03, Th’04, ’05
- >> **The Thayer School of Engineering Corporate Collaboration Council Engineering Design Prize**: for best performance in ENGS 190/290: Matthew D. Hodgson, Monica J. Thomas Th’05 and Colin T. Ulen
- >> **The Thayer School Faculty Award for Academic Excellence** in B.E. coursework: Matthew P. Bell ’05 and Thomas A. Zangle ’05
- >> **The John C. Woodhouse Engineering Design Prize** for cost-effective designs of experimental equipment: Heng Xu Th’05
- >> **The John C. Woodhouse Environmental Engineering Prize** for outstanding work in environmental study or research: Magdalena E. Dale Th’05, Xi Nan Th’05, Ph.D. candidate Jennifer D. Pollock, and Satish Prabhakaran Th’05
- >> **The Brianna S. Weinstein Engineering Design Prize** for new technologies, systems, or devices addressing physical or developmental disabilities: Julie A. Matteini ’03 and Rena L. Yotsu ’03 for their “Switch Adapted Kid Car”
- >> **Special Faculty Award for Engineering and Service to Humanity**: Dartmouth Engineers Without Borders
- >> **The Phillip R. Jackson Engineering Sciences Prize** for outstanding performance in an introductory course: Monica Martin de Bustamante ’08, Ben Koons ’08, Ashley Heist ’08, Patrick Biggs ’06, and TA Gail Sweeney ’03
- >> **The George A. Colligan Memorial Prize** for outstanding performance in materials science: Johnathan A. Loudis ’05
- >> **The Richard W. Olmsted Engineering Sciences Prize** for outstanding performance in the major: Julia L. Ott ’05 and Thomas A. Zangle ’05
- >> **Excellence in Teaching Award**: Charles Sullivan
- >> **Outstanding Service Award for Faculty**: Laura Ray
- >> **Outstanding Service Award for Staff**: Joan Levy, Terry Priestley

# WOMEN OF THAYER SCHOOL

WHAT LIFE'S REALLY LIKE IN ENGINEERING

BY JENNIFER SEATON

AMID ONGOING NATIONAL DISCUSSIONS about why there aren't more women in science and engineering, we asked women of Thayer School to talk about the lives they've made in engineering. Spanning the 33 years since Dartmouth went coeducational in 1972, these alumnae, students, and professors recount their studies and careers, why they chose engineering, and why they love doing it. They also talk about the moments when they've bumped up against the reality that the world of engineering is still getting used to the presence of women. "Even though it seems like there's nothing gender-specific in engineering, I've never met a woman who didn't reach an age where she realized things were different for her because she was a woman," says Elsa Garmire, Thayer School's Sydney E. Junkins 1887 Professor of Engineering and former dean. In the interviews that follow, 14 women offer their thoughts on education, work, and life's challenges.



#### THE VIEW

Women, including (left to right) Julia Ott '05, Th'05, Ursula Gibson '76, and Eleanor Alexander '04, Th'05, comprise 25 percent of Thayer School's student body and 10 percent of the faculty.



### URSULA GIBSON '76

Associate Professor of Engineering  
Thayer School

**As a student at Dartmouth,** I enjoyed the collaborative energy in science and engineering. The material was tough enough that people tended to work together. It was tough but rewarding. I appreciated the sciences, in that if I worked harder I improved. In the humanities there wasn't a strong link between effort and reward, at least for me.

**One of the things I noticed about physics, and science in general,** was that if you were able to do the problems then there was a certain de-coupling from your personality, your gender, and your appearance. You were judged on your ability, and I found that very appealing.

**There were only a few times in my career when I felt gender was an issue.** As an undergrad, there were occasional rude remarks, but those were in the dining hall, not the classroom. In graduate school, I was one of two or three women in a research group in which a faculty member passed around a pornographic magazine from his trip abroad. I flipped through it and passed it on—it wasn't a big deal. Once I was working in an industrial lab and they had a '40s calendar girl in a bathing suit as their good luck charm. When I came for the summer, they didn't want to take her down and they didn't want to offend me, so they put curtains up over her. At some point I peeked to see what was hidden there, then I got a comparable picture of a guy and put it right next to her, with curtains over it. After I put that up, the guys were willing to talk to me about it. I think they appreciated that I could take a lighthearted view of the situation.

**If there's something slightly uncomfortable in a new situation, you can often move past it by using humor.** Then, once you get to know the people better, you can try to shape their attitudes. Most people who make insensitive remarks do it thoughtlessly. If somebody goofs once and you get bent out of shape, they are likely to react strongly as well. If you can either make a joke to help them see your point of view, or if you have a quiet conversation with them later, it may be a better way to improve the environment.

### SUSAN ASHLOCK '00, TH'00

Software Design Engineer, Microsoft  
Redmond, Washington

**One of the things I liked best about Dartmouth** was how well-rounded people were. It's interesting how important it is at work in general to be able to be empathetic and help other people. I think because of the community at Dartmouth, students learn the importance of developing relationships, which is an important trait to carry forward in the working world and life in general.

**In what I do now, working on the next version of the Microsoft flight simulator, there's a huge amount of existing code.** Maybe I want to do X, and the ability to do almost X is in there, so I have to go talk to people. It can be overwhelming and it can be very interactive.

**I never really thought too much about gender issues during school.** I was a leader of the Society of Women Engineers while I was at Dartmouth. But gender didn't concern me until I started working and realized that, for example, there are 20 software engineers on my team and I am the only woman. While you're in school, there are people who are trying to encourage you to pursue a career in sciences or engineering; once you graduate you take on that role of encouraging other women. I've talked to several groups—a middle school group for girls, a summer program for high school girls in technology, a round table, and kids in general. Also, being involved with pilots made me realize how few pilots in the United States are women—I think it's about 5 percent. Now that I've gotten to experience those numbers, it's a little more disconcerting to me. I'm trying to think of other ways I can contribute. It's especially important to get young girls comfortable with science and technology. It's really hard to jump into those things in college and feel comfortable.

**Sometimes in communication or interpersonal matters, women do things differently than men.** It would be nice to have women in senior positions, to have role models to emulate. But there are none.



### MARGARET FANNING TH'79

Research Engineer  
Thayer School

**It was hard for me to go into engineering**, even though my father was an engineer. If you don't see any women in science, it's difficult to think of yourself doing that sort of thing. I was intimidated by engineering because I didn't think I could do it. But once I was at Thayer School as a master's candidate, I found that it was not only possible, but a lot of fun as well.

**At Thayer School I worked hard and played hard.** I studied until 11 p.m., then played hockey, closed down Five Olde Nugget, then headed

back to school to finish homework. Sometimes I slept in my office. There were three women at Thayer when I was there, and I never felt singled out, or even particularly different from anyone else. But I did notice that when I saw one of the other two women in the hall, they stood out—I really noticed them. I guess I stood out too, but I was never made to feel that way.

**Some women went through that time without having much sense of the feminist movement**, but I was definitely aware. Society teaches us a lot of things without our knowing it; when you are raised in a certain manner, you can't help but absorb the stereotypes. I don't think you can totally get rid of internalized stereotypes. The best you can do is not act on them and not reinforce them—that way they lose their power.



### MARGARET WORDEN TH'87

Vice President of Product Development, GlycoFi  
Lebanon, New Hampshire

**As an undergraduate I went to Swarthmore, where there was a very small engineering program and about half the students were women.** When I went to Dartmouth, it was a little bit of a surprise to see how under-represented women were. I think there were three women out of the more than 90 students in the Thayer program. It was a little shocking.

**Going into Thayer, I knew there just weren't very many female engineers to begin with.** The numbers didn't bother me so much as the culture of the gender mix; it often felt more like a fraternity than an academic institution. There were Friday beers and many who had been undergrads at Dartmouth still went to fraternities. And I was gay on top of that.

**What I liked best about Thayer School were the project elements.** I worked with John Collier on cell culture research. The hands-on projects where I tackled a problem and tried to come up with a real solution were the inspiring part of the experience.

**I've had some difficulties being a woman in this field.** When I first started working in the early 1980s, it wasn't uncommon for the men in the machine shop to hang up posters from the tool companies that had scantily dressed women posing provocatively with the tools. There weren't any workplace laws on harassment. The most embarrassing thing that happened to me was actually receiving one of these things in the mail—addressed to my first initial and not my first name. I complained to my male coworkers and the tool catalog company, sarcastically suggesting there should at least be a male version of the calendar. Unfortunately, they did have a male version, which they sent me. I ended up hanging that in the machine shop, and after that, all the calendars came down.

**On the less humorous side, most of the other comments have been around pregnancy.** I was even asked in an interview once if I planned to stay or if I was just going to get married and leave to have babies.

**I just never let it get in my way.** Times have changed quite a bit, but I still am often one of the few women in the room—I still notice it. You have to sit there and wonder why there aren't more of us. When I meet with other companies, I notice that there are so few women in senior management.

**I delayed having kids for a very long time.** I had my first child at 38. By that time I had pretty much established myself in a career. Now I have two boys, ages 4 and 8 months. My partner and I live in Hanover, and she works at Dartmouth. We wanted to be close to our parents and be in the area where we felt we really wanted to raise kids.

**Once you have children, you can't do what you did before unless you have a full-time nanny. I had to cut back on the number of hours I was in the office.** I used to work all kinds of weird hours. I think it's more of a personal struggle than a corporate one. You just have the feeling you don't get as much done as you used to. You have to depend more on other people because you can't be there all the time.

**A lot of things in life are completely random.** You have to go with what excites you because you spend a lot of time doing it. Don't settle for something that doesn't thrill you.

### ELSA GARMIRE

Sydney E. Junkins 1887 Professor of Engineering, Thayer School

**Only two women in my Radcliffe class majored in physics compared to 50 Harvard men.** The world was very different for women then. There was a belief that men knew it all. They had all the power, so we women really looked up to them, and some of us wanted to be like them. Women who chose to go into fields where there weren't other women didn't really look to other women for help. We thought women weren't as smart as men. We didn't have a built-in support network. It was a very lonely time.

**The boys all took shop in high school but girls weren't allowed to.** I was behind on that kind of knowledge. Exams assumed knowledge based on that kind of past experience. Today there's an effort to ask questions that test knowledge independent of cultural background, but that wasn't the case then. Ultimately the only three women in the program did all the problems together and formed a study group. We did okay and supported each other. Maybe there was an effort to discourage women because they figured we would drop out anyway.

**The way universities are set up puts women at a disadvantage.** The tenure program comes around just as you're in your childbearing years. I have two girls. I could do it because I was a post-doc for nine years at Caltech, where my husband was. By the time I started my own career, I already had 30 or 40 papers and was bringing in all my own funding. I was appointed full professor with tenure at USC, where I was the first female engineer on the faculty. By the time I left 20 years later, I was still the only woman in my department.

**My advice to young women who want to go into engineering is to marry a truck driver—someone who can get a job anywhere.** Marry someone who doesn't have their own ego bound up in their career if you're going to.

**It also helps to network with women.** Even though it seems like there's nothing gender-specific in engineering, I've never met a woman who didn't reach an age where she realized things were different for her because she was a woman. When I grew up, women were not taught to respect each other. I had to learn to respect other women. Now at conferences, women seek each other out. The way to be happy in what you do is to talk to other people in the same situation.

## NINI DONOVAN TH'99 '00

IT Project Manager, PricewaterhouseCoopers, Boston, Massachusetts

I majored in math as an undergrad at Swarthmore, and I didn't really know what I wanted to do afterward. Professor Daubenspeck from Dartmouth was visiting Swarthmore my senior year and I heard about him and the engineering program. I talked to him at Swarthmore, and he invited me to go see Thayer and some of the projects that were going on. It was just what I was looking for. I enrolled in the B.E. program and then I did the M.E.M.

I loved living in Hanover. I'm very outdoorsy so it was a good place for me. I met my husband, Patrick Donovan Th'00, in Professor Kennedy's mechanical engineering class. Professor Kennedy still keeps reminding us that he was the matchmaker. For the class you have a project where you build a bridge, and we were partners for that project. The bridge did really well!

I participated in the Society of Women Engineers and went to schools in the area and promoted science by doing magic shows. When I was at Swarthmore majoring in math, being a woman was a bit of a concern because the department was sort of dominated by men. I didn't feel that at all at Thayer. I did better in my classes because I felt comfortable. It was an environment that encouraged creativity. The important thing was getting the job done. A lot of other engineering schools have bigger programs, but I think what Thayer does is really develop the creative aspect of people and teach them how to attack problems from different angles. Going through the B.E. project and working with a company shows you how to get the job done. That's something you notice a lot in the working world—people who know how to develop something and get the work done.

After school I worked for a software company, and I was laid off right after I finished their training program. After that I got hooked up with PricewaterhouseCoopers in Boston. Finding a position has a lot to do with luck and getting out there and making the right connections and finding ways to get opportunities. It takes more than being excellent at what you do, especially if you work for big corporations. There's a lot of politics involved. Connecting with alumni helps.

## SALLY ANNIS '97, TH'98 '01

Senior Systems Engineer, BAE Systems  
Nashua, New Hampshire

I'm working for BAE Systems on anti-missile technology to protect aircraft from heat-seeking missiles. The nature of this industry is that the projects are big and you have to work with large groups of people to get something accomplished. The people who are more purely technical-based struggle a little bit more. I would tell students not to focus too narrowly on one thing. If your education and experience are very narrowly focused, you're kind of stuck. I'm a big believer in a lot of breadth.

Being a woman is almost a non-issue at my company, but it's fairly obvious at other companies we work with that they're not used to a woman being around. Our senior management is about half women, but we work with another large defense contractor that has almost no women. Some of my co-workers who have lots of experience with these types of companies said that the "old boy" culture is the norm for this industry. Since one particular old boy company is not performing as well as expected, I find it humorous that my company's female manager and customer liaison have to go and visit to get these guys to do some work. I am not sure how these guys feel to be working for a couple of women.





### RACHEL ROTHBAUM '00

Mechanical Engineer/Toy Designer, Creativity Inc.  
Menlo Park, California

**When I was in 7th grade an engineer came to our math class to talk to us about engineering, especially to the girls.** I remember thinking, there's no way I will ever be an engineer. I came to Dartmouth interested in pre-med. Then one of my physics professors suggested I take an engineering class. My favorite class was ENGS 21. It was the first engineering class I took. It was really cool to work with three other people. In most classes at Dartmouth you work on your own. I made one of my best friends from that team. The main thing I liked about engineering was the teamwork aspect, and I really, really enjoyed problem-solving. I even enjoyed problem sets because I liked reading the question and then trying to figure out the solution. I'd get a little obsessed. After a few hours you get sick of it, but at first I was always pulled in.

**One of the things we were always told was that we're not really being trained to be technical engineers.** The thing they do teach us is to know a little bit about everything. That way you can manage. You know what you don't know and you can go ask for help. For me it's really exciting because I know a little bit about what everyone does at work. I like having my hands in a bit of everything. It lets me constantly learn about things. I feel Dartmouth made me more curious about a lot of things. We're almost trained not to be specialists.

**Having more women mentors in the program would be helpful.** I'd love to see

more women professors. Students could also benefit from the regular presence of women with real industry experience.

**Now I'm a toy designer.** I constantly think of new ideas and look at what's out there. I do a lot of prototyping and a bit of electrical engineering. My job has that problem-solving approach that's very much what we learned at Dartmouth. I'm the only woman on my floor at work, but I feel like everyone's really open to what I have to say.

**My company recently sent me to a summer workshop at Stanford where there were about 12 men and I was the only woman.** I have to do a lot of letting go and not just think, "I'm the only one, I'm the only one." Over time I've gained a lot more confidence in myself. I think that some women, because they're surrounded by guys, feel like they need to act like guys or act super-girly. I don't admire that. I feel: just be yourself. Eventually it gets better and you learn how to handle yourself. One of the great things women have going for them is that they're not as proud sometimes as guys, and that's a huge advantage when you get out into the workplace. I think women are better at knowing how to ask for help.

**Dartmouth is always talking about how they are teaching us to know about everything.** When you first graduate it's very frightening because you don't feel like you know anything. It's really hard for two or three years, then suddenly you're like, "Wow, I did learn something." I'd tell current students not to be so scared when they first get out. We recent graduates have more going for us than we first realize.

**LAURA IWAN '93, TH'94**

Senior Systems Engineer, Ballard Power Systems Inc., Vancouver, Canada

**I did not originally intend to be an engineer.** I didn't even go to Thayer until the second or third term of my freshman year. But particle physics classes didn't really speak to me, so I thought maybe engineering would be for me. The engineering school had just been renovated and everything seemed sparkly shiny new. I had never done anything like the ENGS 21 class where there was so much working together and brainstorming. I found it exciting to meet and work with the other people.

**My best memories are from my B.E. project.** I worked with a group to convert a pickup truck from gas to electric power. I remember the moment we actually finally got it to run after two terms of getting it together. I was late to a music rehearsal, but I thought, "I'm not going to leave now." So for the truck's maiden voyage, one of the other crew members and I drove in the truck to take me to my rehearsal. I also remember a professor who interspersed his lectures with fatherly advice like always eat breakfast and make sure you marry someone who's your best friend.

**There were always at least one or two other women in the smaller classes and five or six other women in the bigger classes.** In my ENGS 21 class, we had three women and two men in my project group. I never felt that it was anything unusual that I was a woman. It just was never really an issue. I just felt like one of the students.

**I went to Princeton to get my master's in mechanical engineering, then went to work for Ballard Power Systems, a fuel cell company in Vancouver, Canada.** I worked on a stationary power plant, then on a submarine. After that I worked on fuel cell transit buses and was involved in all stages of the project, from conceptual design to commissioning. Forty of the buses are now in use.

**I met my husband at work and now have a one-year-old son.** Maternity leave in Canada is one year, so I am going back to work three days a week. I'm trying to figure out how I want to do it. Luckily, Ballard is fairly flexible.

**I wish while I was at Thayer that I had the perspective to know it's not always worth the stress and the missed sleep to complete every last step of a problem set.** Ten-plus years later, I don't remember most of the details of the classes I took. Just leave things and try to get the bulk of knowledge from it.

**JULIA OTT '05, TH '05**

M.E.M. Candidate  
Thayer School

**I completed my B.E. in June and am now working on my M.E.M.** As the third child in my family to become a Thayer engineer I had quite a bit of prior contact with the school. I knew engineering would be a demanding major, but that was part of the allure for me since I thrive on challenges.

**One of my favorite things about Thayer is the sense of community the school cultivates.** Everyone knows everyone, the professors' doors are always open, and collaboration is part of the culture. **The group work does pose relational and communications challenges** which can be magnified when you're the only woman on a team or in a class. You have to be willing to speak up, and sometimes you have to stand your ground and fight to make your point heard. You also have to realize that sometimes men and women speak different languages, and you may occasionally need to translate.

**As a female engineer you get used to spending all of your time around guys,** but it's definitely a different experience than you might have in more balanced majors. A group of us were working on problem sets in the Great Hall one day, and another girl and I somehow got on the topic of underwear. The guys at the table started to complain, "We don't want to hear about that." She shot back, "I don't want to hear it—do you know what I have to put up with most of the time?" That's pretty reflective of everyday life for a female engineer—good-natured banter with some underlying truth.

**I think women in general are more willing to ask for help, and that's definitely an advantage.** You occasionally run up against the "oh, a girl can't do that" attitude, but that's just another chance to prove that yes, in fact we can. It can create more pressure to perform because you don't want to prove the naysayers right by turning in the worst performance in the class, but that's not a bad goal to have anyway.

**I do think that social attitudes outside of the academic environment regarding women in "non-traditional" professions will be longer in catching up.** When people find out I'm a Dartmouth engineer, it's the "engineer" part that surprises them.



## DINSIE WILLIAMS '97, TH'97 '99

Systems Engineer, G.E. Medical Systems  
Pewaukee, Wisconsin

**I had a good time at Thayer.** I liked it because of the size. I got to know the professors really well. And I was glad that we had the opportunity to join groups such as the Dartmouth Society of Engineers, the Society of Women Engineers, and the Society of Black Engineers. Participating in organizations like these helps when you are looking for a job. The things that differentiate you are work experience and leadership.

**For me being a woman wasn't such a big deal.** I came from a family of educators. My father was a professor in math; my mom was a high school principal, and she taught French. I participated in the Women in Science Project and got one of my internships through it, and I worked in the physics department. At Thayer I remember sitting in one of the biggest engineering classes and there were five women. It didn't bother me too much, but I thought we should have more women. I just thought it was odd. I had more issues being an international student than being a woman—I'm from Sierra Leone in West Africa. I was in the African Caribbean Students Organization and the International Students Association.

**I work on CAT scan development for GE in design and evaluation.** Being a woman, I think I'm lucky that I stayed technical. In jobs where a lot of personalities are involved, male-to-male bonding makes a bigger difference. In my department there are probably three women out of 50 people. I've been given a lot of responsibility. Science and math and engineering are not gender-specific. If you have the talent, you can use it.



## PATRICIA SHEEHAN TH '86

Partner, Cesari and McKenna, LLP  
Boston, Massachusetts

**In 1977 while working towards my math major at Mount Holyoke, I spent my junior year at Thayer School.** I noticed how few women were in my classes at Thayer School, and at Dartmouth as a whole. Many undergraduates and alumni were actually debating the desirability of women attending Dartmouth.

**After graduating from college and then law school, I practiced general corporate law for about two years.** I was unhappy working as a lawyer and, since I enjoyed engineering in college, I decided to go back to Thayer School to get the B.E. with the intention of changing careers. By the time I returned as a graduate student in 1984 the number of women in classes at Thayer School had risen, as had the number of women at Dartmouth.

**During my B.E. year, I decided to combine law with engineering.** I now practice patent law and use my engineering every day, preparing patent applications and prosecuting the applications through the United States and foreign patent offices. To do my work, I have to understand how each invention operates and what it adds to the field of engineering. **I've been with the same law firm for 20 years.** I am the first and only female partner; when I started at the firm I was the first and only female associate. Now three of the firm's 19 attorneys are women.

**I have learned through the years that you have to pick your battles, and that you do not accept situations that are unfair to you.** While you want to fit in, you are not one of the guys, and there are times when you have to make that very clear.

**The one thing that has helped me enjoy what I'm doing is having a strong relationship with a mentor.** Beginning a career can be very intimidating. It is hard to start your career on the lowest rung of the firm ladder. I think women more than men tend to internalize a sense of failure or discouragement when experiencing steep learning curves. So, it is particularly important for a woman to have somebody who can guide her through that time and help her maintain—and increase—her sense of self and her confidence in an environment that is often still predominantly male.

## ELEANOR ALEXANDER '04, TH'05 '06

M.E.M. Candidate  
Thayer School

**Engineering is challenging.** I came in with no AP credit, and I struggled in math and physics. I really love the hands-on part of engineering, though, the process of design and construction where you can wrap your head around a project to create a solution. The projects kept me motivated. I have always wanted to build things that can be used to help people.

**I chose to stay at Thayer for graduate school because I know the professors** and because it fits so well with the four-year undergrad program. For grad students, it's a tight-knit community. You spend a lot of time on research projects and problem sets and become very close to your classmates.

**I got pretty good at counting the other girls in my classes.** I notice it when I sit down, but I like to think it doesn't matter. Often I was the only girl in the group, or the machine shop, or the project room, but I wasn't treated differently—nor should I have been. Today's society doesn't put the same emphasis on gender that my parents' generation struggled with. I had every opportunity my male classmates had, and that's the way it should be. We are all engineers.

**This past summer I worked at GE Healthcare in Texas and used the same skills** I learned in Thayer's design and project classes. I would like to go into operations or project management, to work where engineering, business, and leadership all come together. I hope to work with people and technology—I'm passionate about both.



## HEATHER WAKELEY '00, TH'01, '02

Associate, ENVIRON  
Princeton, New Jersey

**I started in an integrated math and physical science program my freshman year.** It was designed to take care of a lot of engineering prerequisites. We had a couple of labs that we did at Thayer, but it was mainly based in math and physics. What I liked most about the program, and what I also found at Thayer, was the emphasis on teamwork and supportiveness. I really enjoyed being able to work with other people in the labs and on the homework. I found that the supportive environment was a big factor in my success in engineering.

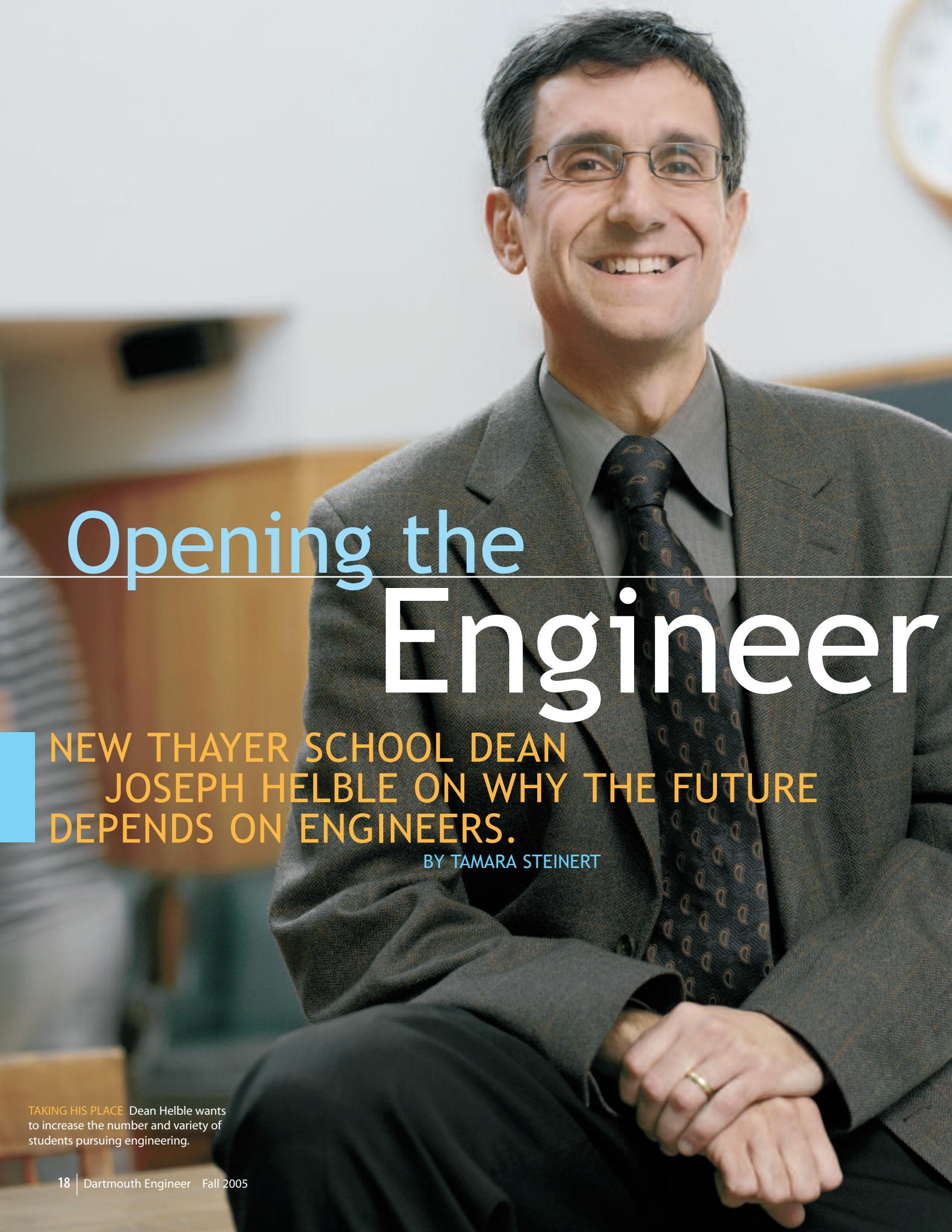
**It was definitely the practicality of engineering that attracted me to the major.** You see the direct effect of the projects you're working on. ENGS 21 is a really good introduction. The fact that we were solving real-world problems gave me more satisfaction and helped me to understand the problems and solutions better because I could relate to them.

**At my job, it takes new employees more than a year to learn the work.** The most helpful thing that I took from Thayer was the problem-solving approach. Problem-solving and analytical thinking are the two main things that I learned at Thayer—it's more the processes than the actual class material that I am able to use at my job. I also appreciate that the education was so interdisciplinary.

**There were more women in my environmental engineering classes than in my other engineering classes.** A lot of women gravitate toward environmental engineering. Those classes were about 50-50. Even in other classes, though, I never felt looked down upon or felt that I wasn't included because I was a woman.

**I'm in Princeton because I trained with the national rowing team for a few years.** My boss allowed me to work around my training hours. We don't have a lot of women in the upper levels at work. But there are a lot of women at my level, and I hope we'll all move up. I think the reason why we don't have a lot of women at the upper levels is because of women leaving to have families rather than because of a glass ceiling.

**I'm going to go back to school to do a Ph.D. in environmental engineering design at Carnegie Mellon.** I hope to teach at the university level after I'm done.



# Opening the Engineer

NEW THAYER SCHOOL DEAN  
JOSEPH HELBLE ON WHY THE FUTURE  
DEPENDS ON ENGINEERS.

BY TAMARA STEINERT

TAKING HIS PLACE Dean Helble wants to increase the number and variety of students pursuing engineering.

**A**fter a decade on the faculty at the University of Connecticut, Joseph Helble is familiar with the rhythms of academia, including the autumn “busy season.” But as fall approached this year, there were more demands on Helble’s time than usual. The 45-year-old chemical engineer was just finishing a year-long fellowship in Senator Joseph Lieberman’s Washington, D.C., office when it was time to turn his attention to the school year—and to his new duties as Dean of Dartmouth’s Thayer School.

As he completed an analysis of the environmental impacts of nanotechnology for Lieberman, there were loose ends to tie up at UConn as well. Add to this the challenge of packing to move with his wife, Becky Dabora, and their three school-aged children to Norwich, Vermont, and it’s a safe guess that this might not have been the most convenient time for Helble to sit down for an interview.

But, if he felt any impatience to get back to the

get? Should we be doing it differently?” asks Helble, echoing the concerns of engineering educators across the country. And, of course, THE question: “Why aren’t there more engineers?”

It’s a question that lawmakers and business leaders, concerned about U.S. competitiveness in a global economy, are beginning to ask as well. Technological innovation has been at the heart of economic growth in recent decades, and the U.S. Bureau of Labor Statistics predicts that jobs in science and engineering will increase at about three times the rate for other occupations in the near future. However, the United States isn’t producing enough engineers to fill these jobs. On a per capita basis, the number of engineering degrees earned each year in the United States has steadily declined, “even through the ’90s, when the economic boom was driven by high tech,” notes Helble. And with the National Science Foundation reporting in the 2004 edition of Science and Engineering Indicators that more than half of the nation’s engineers are age 40 or older, that could mean too few trained engineers prepared to meet the technological challenges of the future.

Developing countries such as China and India, however, are taking up the slack left by too few engineers here. The United States will graduate approximately 70,000 new engineers this year, while China reportedly will graduate about 600,000, and India will give diplomas to 350,000.

“That’s not a recipe for future success” in an economy increasingly dependent on technology, Helble says. However, he believes economic competitiveness is not the only reason why Americans should be concerned about the declining interest in engineering.

“The U.S. is in a leadership position in the globe. There is a tremendous opportunity for us to do the right thing, to do good for the rest of the world through engineering,” he says.

Helble cites global climate change as one issue among many where the United States could provide guidance. “I’m talking about how that affects developing countries, not the impact of a 2-degree increase in temperature in Hanover, N.H., and what that might do to the maple sugar industry. I’m talking about huge percentages of the global population living in low-lying coastal areas as subsistence farmers. How are those people going to be affected by global climate change and what’s that going to do in terms of creating refugee problems,

# Door

tasks pressing upon him, there was nothing about Helble’s cordial greeting in the front office of Lieberman’s suite that revealed it. After all, working on Capitol Hill requires the ability to shift gears quickly as issues demanding immediate attention arise. As the Roger Revelle Fellow in Global Stewardship sponsored by the American Association for the Advancement of Science, Helble spent the year advising Lieberman and his staff on a variety of environmental science and technology issues. Some, like President Bush’s Clear Skies Initiative, have been closely tied to Helble’s research interests. Other topics, like the feasibility of creating an early detection system for tsunamis, have been new to him.

Helble listens closely to questions before answering, often taking a moment to think before speaking. But when he does start talking, the words come quickly. The topic of conversation is the future of engineering and engineering education, a subject which Helble admits with a wry smile is “dinner and hallway conversation” for him and his engineering colleagues. “Are our students getting it? Are we teaching them what we need them to

ing

# "THERE IS A TREMENDOUS OPPORTUNITY FOR US TO DO GOOD FOR THE WORLD THROUGH ENGINEERING."



starvation, poverty, and mass movement of people? These are problems that should concern us as Americans as well. These are problems engineering can tackle," he says.

Educators and other experts have identified a variety of reasons for the declining interest in engineering. A generation or two ago, people in the United States saw engineering as a way "to apply yourself and improve your circumstances," says Helble.

"I think we've reached a point where, for a large number of Americans, perhaps the motivation isn't the same. You can go to Wall Street. There are other opportunities in business where you can perhaps do better economically" without having to take the rigorous math and science curriculum required for engineering, he notes. "In places like India and China, they're where we were 40 or 50 years ago in terms of this being a good, solid opportunity to advance yourself."

Engineers in these developing countries typically work more cheaply than American engineers. McKinsey Global Institute estimates that as many as 52 percent of engineering jobs might be vulnerable to "offshoring."

As Helble sees it, however, these changing circumstances and attitudes are not the cause of plummeting numbers in engineering. In his view, these are symptoms of a bigger problem: an outdated mindset that sees engineering education as nothing more than vocational training.

"We need to stop thinking about engineering education as being training just to produce en-

gineers who will go off and work at engineering jobs and solve engineering problems," he says. "That's clearly a very, very, very important part of what we do. It's our core mission and that won't change," but "engineering education is useful apart from producing engineers."

Engineering education is really about teaching a set of skills—to analyze, create, innovate, and communicate—that are increasingly necessary across many occupations and fields as technology continues to evolve.

"Let's look at medicine. So much of health care in this country is technology based. Wouldn't our health care system be better if people who go to medical school had undergraduate training in engineering rather than all studying biology?" Helble says. He also suggests that young entrepreneurs consider engineering rather than business school since economic development is driven by technological development.

"Whenever we as educators have the opportunity for a public platform—including talking to 17- and 18-year-olds at high school events—we need to say, 'look, this is not vocational training. This is analytical training that helps you develop the skills to analyze a problem, to be innovative, to be creative, to be entrepreneurial,'" he says.

One of the ways to convey this message is by highlighting the myriad ways our lives are touched by technology and science every day.

"The technological training we get in engineering puts us in a position—even if we're not practicing engineers—to make informed deci-

sions in our local communities and as citizens when we go to the voting booth," he says. It happens in the grocery store when people decide whether or not to buy genetically modified foods, at the doctor's office when they're selecting from treatment options, and when they're choosing political candidates who best reflect their views on issues like stem cell research and space exploration. Often the information consumers have about these issues is incomplete, or presented in ways that elicit emotional reactions without scientific context.

"There's a real need for a significant component of society to have the analytical skills to understand these problems and the skills to communicate effectively to people who don't have this training about why these issues are important to them," he says.

"One of the things that's got me excited about going to Thayer is you're starting with a body of students and faculty who think more broadly, who don't think about engineering as strictly a vocational training. People are looking at this as an education to help them attack a much broader range of problems," he adds.

THE ELDEST OF THREE CHILDREN raised in a suburb of Paterson, N.J., Helble says the immediacy of the OPEC oil crisis—made concrete for him by sitting in gas lines as a teenager with his father—started him on the path to engineering. He'd always been good in math and science, and his father was also an engineer, so it was a "natural" choice, he says.

Helble's undergraduate experience at Lehigh University was four years of a "complete and total emphasis on science, math and engineering." It was a solid education, but in some ways he felt restricted because he wanted to explore the bigger picture of technology in the world.

"What I see of the program at Thayer is it provides students exactly the kind of flexibility I think is important and that I would have wanted," he says, noting that even during graduate school he tried to keep a broader focus by completing a minor in Spanish.

Helble entered graduate school at MIT in 1982. A runner and bicyclist who grew up during the early years of the American environmental movement, he had a natural interest in protecting the environment, and so pursued research on air pollution and aerosol science. After completing his Ph.D. in 1987, he took a job as a research scientist at Physical Sciences Inc., a small research firm near Boston, then returned to academia as a faculty member at the University of Connecticut in 1995.

Over the years, his research interests have expanded to include nanoparticle technology. It's a field with potential uses in many industries, from manufacturing to medicine, but in his role as a legislative fellow, Helble focused on investigating the potential impact of the technology on people and the environment, rather than on developing new applications. "We're talking about a new class of materials where, in many cases, we don't have a complete understanding of how they would operate in the environment. We don't know what happens if they're released into the environment, either purposely or not. There are broad legislative questions that need to be answered about how we continue responsible development while putting in place appropriate controls to protect people and the environment. What should that balance be? Does the EPA have the authority and resources to do this?" he asks.

THAYER SCHOOL'S ENGINEERING MANAGEMENT program and its close links to the Tuck School of Business put the program at the head of the next wave of engineering education, Helble says. Companies expect engineers to know their way around a spreadsheet and value employees with entrepreneurial instincts. In recent years, industry has also come to expect engineers to design with the "triple bottom line" in mind. This term means giving equal regard to the environmental and societal impact of a project along with profitability, says Helble. As the population ages, medicine and engineering are also becoming more entwined, presenting another

area of growth for the occupation.

He is concerned about the fact that engineering school enrollments don't reflect the diversity found in the college graduate pool. "We're not doing a very effective job as a profession and as educators of getting the message out that engineers solve applied problems that are important to society," he says. "If we made that connection—that you're solving problems that are important to society—we'd be doing a much better job drawing students from a much broader range of society."

Helble also worries that "the idea that engineering is just the province of those who absolutely love math and science" discourages many potentially talented engineers from exploring the field. "There's got to be room for people who are creative—people who may not have the mathematical skills to immediately analyze and model a problem, but have the engineering creativity to think about technological development from a more entrepreneurial standpoint," he says.

That's not to suggest that engineering students don't need basic math. "We just don't want the first couple of years of engineering education to be a hazing ritual," he adds. "Not everyone is going to go off, get a Ph.D., become a professor or a research group leader at a large corporation, and do computer modeling. What we're trying to teach is a framework for analyzing problems and then applying that framework to unknown situations."

Some observers have suggested that the United States needs a major technological challenge to inspire young people—much like the race to the moon did in the 1960s. However, Helble thinks the problem won't be resolved so simply. "There's no silver bullet here," he says. "I think this is a slow process; it's going to take a lot of engineering and technological leaders across the country to stand on their respective soapboxes and remind people that this is important."

A MAJOR CHALLENGE FACING ENGINEERING programs is how to deal with the rapid pace of technology development. With so many new fields of inquiry, schools are struggling with the question of what to include—and exclude—from the curriculum.

Helble cautions against jumping on the bandwagon of every new technology. Instead, he advocates focusing on fundamental math and science and developing what he calls "the tools for engineering thought."

"We can't teach everything to every student and graduate them in a reasonable period of time. We could keep them forever, but then they

would have no impact on the world at large," he says. However, electives and survey courses offer an opportunity to discuss the science behind new technology, as well as its societal context. A good example, he says, is a survey course on nanotechnology currently being offered at Thayer School that requires students to read a novel about the technology in addition to exploring its technical underpinnings. "This is great. This is helping 18- and 19- and 20-year-olds understand the relevance of technology to the broader society," Helble says.

Graduate and faculty research also helps keep the undergraduate program fresh by giving students the opportunity to participate in research projects in evolving fields, according to Helble. One of his goals is to help enhance Thayer's existing research program.

"I think there's a real opportunity to build upon a strong research program at Thayer and make it even better," he says. "Thayer has got an outstanding reputation as a place that produces first-rate undergraduates. The graduate program isn't as well known. That doesn't mean graduate students haven't gone out and done great things. It just means it's not as well known."

He realizes that some people are concerned that a greater emphasis on research will detract from Dartmouth's and Thayer's teaching missions. However, research "does not diminish or denigrate" teaching, but should "enhance it" as faculty bring their work into the classroom, he says.

One reason people sometimes fear an increased emphasis on research is that they think it means the College will try to fit the mold of other, larger institutions. "I have no thoughts whatsoever of Dartmouth being Harvard or Thayer being MIT. It's not. It is a fairly unique entity, and that's one of the things I'm excited about," Helble says. In fact, he would like to see the graduate program incorporate some of the "things that work so well at the undergraduate level."

"I would like to see our Ph.D. students, even those who come in to work in high-powered research labs for the high-powered research faculty, also be thinking about taking a class in the business school or taking a class in liberal arts so they think about how what they do applies more broadly," he says.

"A strong research program is a win/win situation for undergraduate and graduate students. Plus it gets 18-year-olds and their parents excited about the school." □

---

Tamara Steinert is a freelance writer based in Wichita, Kansas.

# POWER

## IN THE DRIVE FOR ALTERNATIVE FUELS, PROFESSORS LEE LYND AND CHARLES WYMAN EXPLAIN THE GROWING ROLE OF ETHANOL.

BY GENEVIEVE CHAN

The latest spikes in gasoline prices have reawakened the public to the need for viable alternatives to finite and vulnerable supplies of oil. The ideal alternative fuel would be both economically and environmentally sound. It would be renewable, plentiful, sustainable, and clean. And, for widespread use in motor vehicles, it would be easily stored and distributed.

This is a tall order—and an increasingly urgent one. The U.S. transportation sector alone consumes a staggering 130 billion gallons of gasoline each year. Beyond draining a decreasing resource, motor vehicles produce 32 percent of the nation's carbon dioxide emissions that contribute to global climate change.

Scientists and engineers are driving down several promising but challenging paths to break the transportation sectors' thirst for gasoline. One is electric batteries, used in today's hybrid cars. At this point, hybrids still require gasoline, and current battery technology cannot support all-electric long-distance travel. Another is hydrogen, a potentially clean-burning energy source, with water vapor as its only byproduct. Substantial technical challenges must be overcome to economically produce, store, and transport hydrogen. Hydrogen fuel cells, the most promising way to efficiently utilize hydrogen, are still in ear-

ly stages of development and require a radical departure from the internal combustion engine.

Another alternative is ethanol.

Ethanol—including ethanol produced from corn and from cellulosic biomass—offers both immediate and long-term benefits, according to Thayer Professor Lee Lynd and adjunct professor Charles Wyman, until recently the school's Paul E. and Joan H. Queneau Distinguished Professor in Environmental Engineering Design. Because ethanol is made from plants that are continually regenerated, it is renewable and potentially sustainable. It also has the potential to be carbon-dioxide neutral. And as a liquid, ethanol can be readily phased into the current infrastructure without much change to cars or fuel distribution systems.

"Ethanol is already widely used and accepted for blending with gasoline," says Wyman, a former director of the National Renewable Energy Laboratory's alternative fuels division.

In fact, more than four billion gallons of ethanol made from corn and other grain starch are added to gasoline in the United States annually to increase octane and help reduce tailpipe emissions. Brazil makes a similar amount of ethanol from cane sugar and uses it in gaso-

# PLANTS



# “THE ABILITY TO GROW BIOMASS FOR ETHANOL IS MUCH, MUCH MORE WIDELY DISTRIBUTED THAN OIL.”

line blends and as a pure fuel. Several models of “flexible fuel vehicles” already on the road can run on any combination of gasoline and ethanol. The blend E85, consisting of 85-percent ethanol, is available at several hundred refueling stations in 30 American states.

Ethanol isn’t an exact match for gasoline. It has a lower energy density. One gallon of ethanol contains the energy equivalency of 2/3 gallon of gasoline—76,000 BTUs compared to gasoline’s 112,000. But Lynd doesn’t see this as a big problem. “At most, vehicles could have larger fuel tanks to compensate for the difference,” he says.

## >>FIELDS AND YIELDS

The ethanol used now is mainly produced from edible crops such as corn in the United States and sugar in Brazil. Current ethanol production methods use simple enzymes to break down starches to simple sugars, which are then fermented into ethanol.

Lynd and Wyman are working to make it feasible to produce ethanol out of lignocellulosic materials—grass, wood, and various agricultural and forestry wastes. “Cellulosic biomass at \$40 per ton is competitive with oil at \$13 per barrel”, says Lynd, “hence we have a cost-competitive raw material. The challenge is to reduce the cost of processing.” To that end, Lynd and Wyman are using genetically engineered bacteria and bioengineered enzymes to help break down the plant cellulose into sugars quickly and at high yield.

Biomass comes in a wide variety of forms, including agricultural residues such as corn stover (the stalks and leaves left over from corn production), sugarcane bagasse (the cellulosic fiber residue left after extracting sugar from the cane), and wheat straw; forestry wastes such as bark and wood chips; and dedicated energy crops such as willows, eucalyptus, and switchgrass, a tall perennial grass that requires minimal irrigation, tilling, and herbicides to produce high yields.

Raising fast-growing plants and utilizing stover and other forms of biomass are keys to maximizing energy yields per acre. According to Wyman, an acre of land can produce greater amounts of biomass than corn. Moreover,

low-grade land that may be unsuitable for producing corn may still be viable for producing biomass.

Wyman and Lynd are working on several fronts in the biomass energy field. Wyman leads the Consortium for Applied Fundamentals and Innovation, a collaboration between five universities, Genencor International, and the National Renewable Energy Laboratory. The consortium’s goal is to compare and improve pretreatment technologies vital for maximizing yields of ethanol from cellulosic biomass.

Lynd leads a team of students and research associates at Thayer School that is collaborating with Advanced Bioconversion Technologies of Lebanon, New Hampshire, to develop a strain of *Clostridium thermocellum*, a rapid cellulose-fermenting microorganism that can produce ethanol at high yields and concentrations from pretreated substrates.

Lynd is also a leader in a 10-institution project called the Role of Biomass in America’s Energy Future (RBAEF). Sponsored by the U.S. Department of Energy, the Energy Foundation, and the National Commission on Energy Policy, the project focuses on identifying and evaluating paths by which biomass can make a large contribution to energy services and determining what can be done to accelerate biomass energy use and the timeframe in which associated benefits can be realized.

## >>>CONVERSION FACTORS

The economics of ethanol production are growing clearer. A study by David Pimentel of Cornell and Tad Patzek of UC Berkeley argues that corn-to-ethanol production requires more energy to produce than it provides. However, numerous other studies, such as one led by Hosein Shapouri of the U.S. Department of Agriculture’s Office of the Chief Economist, show that corn-to-ethanol processes provide a net energy gain of at least 67 percent. And according to new research by Argonne National Laboratory researcher and RBAEF member Michael Wang, improved technology has reduced energy use and operating costs in corn ethanol production.

Cellulosic biomass requires more intense processing than corn because the sugars in cel-

lulose are more tightly bound. But cellulose processing also yields lignin, and, says, Wyman, “Hypothetically, after you break down the cellulose and hemicellulose to release the sugars for fermentation to ethanol, you can then burn the lignin to provide all the heat and electricity needed to operate the factory with some excess left for sale.”

“Thus,” adds Lynd, “there is widespread consensus that the energy balance for cellulosic ethanol is decidedly positive.”

Another concern about biomass energy production is that it would divert agricultural resources away from food crops. Some people wonder if there is enough land to grow sufficient quantities of biomass. Would the environmental footprint be too big?

Wyman doesn’t see land use as an either-or situation. “With most biofuels, you remove the energy and are still left with the protein for food—or feed for livestock,” he says. “The dried grain byproduct resulting from processing corn into ethanol contains more protein than the original unprocessed grain.”

According to Lynd, the very fact that cellulosic biomass can be grown makes it a leading replacement for fossil fuels—and a source of global social and economic benefits. “There is no question that the ability to grow biomass is much, much more widely distributed than oil,” he says. “As a locally produced, renewable fuel, ethanol has the potential to diversify energy portfolios as well as lower dependence on foreign oil.” He points out that some of the world’s most attractive areas for biomass production are also among the poorest. “Which regions would be the big biomass producers? Africa and South America are way high, and Asia also has significant biomass potential,” he says.

As Indiana Senator Richard Lugar and former CIA director R. James Woolsey put it in an article in *Foreign Affairs*, growing biomass to produce cellulosic ethanol has the potential to “democratize the world’s fuel market.”

## >>>>MOVING FORWARD

The last two years have seen a huge upswing of support for biomass as a viable sustainable replacement for petroleum, not just an interim transition strategy. Lynd attributes this signifi-

**ECONOMIC CATALYSTS** Lynd, right, and Wyman believe that genetically engineered bacteria and bioengineered enzymes will reduce the cost of converting cellulosic biomass to ethanol.



cantly to RBAEF's efforts to articulate future scenarios. In fact, RBAEF has detailed more than 20 mature process technology scenarios for producing a broad range of fuels and electrical power from cellulosic biomass. "The economics for many of these scenarios are highly competitive with established processes based on fossil fuels," says Lynd. And he notes, "By a combination of approaches—incorporating biomass energy feedstock production into currently managed lands, high end-use efficiency, and use of high-productivity cellulosic crops—it is projected that a large fraction of U.S. mobility requirements could be met with little or no additional land beyond that already allocated to agriculture."

"The RBAEF study has redefined the debate about the viability of biomass as a large-scale

energy source," says Tom Foust of the National Renewable Energy Laboratory. "The kind of long-term thinking the RBAEF project embodies is crucial but in short supply."

"Industry is often constrained to taking a relatively short-term view by cash-flow expectations and other factors," says Lynd. "Government should take a long-term view with the public interest in mind, but often does not. As an academic, I am trying to look to the future in part because I do not see others doing this."

There are signs, however, that industry is taking some steps forward. The three major U.S. automobile manufacturers already make flexible fuel vehicles. Royal Dutch/Shell Oil has invested in Iogen, a Canadian-based cellulosic ethanol company. During the next five years, Lynd predicts, agricultural groups, fuel deliv-

ers, and distributors will jointly establish a vertically-integrated biomass fuel supply chain that does not now exist.

Both Lynd and Wyman stress the importance such partnerships will have in developing alternative fuels—and in producing policies and technologies that deliberately promote energy efficiency and sustainability. "Efficiency leverages the other two goals: low environmental impact and a sustainable replacement for oil," says Lynd. "If we continue to make decisions as if sustainability were unimportant, will it happen anyway? I think the answer's no. But if we decide it's important to plan for, then we can make great things happen." □

---

Genevieve Chan is a freelance writer based in Norwich, Vermont.

# Alumni/ae News

## THAYER SCHOOL ANNUAL FUND 2005 Report

The 2005 Thayer School Annual Fund had a banner year under the leadership of Kit Ambrose '86, Th'90. Thayer School alumni/ae and friends contributed \$849,205, surpassing the goal of \$830,000 and increasing participation to 34 percent. Special thanks go to our 112 leadership donors, who, though comprising only 12 percent of donors, accounted for 86 percent of the Annual Fund total. Thanks also go to our 43 Dean's Circle donors, the most generous donors of the 10 most recent classes.

Our 2006 Annual Fund volunteers are looking forward to another great year. As I take over from Kit I know that, with your help, we'll continue to increase the participation in and total contributions to the Annual Fund. The Annual Fund Executive Committee and class agents are already inviting classmates to join the effort. To become a class agent, please e-mail [cpeschel@dartmouth.edu](mailto:cpeschel@dartmouth.edu).

The importance of annual giving cannot be overstated. By providing unrestricted support for Thayer School's operating budget, the Annual Fund directly helps to provide students with an outstanding education. Thank you for aiding Thayer School through the Annual Fund.

—Mike Chapman '76, Th'77  
Chair, Thayer School Annual Fund

### DARTMOUTH SOCIETY OF ENGINEERS

Bill Baschnagel '62, DSE representative to the Dartmouth Alumni Council, reports that minutes of the May meeting of the Alumni Council are available online at [alumni.dartmouth.edu/leadership/council/index.html](http://alumni.dartmouth.edu/leadership/council/index.html).

## spotlights

Thayer School Overseer **Clint Harris '69, Th'70** received Israel's top award for a business leader in June. The award was presented by Israeli Prime Minister Ariel Sharon. Harris is a managing partner at Grove Street Advisors, which has invested in Israel since 1999 for client CalPERS, the world's largest pension fund.

Thayer School Overseer **Barry MacLean '60, Th'61**, president and CEO of MacLean-Fogg manufacturing company, has been elected to a two-year term as a director of the Executives' Club of Chicago, a business forum for thought leadership, education, and best business practices.

**Doug Kingsley '84, Th'85** was featured in an August 8 story in the Boston Globe, in which he weighed in on recent increases in fundraising by venture capital and buyout firms. Kingsley is a managing director for buyout firm Advent International, which raised one of the largest private equity funds this year. He worked for Teradyne in Boston as a sales engineer before earning an M.B.A. at Harvard in 1990. At Advent he has focused on technology investments.

**Philip V. Bayly '86** was recently installed as the first Lilyan and E. Lisle Hughes Professor in Engineering at Washington University in St. Louis. Bayly has taught at Washington University since 1993 and holds a joint appointment in the School of Engineering & Applied Science's departments of mechanical and biomedical engineering. He has also worked as a research engineer for Shriners Hospital, designing prosthetic and orthotic devices for children with limb deficiencies and disabilities, and as a design engineer for Pitney-Bowes Inc. Working with colleagues across the university, Bayly

has conducted research on projects ranging from high-speed machining to measuring deformation of the human brain. Bayly was named the School of Engineering & Applied Science Professor of the Year in 2004 and the Advisor of the Year in 2001.

**T. Jeffrey Putnam '86** was promoted to senior vice president of finance at Northwest Airlines and will now provide senior leadership to the finance team. Putnam was formerly vice president of financial planning and analysis for the Minnesota-based airline.

**John C. Barpouulis Th'87, Tu'91** has been elected vice president and treasurer of energy company USEC Inc. Barpouulis is responsible for cash management, financial aspects of mergers and acquisitions, financing, risk management, and pension and benefit investments. The company processes used uranium—about half of which comes from old Russian atomic warheads—into enriched uranium, which it then supplies to commercial nuclear power plants. Prior to joining USEC, Barpouulis was vice president and treasurer of National Energy & Gas Transmission Inc. He also held financial positions at U.S. Generating Company and served as a consultant with Berner, Lanphier and Associates, which provides analytical services to the U.S. Department of Defense.

**Col. Curtis L. Thalken Th'93** recently assumed command of the U.S. Army Corps of Engineers New England District. Thalken was previously commander of the U.S. Army Corps of Engineers 92nd Engineer Combat Battalion in Afghanistan, a post he took up two months after Sept. 11, 2001. He is the recipient of the Global War on Terrorism Expeditionary Medal.

## thayer notes



**5th and 10th Reunions**  
Left to right, Jeff Braciak, Kent Dahn, Sharon Alexander, Joseph Dadzie, Aya Kamaya, Jason Duty, Katherine DeSimone, Christina Nicholas, Haskins Hobson, Duncan MacLean, Carolyn Rice, Vic Almgren, and Peter Moore.

thayer notes not available online

50th Reunion

Left to right, Ron Muller, Thomas Hamilton, Sue Ballard, John Ballard, Eliot Smith, Elaine Smith, Peter Gulick, Kathy Hoffman, Harlan Jessup, and Shirley Jessup.



thayer notes not available online



#### 35th, 40th, 45th, 55th, and 60th Reunions

Left to right, front row: Donna Cramer, Susana Schwarcz, Virginia Sarno, Nancy Keteku, Terry Nichols, Marcella Starkey, Jocelyn Cain, and Mary Ann MacLean; back row: Joseph Cramer, Robert Kirby, Kojo Keteku, Gerald Sarno, Robert Paulson, Craig Cain, Arthur Nichols, Fletcher Clark, Gordon Starkey, Jerry Boyle, and Barry MacLean.

thayer notes not available online

**25th and 30th Reunions**  
Left to right, Chris McConnell,  
Dave Woodman, Richard  
Akerboom, Geoffrey Edelson,  
Brian Boyer, and Andy Minden



## thayer notes not available online

**DEGREE RECIPIENTS:**  
*continued from page 7*

**Grant Wagner '04**

Front Suspension, Steering, and Braking

**Amy Wallace '04**

Feasibility Study of Anaerobic Digestion at McNamara Dairy

**Rebecca Wang '05**

Fixed-Point Implementation of Feedforward ANR

**John Welsh II '04**

Feasibility of Growing Carbon Nanotubes

**Kristen White '04**

DFR Driver Controls, Ergonomics and Safety

**Courtney Wuistinger '04**

DFR Rear Suspension Development

**Thomas Zangle '05**

Micro Air Vehicle Stability and Control

**MASTER OF ENGINEERING MANAGEMENT**

**Safoa Addo '03**

Feasibility Study for Residential Energy Efficiency and Conservation Services

**Katherine Baus '04**

Handbook of Mitigation Options for Rail-Induced Ground Vibration

**Spencer Boice**

Quick-to-Market Project to Develop a New Sportster Motorcycle

**Bingchao Cao**

Lucrative and Feasible Investment Strategy for CIBC World Markets

**Aarsha Chugh**

Managing Risk for a Portfolio of Fixed-Income Securities

**Erik Dambach '04**

Ground Control and Flight Test Simulation Visualization

**Samantak Datta**

Assessing Plant Capacity Through Simulations

**Jonathan den Hartog '03**

Engineering Analysis for Cox v. Consolidated Rail Corp.

**Keith Dennis '03**

Tool Development for Risk-Based Criteria Calculation

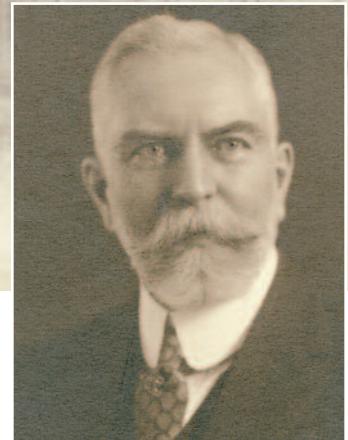
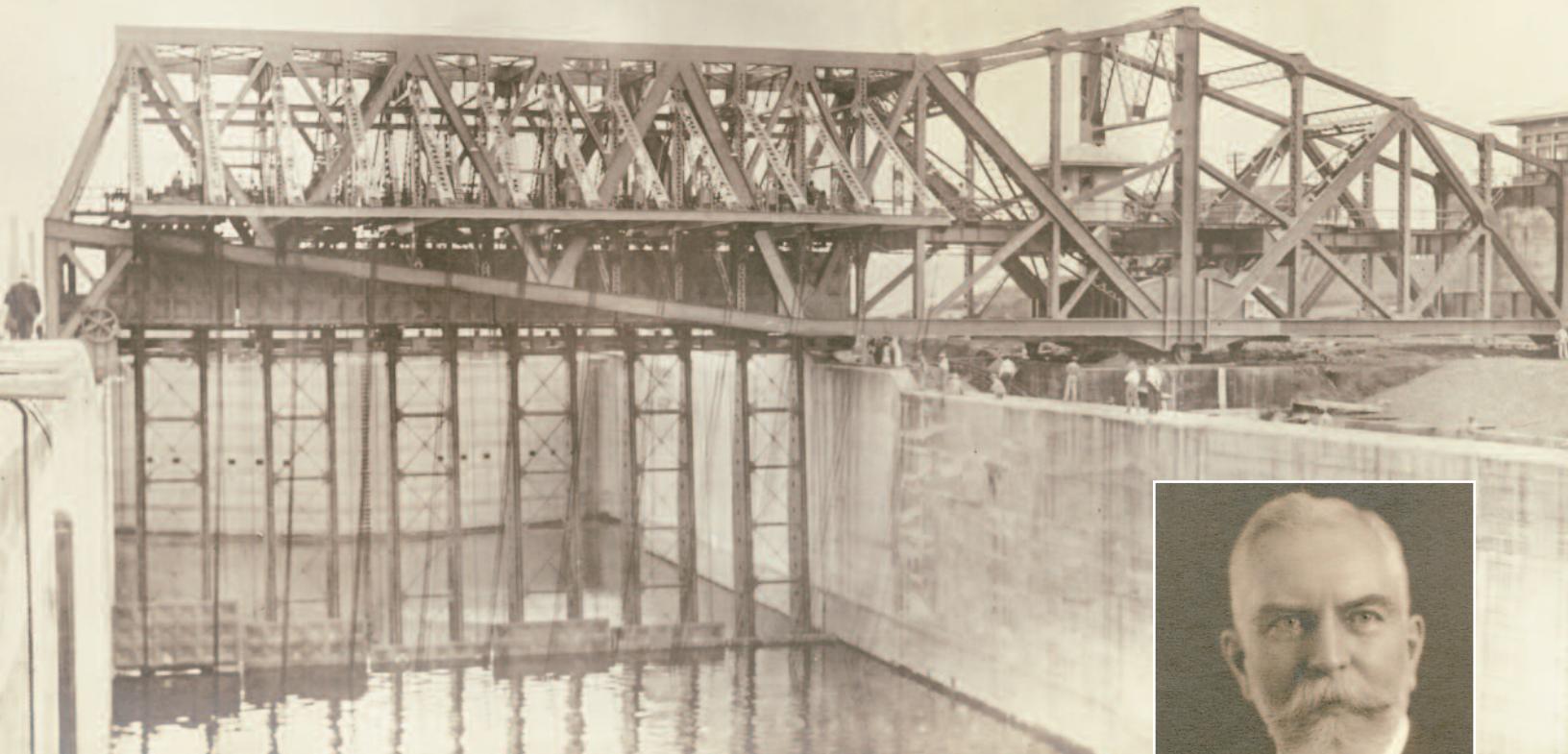
**Ryan Dunn**

Digital Fuel Gauge for a Direct Methanol Fuel Cell System

<b>Haibing Han</b> Planning and Managing a Project for MacLean Quality Composites <b>Scott Hazard '03</b> Fresh Look at Resource Planning	<b>George Tsung</b> Taro-Dynamic Business Development <b>Tomasz Tunguz-Zawislak '04</b> Business Process Model Implementation at Appian Corp. <b>Rena Yotsu '03, Th'04</b> Methods for Recycling Glass Cullets	<b>Brian Lehrman '03</b> Fault Identification for Low Power Deep Sub-micron Static Random Access Memories <b>Scott Lish '03</b> Investigations of the FeCoMnAl Alloy System <b>Matthew Maher</b> Improving Passive Hearing Protection Systems to Reduce Bone-Conducted Sound in Extreme Noise Environments <b>Gabriel Martinez '99</b> Designing an Algorithm for Use of the Pulse Electro-Thermal Brake in Cross Country Skiing <b>Brian Mason '03</b> Mechanical Behavior of Elastomers for Dynamic Applications <b>Jason Merrill '00</b> Design, Simulation and Analysis of a Free-Piston Engine in a Hybrid Power Plant <b>April Mohns '03</b> Finite Element Analysis of the Cornea after Microwave Thermokeratoplasty <b>Kyung Kook Park</b> Network Modeling of Electrical Impedance Tomography <b>Phillip Perrinez</b> Determining the Feasibility of Reconstructing Mechanical Properties of Living Brain Tissue Using Magnetic Resonance Elastography <b>Joshua Peteet</b> Techniques for Aggregating and Analyzing Log Data from Homogeneous Intrusion Detection Sensors <b>David Reed '02</b> Production and Purification of Self-Assembling Peptides in <i>Ralstonia eutropha</i> <b>Christopher Roblee</b> Principled, Scalable Approach to Rapid Autonomic Healing <b>Rebecca Segal</b> Personal Spirometer to Monitor Pulmonary Health of Asthma Patients <b>Alexander Streeter '03</b> Design, Construction, and Control of a Photovoltaic Power System for an Autonomous Antarctic Rover <b>Kanji Takanishi</b> Probabilistic Robust Iterative Learning Control	<b>Kevin Tompsett '00</b> Design of a Linear Switched Reluctance Generator for use in a Free-Piston Engine/Generator <b>DOCTOR OF PHILOSOPHY</b> <b>Gavin Barnard Th'04</b> Expression and Recovery of Recombinant Proteins in a Novel High Cell Density Prokaryotic System Based on <i>Ralstonia eutropha</i> <b>Ben Brooksby</b> Combining Near Infrared Tomography and MRI to Improve Breast Tissue Chromophore and Scattering Assessment <b>Qianqian Fang</b> Computational Methods for Microwave Medical Imaging <b>Matthew Gray</b> Heterogeneous Dissolution Fundamentals for Water Only Hydrolysis of Biomass <b>Philip Heinz</b> Optical Vibration Detection With a Four-Point Photoconductance-Monitoring Array <b>Todd Lloyd</b> Fragmentation of Hemicellulose during Pretreatment: The Predicted Effect of Sulfuric Acid on Sugar Release Selectivity <b>Satish Prabhakaran</b> Microfabrication of Magnetic Components for High Frequency DC-DC Power <b>Jason Solbeck Th'04</b> Damage Identification Using Sensitivity Enhancing Control with an Identified Model <b>Min Song</b> Effects of Particles on Anelasticity, Creep, and Microstructural Evolution of Granular Ice <b>Xiaomei Song</b> Statistical Analysis and Evaluation of Near Infrared Tomographic Imaging System <b>Nirmal Soni</b> Breast Imaging using Electrical Impedance Tomography <b>Subhadra Srinivasan</b> Spectroscopy-based Quantification of Chromophores and Scattering in Near-Infrared Tomography <b>Heng Xu</b> MRI-Coupled Broadband Near-infrared Tomography for Small Animal Brain Studies
<b>Feroze Isaac</b> Marketing Strategy Development/Business Planning for Renesys Corp.	<b>Ameet Jani</b> Product Security Policy <b>Sangeeta Kasturi</b> Development of a Clinical Survey of Data Administration Tool <b>Marina Kolomets</b> Software Development and Optimization for Wireless Mesh Networks <b>Arlie Lam '01</b> DFR Software to Calculate Performance Indicators <b>Ethan Levine '03</b> Life Cycle Assessments for Boat Products <b>Matthew Maher</b> Improving Passive Hearing Protection Systems to Reduce Bone-Conducted Sound in Extreme Noise Environments <b>Julie Matteini '03</b> Consumption-Based Replenishment at GE Healthcare Information Technology Technologies: Splicing Project <b>Drumil Modi</b> Migration and Design of Product Literature System <b>Audi Okullo</b> Project Management Tools for Expansion <b>Craig Rashkow</b> Plastics Sourcing Management: Organize, Consolidate, and Leverage <b>Akshi Singh</b> Global Asset Service Exception (IFA) Reporting Tool <b>Yogesh Soneji</b> Report and Form Authoring in Business Intelligence <b>Gaurav Songara</b> Process of Innovation Adopted by Venture Capital-Backed Start-up Companies <b>Gail Sweeney '03</b> Attracting Grant Money for Kennebunk Beach Improvement Association <b>Daniel Tadesse '03</b> Business Valuation Project <b>Cindy Torres '04</b> Hedge Fund Blamo Report Project	<b>George Tsung</b> Taro-Dynamic Business Development <b>Tomasz Tunguz-Zawislak '04</b> Business Process Model Implementation at Appian Corp. <b>Rena Yotsu '03, Th'04</b> Methods for Recycling Glass Cullets	<b>MASTER OF SCIENCE</b> <b>Sara Atwood '03</b> Backside Wear Evaluation of LCSÆ-Rotating Platform Knee Replacements <b>Tico Blumenthal '02</b> Quantification of Sub-Surface Brain Deformation Using Freehand 3-D Ultrasound <b>Janelle Chang '03</b> Detection of Airway Obstruction Using a Reflectance Pulse Oximeter <b>Mykyta Chernov '03</b> Heart Rate Variability Analysis of Long Term Telemetry Recordings in Piglets: An Experimental Animal Model of SIDS <b>Parul Dhagat ADV'04</b> Selection and Deposition of Soft Magnetic Materials for Micro-Fabricated Thin-Film Inductors <b>Qing Feng</b> Sub-Domain Decomposition and Sub-Domain-Based Material Property Reconstruction for Elastography <b>John Gagne</b> Implementation of Ionospheric Outflow in LFM Global MHD Magnetospheric Simulation <b>Ian Gregorio-DeSouza Th'03</b> SpiceXML: A Web Service for Spice3f5 Circuit Simulation <b>James Hanna '02</b> Investigations of Fe30Ni20Mn25Al25: A New High-Strength Spinodal Alloy <b>Abdelfetah Jibril</b> Retransmissions on the Wireless Medium <b>Alex Jordan '03</b> Models for Tracking and Level 2 Fusion <b>Hyomin Kim Th'04</b> Study of Extremely Low Frequency Waves Observed at South Pole <b>Jonathan Kittredge</b> Investigation of the Relationship between TVI and Gamma Dose in Implantable UHMWPE

# inventions

Hovey's retractable emergency locks for the Panama Canal swung into place like a moveable bridge.



## PANAMA CANAL EMERGENCY DAMS

>> INVENTOR:  
OTIS ELLIS HOVEY

Otis Ellis Hovey, Dartmouth 1885, Thayer 1887, had two words of advice about what it takes to be an engineer: "Hard work." To which he added, "You want more than this? Well, I would add 'common sense.' So many engineers fail because they do not have the last quality."

Hovey was, by all accounts, a hard worker, and he had a lot

more common sense than his Dartmouth classmate and cousin Richard Hovey, author of the drinking song "Eleazar Wheelock." As the assistant chief engineer of American Bridge Company Otis Hovey worked on some of the biggest projects of his era, including designing the superstructure of the Bellefontaine Bridge across the Mississippi and designing and building six emergency dams for the Panama Canal.

Hovey was also the authority on moveable bridges. He wrote

the subject bible—*Moveable Bridges*, published in 1926—and held patents on three moveable bridge designs which he dubbed Types O, E, and H (which just happen to be his initials.)

Hovey's success didn't come from common sense alone. The man had imagination. In 1895, at the age of 30, he designed a 3,200-foot bridge across the Hudson River—twice as long as the Brooklyn Bridge (then the world's longest). Visiting Turkey, he designed a pontoon bridge across Constantinople's Golden

Horn. Though neither bridge was built, his plans displayed his signature blend of diligence, intelligence, and originality.

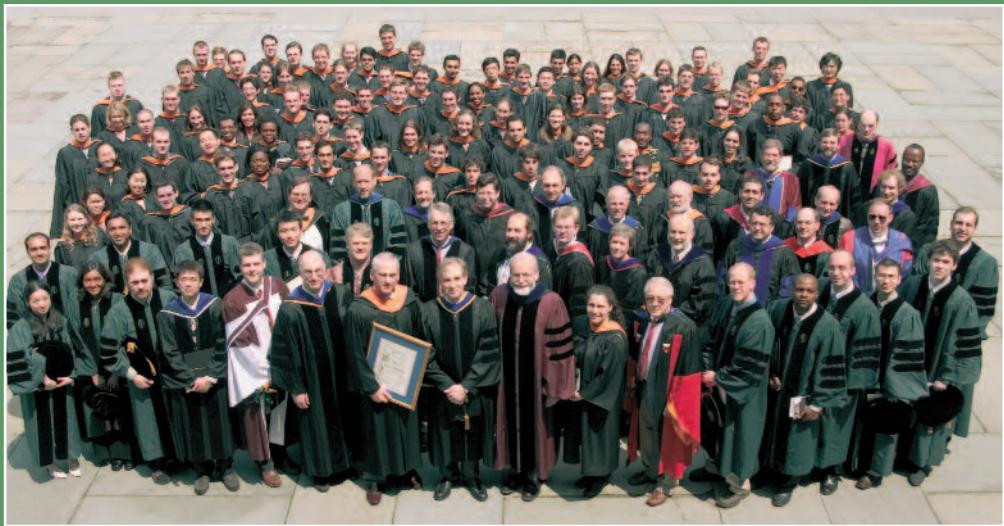
In his later years Hovey was regularly mistaken for look-alike Chief Justice Charles Evans Hughes. Hovey served on the Thayer Board of Overseers from 1907 until his death in 1941.

—Lee Michaelides



## RANDOM WALK

With construction of the MacLean Engineering Sciences Center proceeding apace, building committee members Peter Robbie, left, and Chris Levey stroll through the atrium linking the new building with Cummings Hall. The move into Thayer School's expanded space is scheduled for spring 2006. View more photos at [engineering.dartmouth.edu/thayer/esc/](http://engineering.dartmouth.edu/thayer/esc/).



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

NON-PROFIT  
U.S. POSTAGE  
PAID  
DARTMOUTH COLLEGE