WPI JOURNAL

WINTER 1996

A Personal Space Odyssey

WPI JOURNAL

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DEPARTMENTS

On the cover: Al Sacco enjoys an out-of-this-world view from the space shuttle *Columbia's* flight deck. A member of the crew of STS-73, Sacco was deeply moved by the sight of Earth from space. Even photographs as spectacular as our back cover shot of the Kalihari desert in Namibia, Africa, a photo taken from STS-73, can't capture the beauty of our planet, he says. Opposite: A view of Joe Gale doing what he does best: teaching young people to weld. Photo by Jonathan Kannair.

Staff of the *WPI Journal:* Editor, Michael W. Dorsey • Art Director/Designer, Michael J. Sherman • Contributing Writers, Bonnie Gelbwasser, Joan Killough-Miller and Ruth Trask • **Alumni Publications Committee:** Samuel Mencow '37, chairman, Kimberly A. (Lemoi) Bowers '90, James S. Demetry '58, William J. Firla Jr. '60, Joel P. Greene '69, William R. Grogan '46, Robert C. Labonté '54, Roger N. Perry Jr. '45, Harlan B. Williams '50 • The *WPI Journal* (ISSN 0148-6128) is published quarterly for the WPI Alumni Association by the Office of University Relations. Second-class postage paid at Worcester, Mass., and additional mailing offices. Printed by The Lane Press, Burlington, Vt. Printed in the U.S.A.

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Use Plan as Model for Medical Education

TO THE EDITOR:
I thought the essay by President Parrish in the Fall 1995 *Journal* ("A Work in Progress: WPI and the Future of Technological Education") was excellent. I believe the WPI Plan can be a model not only for engineering education, but across many disciplines—particularly medicine.

Medicine, like engineering, is changing. Medical students need more than just facts—they need to learn to think. The content is intensive and the field is changing too fast to keep up.

Education programs in medicine and engineering share many similarities. The hardest problem is to get students to make the transition from being simple fact regurgitaters to being independent, logical thinkers. When they enter practice, both groups need to quickly gather facts and come up with the best low-cost solution.

Physicians are not just researchers who approach problems from a theoretical basis. The best physician makes a "hunch" based on the presentation, does a quick clinical test likely to verify the hunch, and makes a recommendation based on the outcome. A battery of tests is not needed nor used.

Traditional medical school now requires four years of college work followed by four years of medical school (two years of basic science and two years of clinical rotations). This only prepares one for residencies of three to eight years; then there are fellowships after that! In a time of decreased resources, this timeline is too long.

The WPI Plan shows that it is possible to efficiently get students to perform independently in a short period of time. It is now time to get this paradigm out to other professions.

STEPHEN S. HULL JR. '79
COLLEGE OF MEDICINE
UNIVERSITY OF OKLAHOMA

"Travels" Disappointing

TO THE EDITOR:
It was disappointing that you thought Alex Thorp '92 had something of value to communicate to *Journal* readers ("Travels With Alex," Summer 1995).

I would have given my right arm, upon graduation, to have been able to go off on a bicycle trip. Instead, I had to work. The luxury of Thorp's time off, in my case, would come only after I had served greedy "big business" and the military for over 45 years, practicing what WPI had so well trained me to do.

I also had no trouble figuring out that "commercialism" gives people work so they can eat—the more of it the better. Thorp's fuzzy blatherings about the "too complicated and too commercial world" show that he has failed to learn how our American productive miracle operates, and how its creative, generous workers, together with big business, manage to liberate, feed and defend about half the people on Earth.

THOMAS P. FOLEY '46
NEW BERN, N.C.

Facts Wrong on Tatum and Olmstead

TO THE EDITOR:
I am writing because I believe the *Journal* has become lax in its confirmation of facts. In particular, I'd like to point to the reference to Goose Tatum in an article about the Kobe Earthquake ("Blowing Away Goose Tatum," Spring 1995). The article described Tatum as the Trotters' expert ball handler, and not as the prototype for future Harlem Globetrotters like Meadowlark Lemon. In fact, the fancy ball handler who was responsible, along with Tatum, for the rise in popularity of the Globetrotters was Marques Haynes.

I remained silent about this because the article was a personal recollection and was subject to the author's memory.

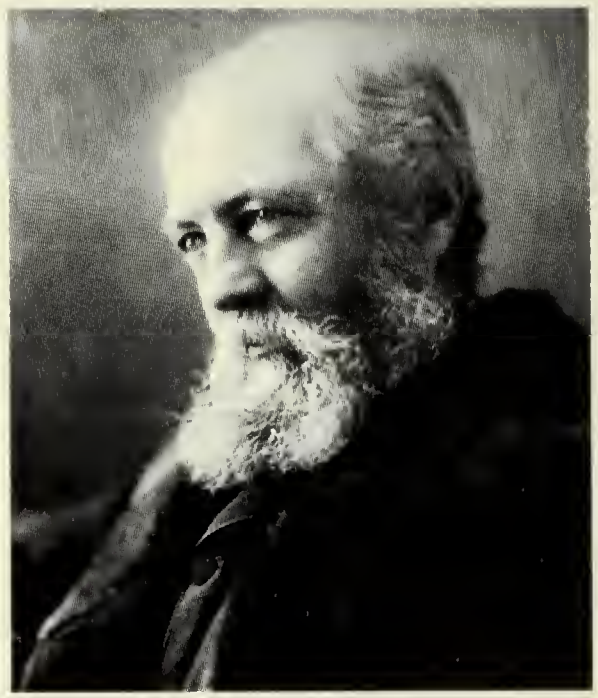
A more important error occurred in an article on architect Wallace Harrison ("One of a Kind," Summer 1995). The article gave the mistaken impression that Frederick Law Olmstead was a son of Worcester. In reality, Olmstead was not even a Massachusetts child. To set the record straight, here is a quote from Vol. 1 of *The Papers of Frederick Law Olmstead*, edited by Charles McLaughlin:

"Frederick Law Olmstead, the first child of John Olmstead and Charlotte Hull, was born on April 26, 1822. Fortunately, his father, a well-established dry-goods merchant in Hartford, Conn., was able to support his growing family....Frederick Olmstead had already tried several schools in Hartford by the time he was seven...."

Harvard has also claimed Olmstead as its own, but the record shows that his formal education was cut short at the age of 15 "by a case of poison sumac that spread to his eyes and threatened blindness," McLaughlin wrote. Olmstead studied civil engineering at Phillips Academy in Andover, Mass., but instead of pursuing that discipline, became a scientific farmer near Waterbury, Conn. I've always considered Olmstead an environmental leader, but the landscape architects have taken control of his legacy.

I hope this background sets the record straight for your readers.

DOMENIC FORCELLA '70
NEWINGTON, CONN.



Frederick Law Olmstead, father of landscape architecture in America, was *not* a son of Worcester.

We'd Like to Hear From You

The *WPI Journal* welcomes letters to the editor. If you have something you'd like to tell us about anything you read in these pages—or if you'd like to share your thoughts about WPI with fellow *Journal* readers—please drop us a line.

There are now three ways to get your missive into our hands:

- **Via U.S. Mail:** The address is The Editor, WPI Journal, 100 Institute Road, Worcester, MA 01609-2280.
- **Via Electronic Mail:** If you have an Internet connection, you can zap your letter to the editor in seconds. The address is *wpi-journal@wpi.edu.*
- **Via the World Wide Web:** A new form on the *Journal's* Web service makes it easy to compose letters and send them right to the editor. The URL is *http://www.wpi.edu/AboutUs/News/Journal.* From the *Journal* menu, select "Send a Letter to the Editor."

A Decade at the Frontier

BY CAROL GAROFOLI

PHOTOS BY MICHAEL DORSEY

In 1983, WPI launched a summer enrichment program for soon-to-be high school seniors. Since then, more than 1,300 students have come to campus to explore science, mathematics and technology at the leading edge and to get a taste of college life. Of those students, many have gone on to graduate from WPI, making WPI Frontiers a successful admissions program, as well. Here's a look back at the program's first 13 years.

Much research would agree with common sense—students interested in careers in mathematics, science and engineering need to have their imaginations fired by seeing science and technology in action before they choose to pursue those subjects in college. The research also shows that the best kind of stimulation for pre-college students is an extended opportunity to work, hands-on, in a real research laboratory.

Recognizing this, William Grogan '46, then dean of undergraduate studies at WPI, and Peter Christopher, professor of mathematical sciences, submitted a proposal to the George I. Alden Trust in the early 1980s requesting funds to start a summer program for exceptional high school students. They were responding, as were many others in higher education at the time, to the need to get more high school students to pursue the demanding curricula of science and mathematics.

"We must return to basics," they wrote in the proposal, "but the 'basics' of the 21st century are not only reading, writing and arithmetic. They include communication and higher problem-solving skills, and scientific and technological literacy—the thinking tools that allow us to understand the technological world around us."

The program Grogan and Christopher envisioned would encourage young people from central Massachusetts to pursue their burgeoning interest in science and math in a stimulating and supportive learning environment. They decided that the program would focus on physics, chemistry and mathematics, with the hope that students who were turned on by their experience on campus would go on to major in those disciplines at WPI, helping increase enrollment in these comparatively small departments.

Above, students in Frontiers' civil and environmental engineering discipline set out to test their concrete canoe.

The Alden Trust funded the proposal, and Frontiers in Science and Mathematics (now called simply WPI Frontiers due to its expanded focus) made its debut in the summer of 1983. The initial offering was a great success, attracting 36 students (including 14 women) who paid $350 apiece for the 12-day residential experience. With Provost Diran Apelian's support, the program's offerings were expanded to include mechanical engineering, design, theater technology and computer music. In 1995, 106 students from 14 states, Puerto Rico and Belgium participated.

Frontiers has evolved from a program designed chiefly to increase interest in undersubscribed academic departments to an effective general recruiting tool for the Institute. Of the 106 students who participated in the program in 1994, for example, 25 enrolled at WPI in the fall of 1995. (Students who matriculate at WPI have the cost of attending Frontiers deducted from their first year's tuition.) Early results indicate that about 50 percent of the students who attended Frontiers last summer have applied to WPI.

The program is designed to give rising high school seniors the opportunity to

study subjects not typically offered in the secondary school classroom. Since 1983, the range of subjects has expanded significantly, as the program's focus areas have grown from three to 10, including three fields of engineering: civil and environmental, electrical and computer, and mechanical. The emphasis has remained on hands-on learning, not passive lectures. The WPI faculty members who serve as teachers and mentors in each of the 10 disciplines endeavor to offer students a challenging and rewarding research and learning experience.

In the summer of 1995, for example, students choosing the biology option cloned genes and sampled wildlife in a coastal wetland. Students in the civil and environmental engineering concentration got hands-on experience with testing procedures by building small bridges and evaluating them with sophisticated computer analysis and design techniques. They also built a concrete canoe and launched it on Salisbury Pond.

In chemistry, students probed the molecular basis of matter using such state-of-the-art lab tools as spectrophotometers and gas chromatographs. Students in the computer science section sat at powerful workstations and collaborated on a software engineering project using C++, an object-oriented programming language. In electrical and computer engineering, students designed control systems and microprocessors. In mechanical engineering, they designed and built working model electric cars that were entered in a competition and did some aluminum casting.

Though the students spend the majority of their time working in a technically-oriented field, the Frontiers staff believes that future scientists and engineers should also be exposed to the humanities so they can appreciate the important role nontechnical disciplines play in the working and personal lives of technological professionals. Accordingly, students spend part of their time on campus in workshops playing music, writing, developing their public speaking skills, and learning about drama and theater.

Recognizing that science and technology are becoming increasingly important in many areas of the humanities and arts, the Frontiers staff recently added two new academic areas to the program: theater technology (see related story, page 10) and computer music. The faculty felt that expanding the focus of the program in this way might also broaden its appeal by attracting students who might not have realized such opportunities exist at our technological university.

In theater technology, students learn to use computers to design sets, stage lighting and sound. To put what they learn into practice, they work with students from the drama/theater workshops to produce a play. Students who choose computer music work with the sophisticated equipment and electronic composition software in WPI's Computer Music Laboratory. Over the course of the program, they write and perform an original composition. They also work with students from the music workshop to rehearse and put on a concert featuring several music groups.

One of the broader goals of Frontiers is to offer students a taste of college life—in particular, life at an outstanding technological university. Students live in residence halls and dine in the student dining hall. They have full access to the library and the university computer facilities. They attend lectures, work in labs and do homework. They also receive insights into the academic and social sides of the college experience by talking to the graduate and undergraduate students who serve as teaching assistants and resident advisors in the residence halls.

Not surprisingly, Frontiers is an academically rigorous, intense program. But just like real college life, it's not all work and no play. There is time for relaxation, sports and social activities, especially on Sunday, the only day students don't spend in the classroom and lab or on field trips. In the evening and during free periods, they enjoy recreational sports, movies, dances, tournaments and live performances. There are programs on diversity and campus safety. Students may also take classes in word processing and accessing the Internet—they even learn to make their own home pages on the World Wide Web—among other computer-related topics.

WPI Frontiers now encompasses 10 disciplines. Last summer, students in theater technology designed stage lighting, left, and students in mechanical engineering built electric cars, below. Other disciplines represented last summer were biology and biotechnology, right, where students spent time in the lab cloning genes, and electrical and computer engineering, where activities included designing control systems and microprocessors, far right.

In the years since Frontiers was founded, competition among summer pre-college programs has intensified. In 1983, WPI was one of the few colleges that offered such a program. Now there are hundreds of similar initiatives. The growth in the summer enrichment business has required WPI to dramatically increase its marketing efforts for Frontiers. Where once we could simply advertise the program in publications aimed at high school students, now we send direct mail pieces to potential students and mail announcements to guidance counselors and drama/theater, math, music and science teachers around the country.

And, of course, we must put Frontiers on the frontiers of communication. Last year we started listing e-mail and World Wide Web addresses for Frontiers in our brochure (*frontiers@wpi.edu* and *http://www.wpi.edu/Academics/Special/Frontiers*). The response has been overwhelming. The program now receives more inquiries over the Internet than by telephone or mail. We've endeavored to provide Internet visitors with information that can't be captured in a simple brochure, including photos of the buildings in which they will be studying and residing and information about the teaching faculty. Students can even send the faculty messages by e-mail. As a new feature this year, we've made it possible for students to apply for Frontiers on-line.

Each year, as the Frontiers program draws to a close, we ask the participants what the program meant to them. The comments we receive are heartening and heartwarming. For many, the program expands their understanding of science and technology and cements their conviction to pursue those fields in college. For others, it opens their eyes to the challenges and rewards of college life. And for virtually all, it builds friendships and memories that endure.

If you have a son or daughter who is a rising high school senior, or know of young people who might enjoy Frontiers, I hope you will tell them about our program. We are currently accepting applications for the 1996 program, which will run from July 6 to July 18, and we'd love to hear from them.

Garofoli, director of academic operations at WPI, coordinated the Frontiers program from 1986 to 1995. The 1996 edition of Frontiers is being coordinated by Blanche Pringle, director of minority affairs, and Lance Schachterle, assistant provost for special programs.

One of the broader goals of Frontiers is to offer students a taste of college life—in particular, life at an outstanding technological university.

Working at the Frontier

The following faculty and staff members have been involved with Frontiers over the years as instructors and administrators:

Faculty

Padmanabhan K. Aravind, Physics
Frederick W. Bianchi, Humanities and Arts (Music)
Peter R. Christopher, Mathematical Sciences
Robert E. Connors, Chemistry and Biochemistry
Tahar El-Korchi, Civil and Environmental Engineering
Richard G. Falco, Humanities and Arts (Music)
David Finkle, Computer Science
Daniel G. Gibson, Biology and Biotechnology
Frederick L. Hart, Civil and Environmental Engineering
Edmund M. Hayes, Humanities and Arts (Speech)
Thomas H. Keil, Physics
Fred J. Looft III, Electrical and Computer Engineering
Karen A. Lemone, Computer Science
Barbara L. McCarthy, Humanities and Arts (Communications)
Denise W. Nicoletti, Electrical and Computer Engineering
Dean M. O'Donnell, Humanities and Arts (Theater Technology)
Philip E. Robakiewicz, Biology and Biotechnology
Susan Vick, Humanities and Arts (Drama/Theater)
Douglas B. Walcerz, Mechanical Engineering
Matthew O. Ward, Computer Science
Douglas G. Weeks, Humanities and Arts (Music)

Staff

Bernard H. Brown, vice president for student affairs
Philip N. Clay, director of residential services
Gail A. Hayes, budget coordinator and administrative secretary, Provost's Office
Christopher S. Jachimowicz, assistant dean of students
Kristine M. Neindorf, assistant director of residential services

Without thinking, as we paused at one of the three-dimensional exhibits, I asked Dad the question I always asked:

"What's it like, out in space?"

Mother shot me a frightened glance. It was too late.

Dad stood there for a full half minute trying to find an answer, then he shrugged.

"It's the best thing in a lifetime of best things."

— From *The Rocket Man*, by Ray Bradbury

Coming Home

By Michael W. Dorsey

As he stepped out of the silver NASA van onto the rain-slicked apron by Launch Pad 39B, Al Sacco Jr. looked out on a spectacular site. Rising 240 feet atop the huge octagonal pad, space shuttle *Columbia* seemed to have come alive. Its giant orange fuel tank burgeoning with supercold liquid hydrogen and oxygen, the shuttle hissed and spit and exhaled cold jets of billowing vapor. Metal creaked and groaned. Valves opened and shut with resounding clanks and bangs. Machinery on the spindly gantries buzzed and hummed. And in the middle of it all, the gleaming white skin of the orbiter blazed in the brilliant light from xenon spotlights, seeming to inhale and exhale as the shadows of the vapor clouds played across it.

It was Oct. 20, 1995—just before 7 a.m. at the Kennedy Space Center in Florida. Sacco and the six other members of the crew of STS-73 were about to board *Columbia* for the seventh attempt to launch into orbit the second United States Microgravity Laboratory. As one of two payload specialists on the mission, Sacco would spend 16 days inside the lab conducting science in the microgravity environment of space. But right now, his mind was on the beautiful view before him and on the incredibly dangerous thing he was about to do.

Strapped tightly into a seat in the orbiter's middeck, Sacco would be propelled at speeds nearing six miles a second, riding on rocket engines capable of cranking out nearly seven and a half million pounds of thrust, into a world without air and where a collision with a bit of space junk could result in instant obliteration. But he was also about to realize the dream of a lifetime: to go where only 326 other human beings have gone before and to see the Earth, the universe—and his own life—from the vantage point of 150 nautical miles up. It was an experience that would change him forever.

Al Sacco's voyage into space began more than three decades ago in Belmont, Mass. The son of a former professional boxer and successful restaurant owner, Sacco grew up in a tight-knit Italian-American family that believed in hard work. Sacco did work hard—in school, on the athletic field at Belmont High School, and in Mario's, his father's restaurant—all the while eagerly following the Space Race and dreaming of one day becoming an astronaut himself.

He studied chemical engineering at Northeastern University and went on to earn a Ph.D. in the same discipline at MIT. With a NASA grant, he designed a regenerative life-support system to convert metabolic carbon dioxide from the air inside spacecraft to water. In 1976 he submitted his application to the astronaut corps, but was turned down. Assuming his dream of spaceflight was at an end, he joined the faculty at WPI, where he is now, 18 years later, head of the Chemical Engineering Department.

In 1983, a conversation with a fellow faculty member started Sacco down a new path that would ultimately take him to that rainy October

(Continued on page 14)

Last fall, Al Sacco realized his lifelong dream to fly in space. He says being in orbit felt so natural he became convinced that it is his destiny–and mankind's–to live among the stars. That conviction made returning to Earth all the more difficult.

The Case of the Pur

By Joan Killough-Miller

THE NEWS was broken at halftime of the Homecoming game last fall: "The Class of '96 has the goat!" A few brazen seniors bearing a hand-painted banner raced across Alumni Field in the middle of the singing of the alma mater. Their unexpected announcement reignited the century-old Goat's Head competition, which had been dormant for decades.

Spectators who turned in time caught a glimpse of the bronze trophy, which was briefly held aloft. But just as quickly as it appeared, the goat was tossed over two fences to a waiting senior, who spirited it across Institute Road and back into seclusion.

The Goat's Head is finally back, after years of work by more individuals and campus groups than can be named here. Lisa Hastings, former director of young alumni programs, says the movement evolved from the rebirth of the Student Alumni Society in the early 1990s.

"Reviving traditions was the issue around which SAS was rebuilt," says Hastings, who is now director of development at Harvard University's Arnold Arboretum. Students produced a new version of the *Tech Bible*, a handbook for freshmen first published in 1897, and established Traditions Day in 1991 to educate the WPI community about its heritage. Class rivalry events, including the Pennant Rush and the alma mater singing contest, have also been reinstated.

The most celebrated rivalry in WPI lore is the competition to acquire and hold the Goat's Head for one's class. The contest originally involved the preserved head of an actual goat, but when the stuffed trophy grew too fragile, it was replaced by a bronze statue in 1926 (see the story on page 24 for more on the history of the Goat's Head and the story of Gompei Kuwada,* the original goat keeper). After the 1950s, the Goat's Head tradition waned and the bronze goat was relegated to a shelf in the WPI archives, to be brought out occasionally for display at alumni functions.

With the revival of enthusiasm for WPI's traditions in the 1990s, interest naturally turned to the Goat's Head. By then the 1926 goat was deemed too valuable to again serve as a trophy in a student competition. So a group of students approached the Executive Committee of the WPI Alumni Association in 1993 requesting funding for a new statue. The request was approved, casting arrangements were made (see box, page 23), and the Goat's Head Committee was formed to draft a new set of rules for the class competition.

In the fall of 1995, the bronze replica was finally ready. Then a new question arose: how, exactly, should the Goat be put back into play? The SAS debated the issue and decided to hand the new Goat's Head over to the Class of 1997, on the grounds that the class had won more rivalry events than any other class during its sophomore year. The presentation would be made at a ceremony during Homecoming in September 1995.

Not all students were satisfied with that decision. A group of disgruntled seniors gathered after the meeting, aggrieved that their efforts

(Continued on page 23)

*According to WPI archivist Lora Brueck, WPI's records are inconsistent as to the correct spelling of Mr. Kuwada's first name. Records from his student days show it consistently as Gumpei. In later years, he signed letters to the Alumni Office, Gompei Kuwada, yet a business card from the same period lists it as Gumpei. From about 1920 on, all WPI documents spelled it Gompei. In this issue we have chosen to use this more familiar moniker.

oined Goat's Head

For more than a century the Goat's Head has been WPI's Maltese Falcon—an object of unbridled desire and elaborate schemes. The class that grabs it lays claim, not only to bragging rights over every other class, but to a rich WPI tradition.

DIGITAL Dra

In the increasingly high-tech world of the theater, professionals who are well versed in the dramatic arts and modern technology are in great demand. To meet this need, an innovative new program at WPI is preparing students for careers in the emerging field of theater technology.

PHOTOS BY VAUGHN WINCHELL

By Amy L. Plack '96

Technology has always been an integral part of the theater. Through the centuries, machines, gadgets and ingenious contrivances of all sorts have been employed to engineer the illusions that are so important to live drama and to create stage-bound worlds for actors to inhabit.

During the last few decades, the world of theater technology has been growing increasingly sophisticated as producers like Andrew Lloyd Webber have engineered extravaganzas in which elaborate mechanical sets, spectacular lighting and sound, and eye-popping special effects often upstage the big-name stars. In this new era of the performing arts, professionals who understand both theater and modern technology are in great demand, according to Susan Vick, professor of drama/theater at WPI and director of the Institute's new Theater and Technology program.

"The world of the theater is changing," says Vick, who is serving this year as a member of the Drama League, the nation's oldest theater organization. "People who are well versed in leading-edge technology are becoming critical to the success of modern theater productions. For example, when shows like *Phantom of the Opera* tour, there is often only one backstage person who goes along, and that's the computer guy."

In fact, computers are everywhere in the theater today. Scenery is often designed and modeled using computer-aided design software. Computers control the lighting boards and sound systems, enabling designers to create complicated effects never dreamed possible. Costume designers try out possibilities on the computer screen before they sew a stitch. And scripts are likely to be written, edited and customized for use by actors, directors and technicians with the help of computerized word processing packages. In short, modern computer technology is becoming as important to the theater as it is to virtually every other business and industry.

Theater technology differs from the more traditional field of technical theater, Vick says. "Technical theater deals with the way certain technical things are done in the theater—for example, how one builds flats," she says. "Theater technology is a more contemporary term that encompasses technology of all sorts that supports the theater performance. There is an emphasis on emerging technologies, like computer-aided design, that work to create, build and enhance theater and to expand the bounds of what constitutes theater."

Currently, the best way to prepare for a career in theater technology is to complete an undergraduate degree program in a field of engineering,

ma

NEIL NORUM

Opposite page, top, Stephen Richardson '97, audio technician for last fall's production of *Henry V,* works the audio boards. Bottom, fly operator Jedidiah Miller '97, left, and set designer Noah Weisleder '96 confer backstage during a technical rehearsal.

and then go on to do graduate work in theater. "A technically oriented theater professional must not only be expert in the nuts and bolts of the technology itself, but understand drama and be familiar with the literature of the stage. That's a combination you simply can't get through most undergraduate engineering programs."

But thanks to a new curriculum within the Department of Humanities and Arts, it is a combination you *can* get now at WPI. The new program, unique among undergraduate offerings in the U.S., according to Vick, enables students to blend their engineering knowledge with their love for the performing arts by earning a bachelor of science degree in the humanities and arts with a focus in theater technology, or by completing a double major program, with one major in a field of technology, such as computer science, electrical and computer engineering, or mechanical engineering, and the second major in the humanities and arts.

Vick says students may also pursue an individually designed major in Theater and Technology, an option that appeared for the first time in this year's undergraduate catalog. This program draws heavily on an Interactive Qualifying Project, "The Design of WPI's Theater Technology Program," completed by Melissa LaGreca '97, and takes advantage of the wide range of existing courses at WPI in engineering, design, mathematics, science, and the humanities and arts.

In addition to their technical and theater course work, students in the Theater Technology program frequently have opportunities to learn about theater technology from working professionals. Last fall, for example, Robert Webb, technical director of the Huntington Theatre Company in Boston, conducted a seven-week seminar that introduced students to basic elements of designing for the theater. In the lab, Webb, a specialist in drafting and design, rigging, working with foams and plastics, and other types of theater technology, covered everything from counterweight fly systems to stage construction to lighting design to materials used in scenic design.

Last fall also saw visits from professional scenic designer Brigitte Altenhouse, who conducted a workshop for students, and the Clyde Unity Theatre troupe of Glasgow, Scotland, which mounted a performance of John Binnie's *A Little Older* at WPI in October and then conducted a workshop in theater and theater technology for WPI students. The company, considered Scotland's most exciting new theater group, has offered workshops on three continents.

Hands-on workshops with theater professionals give students the opportunity to get a taste of how design is done in the real world of professional theater, Vick says. Another way to get that first-

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Joe
WPI
MECH. ENGR.

In 1946 Joe Gale continued a family tradition and came to work for WPI. Half a century later, he's still here. For 50 years—in the classroom, in the shop, in the press box, and in countless locales in between—he's touched thousands of lives and built a treasure trove of memories.

Hey, Joe!

By Ray Bert '93

Joe Gale stepped off a boat in early February 1946, setting down onto American soil again for good after a four-year hitch in the Army during World War II. Returning home to his native Worcester, Joe was informed of the following conversation that had taken place between his father, John Gale, and A.J. Knight, then the superintendent of buildings and grounds at WPI and the future namesake of one of its athletic fields:

Knight: When's Joe getting out of the service?
Gale: Feb. 6th.
Knight: When he gets home, tell him to take a few days off and then get his butt in here to work.

On Feb. 25, 1946, 19 days after his discharge from the Army, Joe Gale began work as an employee of Worcester Polytechnic Institute. Fifty years later, that relationship and so much more are still going strong.

To call Joe Gale a fixture at WPI, while accurate, doesn't do the man justice. He's a living, breathing part of the fabric of the institution—a human timeline of WPI's recent history. In his 50 years on campus (longer than most of the Institute's living alumni have been around) Joe has witnessed more growth and change, known more people, and touched more lives than perhaps anyone else in the Institute's history.

But to get a true sense of who Joe Gale is, don't look for pivotal, life-shaping events. Joe's life is more accurately represented by the piles upon piles of small events, conversations and memories that live on in his mind and in the minds of those who have known him. Put together, they form a remarkably consistent picture of a man who, through gestures large and small, and through the overwhelming force of his warm and hard-working nature, has won over generations of WPI students, faculty and staff.

Editor's Note: *In a typical profile, this is where the author would begin referring to the subject by his last name. But "Gale" doesn't seem right here. While "Mr. Gale" is appropriate, given the respect and esteem in which John J.B. "Joe" Gale is held, it is thoroughly at odds with his friendly, informal persona. Therefore, we have decided to simply use "Joe."*

Joe was accepted into the Army on Dec. 10, 1941, just three days after the Japanese attacked Pearl Harbor. He and one-fifth of his division were selected for the Armored Board Test Operations unit at Fort Knox, where Joe eventually became a shop foreman. Scheduled to travel to Europe in 1945 to instruct soldiers in the use of the first mechanized flame throwers, Joe received new orders as the war in Europe ended.

"The flamethrowers were mounted on tanks with 500 gallons of napalm for each," Joe recalls. With just a hint of a boyish fascination for things powerful and destructive, he adds, "They sent me to ESSO Labs to learn to operate them—you could get about 200 yards out of them! They were never used, though."

(Continued on page 28)

Coming Home

(Continued from page 7)

morning in Florida. The late Len Sand, a chemical engineering professor and renowned expert on zeolites, convinced Sacco to think about the microgravity of space as a possible breeding ground for large and highly valuable versions of these aluminum and silicon crystals, which are used as sieves and catalysts in many industries—especially petroleum refining.

[Before a launch attempt] "you'd get up in the morning and start trying to make peace with yourself, knowing that in a few hours you might not be around anymore."

From that conversation came a student-built experiment that flew into space as part of a package of WPI experiments in 1990. That experiment led, in turn, to a major space-based zeolite research program, supported by NASA and Battelle Advanced Materials Center, that flew an experiment on the first United States Microgravity Laboratory in 1992. As that experiment was in development, Sacco learned that NASA needed two payload specialists for the mission—scientists who would train to be astronauts and then carry out a host of scientific experiments in orbit.

Sacco was one of four scientists ultimately chosen to compete for the two flight slots. He spent more than a year in training only to learn that he would be a standby. Devastated, he carried out the duties of an alternate payload specialist during the USML-1 mission, which included working long shifts at the Marshall Space Flight Center in Alabama as the primary communication link with the astronauts orbiting overhead. After the shuttle landed, he returned to Worcester, an exhausted and emotionally drained almost-astronaut.

"We live in a success-oriented society," he says. "The fact that you train to be an astronaut and do everything the other crew members do means nothing if you don't fly. I could see that in people's faces when I'd give talks. They'd ask me what it was like in space, and I'd tell them I hadn't been there. You could see their faces sink. It made me feel crummy."

A few years later, NASA began gearing up for a second USML mission, and once again the call went out for payload specialists. Sacco's name was submitted and, out of the thousands of candidates, he was chosen to be part of a pool of fewer than 15 contenders. As before, he was grilled by a panel of science experts, who narrowed the field to six. Then Sacco underwent a battery of physical tests, made a presentation to a NASA review panel about why he thought he should be chosen, and submitted to an FBI background check before returning to Worcester to await the verdict, hoping his expertise and his experience with the first USML mission would make a difference.

They call them flashbulb memories—moments so powerful they become permanently seared into our brain tissue. For some, they include the day John F. Kennedy was shot, or the morning *Challenger* blew up. For Al Sacco, the flashbulb exploded the day he got "The Call."

He was sitting in the family room of his home in Holden, Mass., with his wife, Terri, watching a rerun of an old *Star Trek* episode. As the *Enterprise* and its crew boldly slipped among the stars, the phone rang. It was Kathy Thornton, the astronaut best known as a member of the crew of space walkers who helped repair the nearsighted Hubble telescope. "I didn't know Kathy," Sacco says, "but I'd read that she'd been chosen to be payload commander for the USML-2 mission. So I knew this was going to be very good or very bad news."

Getting right to the point, Thornton said simply, "Al, welcome to the USML-2 crew. You've been selected to fly." Sacco was elated. The official announcement of his selection came two weeks later, and then in the spring of 1994, he began the lengthy process of training. For 18 months, he learned everything he could about the 20 experiments slated to fly on USML-2. And he learned, once again, how to be an astronaut—how to prepare for the rigors of launch and reentry, how to eat, sleep and go to the bathroom in microgravity, what to do in the case of innumerable problems and malfunctions that might occur on the orbiter, and how to survive (or at least attempt to survive) the truly serious malfunctions that can threaten the survival of the shuttle and its crew.

Sacco says the training was easier this time around because he had been through it before and because there would be a ride into space at the end of it all. But the thrill of being a payload specialist, and not an alternate, also brought with it a tremendous weight of responsibility. "The hardest part of the mission was worrying about whether I was going to screw up somebody's experiment," he says. "Some experimenters had worked 10 years to get on the shuttle. They were going to have two or three days of my time. If I messed up, God knows when they'd get to fly again."

Despite the pressure, Sacco says he thoroughly enjoyed the launch preparations, in large part because of the chemistry of the USML-2 crew. There was Thornton, a veteran of three space flights who holds master's and doctoral degrees in physics; mission specialist Catherine "Cady" Coleman, making her first shuttle flight, who holds a doctorate in polymer science and engineering; Navy Lieutenant Commander Michael Lopez-Alegria, on his first flight, who holds a master's in aeronautical engineering; Navy Commander Kent Rominger, the orbiter pilot, also

making his first flight, who has a master's in aeronautical engineering; Navy Commander Ken Bowersox, orbiter commander and veteran of three flights, who has a master's in mechanical engineering; and Sacco's fellow payload specialist Fred Leslie, a NASA research scientist with a Ph.D. in meteorology.

"We just had one of those mixes," Sacco says. "We were a group of people who really gelled."

The space shuttle *Columbia* has a number of distinctions. It was the first operational shuttle in NASA's fleet, kicking the shuttle program off with its first flight in 1981. In the 17 trips into space it had made prior to USML-2 (constituting 2,500 orbits and 64 million miles), it had developed a reputation as a reliable vehicle in orbit. But it also can be tough to get off the pad. In fact, it holds the record for the most consecutive launch cancellations. During the USML-2 mission, it would come within a hair's breadth of breaking that record.

Due to mechanical problems, computer glitches and bad weather (including a visit by hurricane Opal), the launch of STS-73 would ultimately be delayed six times, enough to tie *Columbia's* record. For the crew, the delays took a mental toll. "You'd get up in the morning and start trying to make peace with yourself, knowing that in a few hours you might not be around anymore," Sacco says. "You'd get psyched up to do something just to have them say, 'We're canceling—see you next week.' I would feel devastating disappointment, tempered by a feeling of relief that, 'Geez, I've got a little more time."

By NASA protocol, astronauts must go into quarantine seven to 10 days before a flight to minimize the risk of catching something that might be a problem in orbit. By the time *Columbia* finally flew, the quarantine for the STS-73 crew had stretched to 34 days. "I only got to see my wife in certain areas, most of the time," Sacco says. "I never got to see my sons, my daughters or my granddaughter. They did let us go home for 12-hour periods as the delays continued. But I think the experience was more trying for people on the outside than it was for me. I had the benefit of being part of an outstanding crew. They were my family, too. We would commiserate together, laugh together, cry together."

They also played together. Sacco says he and the other *Columbia* astronauts passed the time between launch attempts shooting skeet, riding all-terrain vehicles through the Florida swamps, and doing aerobatic maneuvers in T-38 jets out over the deep blue waters of the Atlantic. "I got in between 10 and 15 hours in high-performance aircraft over the course of that month—that's a lot," he says. "I had a ball."

The seventh launch attempt was set for Thursday, Oct. 20. As Sacco and the other crew members arose at 3:30 a.m., the prospect for a launch seemed dim. The weather was rainy and the forecast offered little hope for clear skies. Sacco showered and pulled on a pair of slacks and a dark blue shirt with the USML-2 patch over the pocket—the uniform the crew had agreed to wear that morning. He opened the door to his room just before 4 a.m. and stepped into the hall as Kathy Thornton was leaving her room. "Well, Al," she said. "I think we're going today."

Preparations for the launch of a U.S. manned spacecraft have always been a mix of public and private rituals. The first public event that morning was the astronauts' breakfast. The crew sat around a large table and chatted with reporters as breakfast was brought out. Once upon a time, astronauts ate steak and eggs on launch morning, but that tradition was largely left behind before the dawn of the shuttle program. On this morning, no one ate steak and eggs. In fact, no one ate much of anything. Most of the crew was following what came to be called the "Thornton Protocol."

Sacco says astronauts can spend up to six hours strapped into the shuttle before a launch. Antici-

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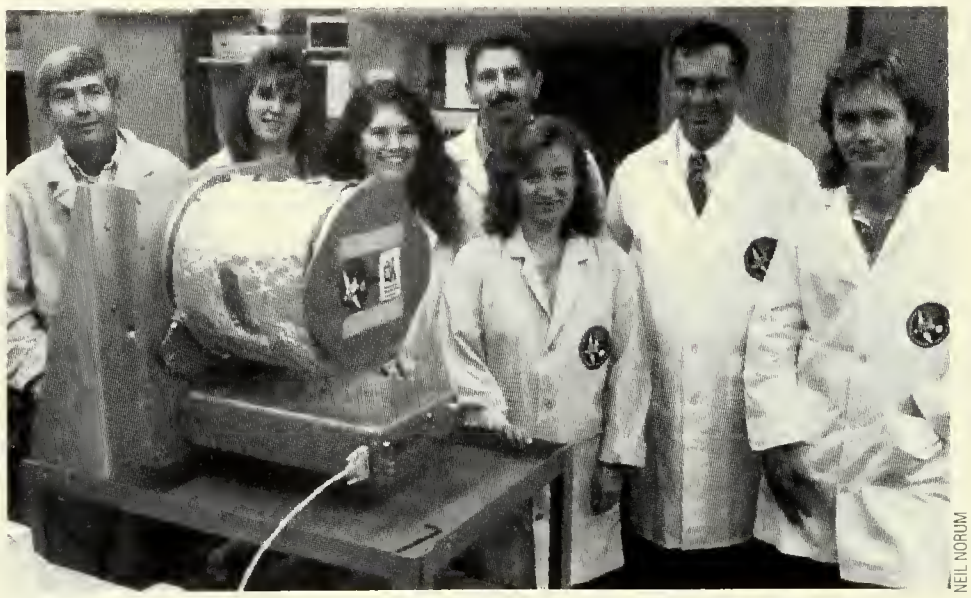
"I had the benefit of being part of an outstanding crew. They were my family, too. We would commiserate together, laugh together, cry together."

The STS-73 crew at the pre-launch breakfast. From left, Thornton, Lopez-Alegria, Sacco, Leslie, Bowersox, Coleman and Rominger.

The Z Team

While Al Sacco was entering the annals of space lore 150 miles above the Earth in *Columbia*, WPI's Zeolite Crystal Growth (ZCG) research team was making its own kind of space history on the ground at the Kennedy Space Center.

The team included Nurcan Bac, visiting professor of chemical engineering and leader of the ZCG launch preparation team; Giacomo "Jack" Ferraro Jr., principal lab machinist for the Chemistry and Chemical Engineering departments and hardware specialist for the ZCG experiment; postdoctoral fellow Juliusz Warzywoda, synthesis expert; graduate student Ipek Guray; and chemical engineering majors Michelle Marceau '97 and Terri Sacco '97 (Al's daughter). Al Sacco was principal investigator for the experiment, and Lisa McCauley at Battelle was in charge of integrating the space hardware. Battelle technician Robert Whitmore and postdoctoral fellow Eric Coker, working for the European Space Agency (ESA) in Delft, Netherlands, assisted with the hardware.



NEIL NORUM

With the ZCG furnace, from left, Ferraro, Sacco, Marceau, Warzywoda, Guray, Bac and Coker.

The launch team members were responsible for preparing the solutions and autoclaves that would be used in the ZCG experiment on USML-2. It was also the team's job to monitor the progress of the space experiment and to run a duplicate control experiment back in the lab at WPI. According to Bac and Ferraro, they also saw as part of their mission offering moral support to Sacco and the rest of the STS-73 crew. This pursuit would take them where no ordinary Space Center visitors had ever been before, according to Ferraro.

"Before a mission, the astronauts fly into Kennedy in T-38s," he says. "Normally, only members of the media are allowed to be there when they land. But Lisa McCauley is a friend of the head of public relations at Kennedy, and she was able to get permission for us to be there when the STS-73 crew flew in, as long as we stayed in one spot and didn't talk to anybody. Well, of course, we brought along some big signs saying, 'The ZCG Team Welcomes STS-73 Crew,' and we waved and jumped up and down and yelled as the crew arrived. The media noticed and started taking pictures of us."

NASA must have been pleased with the results, Bac says. "We've heard that they are thinking of changing their policy and inviting people other than the media to attend the crew arrival events now."

The team's desire to reach out to the *Columbia* astronauts got Ferraro in trouble one morning, however. Knowing that the astronauts would be walking out of the Operations and Checkout (O&C) Building to begin their trip to the launch pad, the team members decided that Ferraro should drive their rental truck, adorned with a large sign reading, "STS-73: Take Us With You," to the back of the building where the shuttle crew could see it. As he neared the building, Ferraro was surrounded by police cruisers from NASA's security forces. He stopped the truck, and got out with his hands in the air. "They brought out a bomb-sniffing dog and went all through the truck," he says.

The ZCG team arrived in Florida in late September to set up a laboratory in the O&C Building, where they would prepare a variety of zeolite solutions to go into the 44 metal and 16 clear acrylic autoclaves that would fly in USML-2. The metal autoclaves would be heated for nearly 13 days in a furnace on the middeck, while the clear units would be used to test the mixing protocol for the zeolite solutions. On Sept. 26, after a nearly 12-hour work day, the team handed the autoclaves over to NASA to be stowed in the shuttle. But the launch was scrubbed the following morning, and that evening the autoclaves were returned.

The team refilled several autoclaves containing solutions they thought might go bad during the delay and gave them back to NASA in time for the next attempt on Oct. 5. It would be the first of three times they would have to prepare new solutions for the flight. For two longer delays, as many as half of the autoclaves had to be emptied, chemically cleaned (a three-day process) and filled with fresh solutions. By the time *Columbia* finally flew on Oct. 20, the team was running dangerously low on supplies. "If the flight had been delayed again, we'd have had nothing left," Ferraro says.

After the Oct. 20 launch, Bac and Warzywoda flew to Huntsville, Ala., to man the ZCG experiment console at NASA's Spacelab Operations Center. The rest of the research team returned to Worcester to set up the lab to run the duplicate experiment.

On Nov. 5, *Columbia* returned to Earth. Bac met with Sacco a few hours after the landing and retrieved the autoclaves to bring back to WPI for analysis. He and Ferraro say the preliminary examination of the crystals grown in orbit show that the experiment was a tremendous success. On its two previous trips into space (including its debut flight on the first USML mission in 1992), WPI's experiment had produced some of the largest zeolites grown. This mission topped those results, producing crystals between 280 and 300 microns wide (commercially grown crystals are typically about 2 microns, while the largest crystals the ZCG team had previously grown in space were about 140 microns). Crystals of this size could open the door to new technologies and applications—and could mean significant savings for industries that use zeolites.

Will the ZCG experiment fly again? Bac says WPI hopes to secure a slot on another shuttle mission, or, barring that, a place on the International Space Station. The next flight may well be made in collaboration with ESA. The ZCG team began a collaboration with ESA on USML-2 by including two zeolite solutions prepared by ESA researchers in the ZCG furnace. "Every time we fly the experiment, we get a better idea of which solutions work best and the best way to prepare them," Bac says. "We've already had very good results; I think we can do even better on future flights."

—MD

Coming Home

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pating that they may need to urinate during that time, they wear diapers under their space suits. But Sacco says the shuttle seats place an astronaut's head about six inches lower than his body, which can make urinating difficult. "Kathy learned from experience that if you eat or drink anything on launch morning, your bladder fills up and you get the worst case of having to go to the bathroom you've ever had," he says. "This happened to me during the launch dress rehearsal. I found it impossible to go lying on my back with my head down. It was the worst six hours I ever spent."

The Thornton Protocol calls for avoiding drinking for 12 hours prior to launch. Sacco says it works. So on the morning of Oct. 20, he ate only a handful of dry Cheerios and drank nothing.

From the breakfast room, the astronauts went to the suiting-up area to change out of their casual clothes and into the bright orange pressure suits they would wear for launch and re-entry. Before suiting up, they pulled on their LCGs, or liquid cooling garments (essentially long underwear with plastic tubing stitched into it—water flows through the tubes to keep the crew comfortable inside the insulated suits). Like warriors being dressed for battle, the crew went before the photographers once again as technicians helped them into their pressure suits.

The Operations and Checkout Building, which houses the crew facilities, is just a few miles from Launch Pad 39B. To get there, the crew and the suit technicians ride in streamlined silver vans. The image of the astronauts striding confidently out of the building to board those vans has become one of the signatures of the U.S. space program. But before the STS-73 crew could make that walk, they had to make a decision. Lopez-Alegria had arranged for a friend to make special baseball caps for the crew. The attractive caps featured "STS-73" printed in gold against the stars and stripes of the U.S. flag.

The crew agreed to wear the caps on their ride to the pad. Lopez-Alegria and Sacco suggested that everyone put them on with the bills facing backward, in the style preferred by young people today. Bowersox objected, fearing the gesture could be seen as frivolous and undignified. The crew lobbied him as they descended in the elevator to the vans, but he remained unconvinced. Finally, they took a vote, and at 6:25 a.m., the seven emerged into the glare of TV spotlights and strobe flashes, smiling broadly, waving, and sporting a look that would go a long way toward meeting a personal goal of Sacco: erasing the image of scientists and engineers as staid, up-tight geeks. "That's my son's favorite picture from the whole mission," Sacco says.

The ride to the pad took 15 minutes. Police cars escorted the caravan and a helicopter flew along overhead as the vehicles made their way through the lush greenery of the Florida swamps. Emerging from the vans, the crew walked to the elevator that would carry them to the White Room, the small enclosure surrounding the shuttle's hatch. The NASA television feed would show them striding down the 65-foot-long orbital access arm and into the White Room several minutes later, but along the way, there was a brief stop to make.

"There is a bathroom on the 195-foot level," Sacco says. "We all decided to use it, which required taking off our suits. The suit techs were not happy. That was the only record we set on this mission. All seven of us used the bathroom, got back in our suits and made it to the White Room with no delay in the timeline. We were really good at getting in and out of those suits, having done it so many times before."

AP WIDE WORLD PHOTO

The STS-73 crew voted to wear their caps with the bills backwards as they emerged from the O&C Building to begin their trip to the launch pad. The jaunty look was a big hit with young people, Sacco says.

Bowersox, as commander, was first to crawl into *Columbia;* Sacco was next. He pulled on his Snoopy cap (the white and black cap with a built-in communications headset that astronauts wear under their flight helmets) and crawled through the hatch into the middeck, a 2,600-cubic-foot space that serves as the crew's living room, dining room, bedroom and bathroom. He settled into his seat against the sleeping compartments on the far wall. Technicians helped him buckle and tighten the lap belt and two shoulder harnesses.

It took more than two hours to get the rest of the crew strapped in: Rominger, Lopez-Alegria and Coleman on the flight deck, and Leslie and Thornton side-by-side in the middeck. The hatch was closed just after 8 a.m. and the suit techs made their way back down to the vans. With a tremendous bang, the cabin was pressurized and *Columbia* was ready for liftoff.

Inside the shuttle, tensions and spirits were both high. The crew bantered over the intercom and good-natured barbs flew back and forth. Sacco was kidded about a bet he'd made that he wouldn't eat NASA spaghetti sauce in orbit. Having grown up in an Italian family, he knew good tomato sauce when he tasted it, and the NASA stuff wasn't it. He didn't know that the crew had brought aboard a freeze-dried version of his wife's sauce for him to enjoy.

For nearly two hours, songs were sung, jokes were told and bladders were discussed as the men and women of Mission Control watched the

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Coming Home

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weather. At some point, Sacco fell asleep. He awoke at the T-20 minute mark, as the count entered a planned hold, then dozed again. The count stopped again at the T-5 mark for a final check of the weather. The dreary skies had parted and sun now shone down on Pad 39B. Through their headsets, the crew heard the verdict from the launch director. "Looks like you folks are going flying today."

Leslie, who was seated between Sacco and Thornton, punched the still sleeping Sacco in the side. "Al, we just went by the five-minute mark." Sacco experienced what he describes as a mild anxiety attack. "For about 30 seconds, I had a vision of my life. I saw my kids being born. I saw my brothers and sisters as we grew up. I had a vision of everyone I really care about. I thought, 'What am I doing here?' Then it all went away and I felt at peace with myself; at peace with everybody around me. I accepted that what was going to happen was going to happen. It was like being in the hands of God."

With 90 seconds to go, the crew pulled down their visors and turned on the flow of oxygen in their suits. Sacco, Leslie and Thornton exchanged glances and held hands across Leslie's chest. As the count reached the 6.6-second mark, the onboard computer started the three main engines. Sacco heard a muffled roar and felt low-frequency vibrations through his seat as the engines revved to 90 percent of full thrust, rocking the shuttle forward. With a twang, the shuttle came to a stop and began to rock back again. Just then, the clock reached zero and the two solid-fueled boosters erupted with a boom that resonated through the cabin. The shuttle leaped from the pad.

Emerging a few seconds later from a massive cloud of smoke and vapor, *Columbia* rolled gracefully and headed for space. "When the solids lit, the whole thing started to shudder a lot more," Sacco says. "I felt a compression in my chest as we gradually went 'uphill' to about 2.4 Gs. The vibrations felt as though we were driving over railroad tracks. All the while, we could hear Ken and Kent calling out altitudes and speeds."

The crew waited in near silence for the separation of the solids. No doubt, thoughts about the *Challenger* explosion—caused by a breach in a seal in one of the boosters—played across their minds. "There are a number of phases of flight that are just as dangerous as those first two minutes," Sacco says, "but that is the only period for which we have no contingencies. For other phases there are contingency plans, which I have to admit, in all honesty, are not likely to help very much, but at least you can do something—you can keep your mind active until you obliterate."

The boosters blasted away with a sound like cap guns firing, and suddenly the ride grew smooth and strangely quiet. The main engines continued to burn, but the shuttle, now traveling several thousand miles an hour, was outpacing sound. "All you can hear is your own breathing and the voices over the intercom," Sacco says.

With the solids safely away, the crew became more animated and talkative. As the shuttle climbed to 50 miles—traditionally considered the point where the atmosphere ends and space begins—Bowersox called out, "You're all astronauts, now." A cheer erupted from the entire crew.

The shuttle, having throttled down, began to accelerate again, climbing up to 3.2 Gs. Sacco concentrated on his breathing, but, he says, the hours he'd spent hitting 6 and 7 Gs in the T-38s made 3.2 seem easy. And then, eight and a half minutes after they had ignited, the main engines cut out as the shuttle reached orbit. "We went flying forward in our seats," Sacco says. "It was the most violent portion of the whole ride. I thought I was going to go right through the bulkhead in front of me. No one had told me about that sensation."

Now drifting through space, the shuttle ejected its external fuel tank and began automatically switching on electrical systems, fans and lights, filling the middeck with noise. Still trussed tightly to his seat, Sacco had no sensation of weightlessness. He and Leslie had been instructed to stay put for at least a half hour to get their space legs and to be sure they weren't going to become sick. [Sacco says none of the crew experienced any nausea.] Thornton undid her straps and began to help "safe" the orbiter. Despite the sight of her floating by him, Sacco remained unconvinced that he had arrived in space. "Are we in orbit?" he asked Thornton. "Damn right, we're in orbit!" she replied with a smile. Finally, Sacco pulled a pen out of his pocket, held it in front of him and let go. It didn't fall. "Damn right!" he thought.

Releasing the buckles on his harnesses, Sacco rose from his seat and into what he calls "the three-dimensional world of microgravity," a world where Isaac Newton's second law of motion (a body in motion will remain in motion until compelled by external forces—or a space shuttle wall—to change that state) governs every move an astronaut makes. He says he felt right at home. "It sounds strange, but I felt more normal floating in microgravity than I do walking on the ground. It was like I had come back to something that was natural for me. The thought did cross my mind several times during the mission that this is where mankind belongs."

Sacco busied himself with housekeeping chores—helping other crew members out of their pressure suits, stowing the suits and the seats, checking circuits breakers, and so on. Two hours

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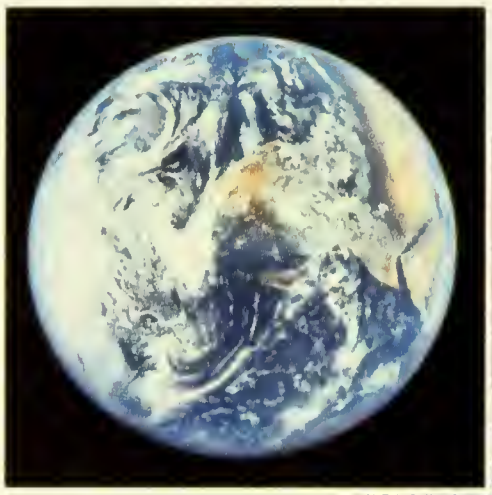
passed by in an instant, and then he heard his name over the internal intercom. Bowersox was calling down from the flight deck, "Tell Sacco to get up here immediately!" Fearing he had made a blunder, he drifted up through a passageway and into the flight deck. Before him, shining through the shuttle's forward windows, was the most awe-inspiring sight he had ever seen.

"There was the Earth—sitting right in front of me," he says. "It was a gigantic ball, predominantly robin's-egg blue—bluer than any blue you have ever seen—with clouds and land masses. Around the edges was a thin limb—the atmosphere—that went from the deep blue of the ocean to a white haze to a beautiful sky blue to indigo to the black of space. And that black was the blackest velvet you can imagine. As you looked away from the Earth, you could see millions of stars—galaxies of stars."



For the moment, though, Sacco could not take his eyes off that deep blue planet, for right in the middle, turning slowly under the shuttle, was Massachusetts. "It looked just like a map, it was so clear and sharp," he says. "I could see Logan Airport—I could even see the runways. It's amazing how clear everything is from space."

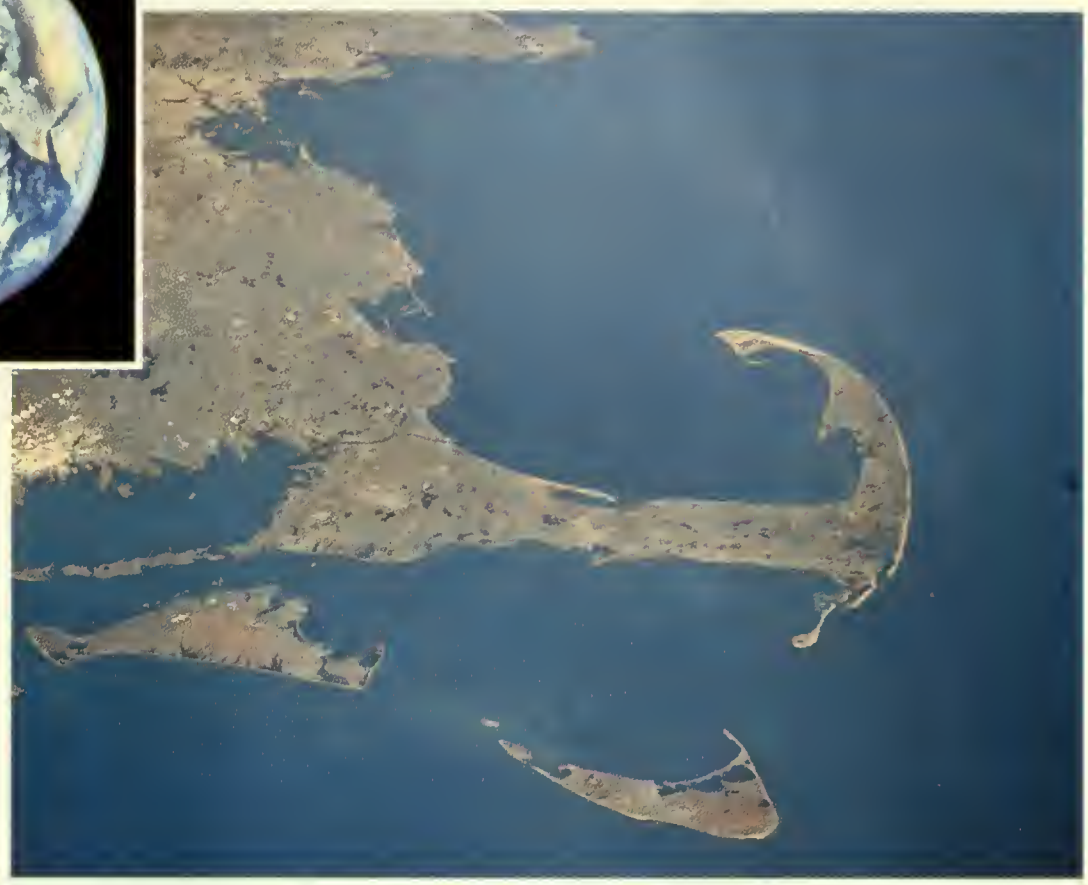
Sacco says seeing the Earth from orbit is "a humbling experience—a spiritual experience. I had the feeling as I looked out into the cosmos that we are smaller than the smallest grain of sand on the largest beach I've ever been on. I felt that if everyone could spend an hour and a half up there—one orbit of the Earth—that there'd be a lot fewer problems. There certainly would be no environmental problems, because everyone would realize how delicate the Earth is."

During one of his rest periods, Sacco went up to the flight deck alone and shut off all the lights—even the eerie green glow of the computer CRTs. In total darkness, he waited while the shuttle moved into the Earth's shadow. "I let my eyes adjust to the darkness," he says, "and I could see hundreds of thousands of stars. In some places, the stars were so thick they looked like a shimmering veil."

Sacco says that experience has changed him. "I don't know whether it's for good or bad," he says. "But now a faculty member or a student will come in to see me about something, and the problem, while it's important to them, will seem quite tiny to me. It's hard for me to give it the attention I should. It's not that I'm not interested, it's just that I've had an awakening they haven't."

USML-2's payload crew consisted of two teams. Sacco and Thornton made up the Red Team; Leslie and Coleman were the Blue Team. The teams worked alternate 12-hour shifts, so science could be carried out around the clock. After the orbiter was checked out, the Blue Team headed off to sleep while Sacco and Thornton opened up the spacelab, a 23-foot-long cylinder that sits in the shuttle's cargo bay and is connected to the middeck by a long, narrow airlock. The Red Team began setting up experiments designed to grow commercially important protein crystals, study the physics of water drops, and investigate surface-tension-driven convection (experiments that may help develop manufacturing techniques for the International Space Station). There were tests of bioprocessing apparatus, work on processing techniques for semiconductor manufacturing, and studies of microgravity combustion, among other experiments. In all, the work of hundreds of scientists from university, government and industry research labs was packed into the lab and in racks on the middeck.

From orbit, the Earth is a gigantic ball of brilliant colors—an awe-inspiring sight, Sacco says. His first view of the planet was a glimpse of his home state of Massachusetts.



Among the apparatus on USML-2 was the Zeolite Crystal Growth Experiment, created by Sacco and a team of faculty and student researchers at WPI (see story, page 16). One of Sacco's first assignments was to prepare the autoclaves for his own experiment and place them into a furnace on the middeck. The work went smoothly, which he says gave him confidence to tackle the many hours of science work that lay ahead. In all, Sacco says the Red and Blue teams carried out one of the most successful science missions in NASA's history.

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"This one outshined even USML-1, which was a highly successful mission," Sacco says. "I got a great compliment from Gene Trinh at the Jet Propulsion Lab, a payload specialist on USML-1 who is a co-investigator on the Drop Physics Module. He said, 'You guys did much better than I did, and I'm supposed to be the expert.' I've had a lot of people tell me similar things. They said we were so well-trained that after a while they didn't worry about us; they didn't try to interact with us. They just let us do our thing. A lot of people trusted my judgement about things that are not my areas of expertise, and that made me feel really good. A great deal of credit has to go to the scientists and trainers who prepared us so well."

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In his 12 hours a day outside of the lab, Sacco slept, rode an exercise bike, communicated with his family by an e-mail-like system, and prepared for the day's science work by reading messages sent up by the experimenters on the ground. He also spent an hour or more just looking out the windows. The crew used some of their free time to tape not one, but two bits of business for national prime-time television.

For one network spot, they threw out the first pitch of the World Series. A baseball had been brought aboard, and Bowersox effortlessly sent the ball sailing toward the camera while the crew waved (a moment that took 35 takes, Sacco says). The television audience then saw a ball appear to fall from the sky and into Atlanta-Fulton County Stadium.

The other spot was taped for the ABC situation comedy *Home Improvement*. A big fan of the space program—and of Thornton's high-flying handiwork on the Hubble repair mission—star Tim Allen invited the crew to film a brief segment in orbit and then, after the flight, to come to the studio to tape another bit. The in-orbit segment showed Thornton attempting to use a screwdriver brought along for Sacco's experiment, but spinning around and around from the torque. Footage showing Sacco in a plaid shirt he had smuggled aboard (the look sported by the character Al on *Home Improvement*) never made it on the show, though it did appear in a segment of the syndicated program *Entertainment Tonight*.

Several members of the crew also used their personal time to do a bit of teaching. Long before the launch, Thornton, Coleman and Sacco—lamenting the declining interest among young people in science and technology—decided that they had a rare opportunity to do something about it, *and* to pay tribute to the legacy of Christa McAuliff, the New Hampshire elementary school teacher who died in the *Challenger* accident. They drew up a plan to do several live telecasts to schools around the nation, conducting science experiments in space while the students did the same experiments on the ground. It took months of work by Thornton to convince NASA to go along, albeit with a smaller number of broadcasts than the astronauts had hoped for.

In the end, four sessions were planned, with schools in Worcester, Kentucky, Montana and New Mexico. During the Worcester broadcast, students at South High School did an experiment on adhesion and cohesion of liquids while Sacco talked about the behavior of liquids in space. He demonstrated how surface tension holds liquids together by squirting orange juice from a tube. The juice immediately gathered into a perfect sphere, which Sacco gobbled down to the delight of the 22 students in the South High television studio. The

four broadcasts were seen by thousands of students in 12,000 classrooms around the country over the Channel One network.

"The broadcasts were quite successful," Sacco says. "It took some astronauts who are committed to education and the work of many, many people on the ground—people who were willing to organize this all for nothing, because there is no money for this. Fred and Linda Looft and Bob Labonté from WPI did an outstanding job of coordinating everything. The idea we all had was to get young kids excited and to show them that scientists and engineers are not geeks. If we reached just a few of them, then we succeeded."

Much of Sacco's time in orbit was spent in the spacelab doing research. Opposite, he and Kathy Thornton adjust a camera on one experiment. Above, he prepares autoclaves for his own zeolite experiment (left) and protein crystals in the glove box. Below, in his spare time, he taught students about cohesion, and discovered the challenges of eating in microgravity.

Sacco said he enjoyed daily life in space and adapted well to microgravity. After a bit of insomnia (which he learned was caused by over-the-counter medication he took for sinus congestion), he slept well. He says that although he rarely felt hungry, he ate everything in sight (and still lost 12 pounds during the mission). Eating in space is not easy at first, Sacco says. With no gravity to hold food on your spoon or in your mouth, it takes practice and concentration to avoid making a mess.

"It took some time to get used to chewing so the food stayed all together in your mouth," he says. "You had to be careful to suck straws clean before you removed them from your lips to keep from sending drops of juice flying into someone's face. I remember having Kent tap me on the shoulder and point to his forehead, where one of my meatballs was splattered. You also had to allow a lot of time to clean up floating food after you'd finished eating."

Brushing his teeth in space was something Sacco never got used to. Without gravity to override it, surface tension causes toothpaste to foam up dramatically. "No one had told me what to do with that foam," he says. "You can't very easily spit it into a bag—it will just bounce off and hit you in the face. So we spit it into napkins, but the stuff would float around and climb up your face. Then you'd rinse your mouth with water and you'd have to spit that into napkins, too. And all the while, you'd try to brace yourself against something so *you* didn't float all over the place."

The last day of the mission was a bittersweet one for Sacco. As he helped pack equipment away, break out the seats and space suits for the return to Earth, and prepare large bags of cold fluid (the "liquid load" each astronaut must consume before reentry), he felt anxious to return to his family. But at the same time he was overwhelmed by depression at the thought of possibly never being in space again. When his turn came, he floated for a few final minutes in the flight deck soaking up the view that so few Earthlings will ever see, before returning to the middeck to suit up and strap in.

(Continued on next page)

Coming Home

(Continued from previous page)

Speeding over the Pacific Ocean, *Columbia* turned to point its orbital maneuvering engines toward North America; a series of blasts from the engines slowed the shuttle, which began dropping out of orbit. In the middeck, Sacco felt the push of the engines and then waited for the gradual onset of gravity. As the spacecraft encountered the atmosphere at 17,300 miles an hour, its heat-shielding tiles began to glow bright orange. Through the small window in the middeck hatch, the view went from black to yellow to orange as the shuttle turned into a meteor. Sacco says it looked as if someone had placed sheets of colored paper over the window.

Periodically, Sacco released a pen over his lap and watched it fall faster each time as gravity returned. As the shuttle neared the Florida coast, he picked up his 6-ounce tape recorder and found that it seemed to weigh 50 pounds. Clearly, his body had acclimated to a world without the constant tug of the Earth. Near the end of the descent, the shuttle was buffeted a bit before dropping gently onto its main gear on the landing strip at Kennedy. The nose gear hit the ground with a solid bang. Sacco was an Earth dweller, once again.

After the landing, came a period of adjustment—both physical and psychological. Feeling heavy and awkward, Sacco walked from the shuttle and into a waiting van. Having volunteered for a NASA medical experiment, he, along with Thornton and Leslie, agreed to lie down for several hours rather than walk around the shuttle with the rest of the crew. When he finally stood up again, he felt worse than he had when the shuttle landed. He later learned that lying down right after landing prolongs the aftereffects of weightlessness. The dizziness and weakness went away in a few days, but even several months later, Sacco says his muscle capacity is only about three quarters of what it had been before the flight.

The mental adjustment has taken even longer. In fact, he may never really be the same person he was before "strapping himself to a hydrogen bomb," as he refers to flying in the shuttle. Returning to life as a faculty member and department head has been especially difficult. "I never thought it would affect me like this," he says. "I'm a different person. I feel a bit like a fish out of water here, and I never thought I would, because I've been here 18 years.

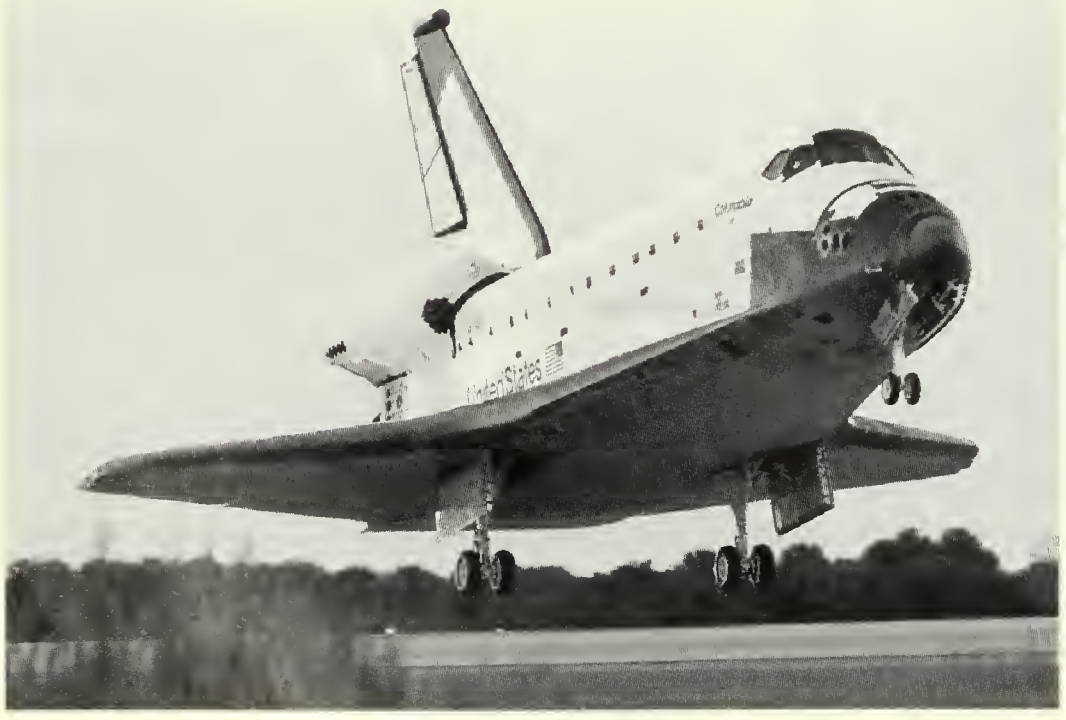
"I'm sure this feeling will change in time, but right now I really miss being part of the space program—I miss the adventure. I don't like to think about the fact that I may never go into space again. I'm feeling a tremendous letdown. My family feels it, too. They miss the friends we made in Houston. They will still be our friends, but it won't be the same. That was my home for 18 months. These were people I was prepared to die with, and we became very close. But when you are a payload specialist...when the flight's over, its over. My office is gone, my desk is gone, my phone number is gone—it's like I was never there."

Except for the bottle. The bottle on the mantel. On the shore not far from the launch towers of the Kennedy Space Center is a small beach house. Since the early days of the space program, astronauts have gone there before their flights to share some laughs and drink a bottle of wine. Tradition calls for everyone to sign the bottle and put it on the mantel in the living room. Now there is a bottle there with the signature of Al Sacco. He is a part of space history.

Will there ever be another bottle on that mantel for Sacco? "I doubt very much that I will fly again," he says. "Every year you get a little older, and you get a little shakier physically—I'm already on the bubble in a few areas. Plus, this took a toll on me and my family. My daughter has told me she hopes I never do it again. My oldest son didn't think I was coming back. My wife is the tough cookie of the family, but there were times when I saw a loneliness in her eyes—a fear I'd never seen before."

Still, he's not ready to completely rule out another flight. He says NASA has suggested that he apply for an upcoming mission. While he may pass on that flight, if another comes along and the invitation is extended, who knows? "It was the greatest expericnce of my life," he says. "I've never enjoyed anything professionally as much as that. I love to teach, but this outshone that by a country mile. If something were really to work out..." He pauses, his eyes focused on a point far away—maybe 150 miles away. "I'd go in a heartbeat." ■

"I really miss being part of the space program—I miss the adventure. I don't like to think about the fact that I may never go into space again."



The Case of the Purloined Goat's Head

(Continued from page 8)

to restore the goat were going unrewarded. In the spirit of Gompei Kuwada and his friends, they contrived to steal both goats. "We wanted to be the last class to possess the old goat before it went to the archives forever," says Skull president and SAS member Brian Klauber '96. "We figured we could get our hands on the new one eventually."

The seniors quickly came up with a plan—actually, several plans. All of them revolved around Hastings' successor, Christopher Boffoli, who was scheduled to pick up the goats—new and old—from the foundry on Friday, Sept. 15, 1995. When Klauber and Justin L. Holwell '96 asked to go along for the ride, Boffoli agreed.

Plan A, according to Klauber and Holwell, called for two carloads of reinforcements to tail Boffoli's car and swipe the goats at the foundry. If that failed, Plan B was to feign the need for a rest stop on the return trip, giving the henchmen another opening. The actual thieves were to remain anonymous, so Boffoli wouldn't connect the deed with the senior class. "We didn't want to betray Chris," says Klauber. "He really helped us out, so it was important not to let him know that we were behind this. I didn't want it to get ugly."

Both plans quickly went out the window, as the chase cars were separated from Boffoli's vehicle before they had even reached the Worcester city limits. Boffoli pulled onto I-290, leaving the trailing cars heading south on Main Street. Boffoli explained that the goats were not at the East Bridgewater, Mass., foundry of Jeff Burek '76, as the seniors had thought, but at a foundry in Rhode Island, where Burek had arranged for the casting to be done.

Their hopes dashed, the seniors returned to campus in Boffoli's car, eyeing their bronze traveling companions and fishing for clues as to their weekend accommodations. That was simple. Boffoli told them right off that he had been instructed not to risk storing the goats at the WPI Alumni Office in Higgins House, but to take them home.

Although Boffoli's address is not listed in the phone book, the seniors came up with a scheme for getting it. Posing as a radio disk jockey, Jesse Parent '96 called Boffoli Sunday night and fabricated a contest that Boffoli was sure to win. Boffoli's prize was a pair of tickets to a concert, which the station would be happy to mail to him, Parent said. He verified Boffoli's address twice before hanging up.

A group of seniors staked out Boffoli's home at dawn, until they were chased away by suspicious neighbors. They knew that once Boffoli returned the goats to the Alumni Office, it would be too late. An ambush at Higgins House was their last hope.

(Continued on page 25)

COROLLARY

Casting Call

The Birth of a Goat

It was the ugliest animal I've ever seen," jokes Jeff Burek '76, the man responsible for casting a reproduction of WPI's original bronze Goat's Head. "My kids are probably having nightmares after looking at it."

Burek, owner and president of D.W. Clark Inc., a metal casting company in East Bridgewater, Mass., was asked by the Alumni Office to make a new goat for his alma mater. He judged the artistry required by the job too delicate for his foundry, which produces machine parts for industrial and military use. He arranged to have the work done by Paul King Foundry in Johnston, R.I., at his own expense, as an in-kind gift to the Institute. WPI paid only for the materials.

JANET WOODCOCK

Jeff Burek '76 in his East Bridgewater, Mass., casting company. He was responsible for cloning the Goat's Head, which he calls "the ugliest animal I've ever seen."

The duplicate goat was made using the lost-wax process, an investment casting method capable of reproducing fine detail. First, an impression was taken of the original goat and used to create a plaster mold. The mold was then injected with hot wax.

After cooling, the hardened wax "positive" was dipped into a series of heat-resistant ceramic coatings to form a durable shell, with holes for draining and filling. Next, the mold was placed in an autoclave to melt the wax. The remaining ceramic shell was then filled with molten bronze, which took up the space once occupied by the "lost wax."

The painstaking finish work of cleaning, perfecting surface detail, and applying a patina took many months of intensive hand labor. The replica is said to be virtually indistinguishable from the original, with all of the class inscriptions (even the original 1926 foundry stamp) reproduced in exact detail. The new goat may lack the luster that bronze acquires from being handled over time, but with so many students vying to get their hands on the beast, it won't be long before it starts to glow.

—JKM

Why a Goat?

EDITOR'S NOTE: *Anyone familiar with WPI traditions knows that the Goat's Head trophy is but a memento of the Institute's first mascot, a live black goat kept by Japanese student Gompei Kuwada. But why a goat? Why Gompei? And why that huge head? Here's the whole story.*

The tale of the Goat's Head dates back more than a century to the spring of 1891. At that time, the enthusiastic members of the Class of 1893, then sophomores, decided they wanted a mascot. One day a group of classmates took a half-day road trip to Dungarvan Hill, east of Worcester's Union Station. Here they secured—kidnapped, it might be said—a live black goat they felt would represent their "defensive and buttinsky" temperament.

The goat was taken to a farmhouse on Park Avenue. A Japanese student, Gompei Kuwada, who the class considered to be quite a humorous character, was chosen to care for the unmanageable animal. Gompei's selection resulted from his ability to handle and placate the beast and because his were the only initials that fit the title, "Goat Keeper." The goat, led by Kuwada, soon became a popular attendant at class activities.

As the end of the academic year drew near, the class met to discuss the expense of boarding the goat for the summer. Kuwada suggested that anyone would be honored to keep his friend the goat. However, no suitable situation emerged, so the goat was chloroformed and decapitated. The head was stuffed and mounted on a board, and for the following two years, this served as mascot for the Class of 1893.

The first recorded Goat's Head theft occurred in the spring of 1892, when Kuwada and a few of his classmates returned from break to find the head missing from their John Street rooming house. The men of '93, now juniors, had to show their mascot in just a few days, or be made a laughingstock by '94. With little time to act, a few members of the class traveled by night to procure another black goat and have him similarly foreshortened.

The fate of the original head was not discovered until 1913, at the Class of 1893's 20th Reunion dinner in the Electrical Laboratory (now Atwater Kent Labs). The lab's big crane began to move down the room until it stopped over their table and lowered the original Goat's Head. The trophy now bore an inscription from the Class of 1894, which had taken it to Nova Scotia and kept it hidden for 20 years.

Many years after the original head was returned to the Class of '93, the Class of 1928, as sophomores, decided that life at the Institute would be more spirited if some source of rivalry between odd and even classes was implemented. They had in mind a contest much like that at Amherst College, in which the Sabrina statue was constantly stolen back and forth between the classes. The Class of 1928 asked the Class of 1893 to contribute the mounted goat's head for this purpose.

The Class of 1893 and "Goat Keeper" Gompei Kuwada (inset) with the original stuffed Goat's Head.

Not surprisingly, the original was thought too fragile. However, for the occasion of its 35th Reunion, the Class of 1893 made a bronze casting to represent the Goat's Head. Its body was only about a foot long, but its head was life size and sculpted in the likeness of the original goat. The miniature, which was said to weigh "twenty and a Kuwada" pounds, was presented to the Class of 1928 at its sophomore banquet, along with a list of rules. The rules required the possessing class to display the goat at least once a year at some school gathering.

Some of the more creative showings have become legendary. In 1929 freshmen dangled the goat from an airplane that circled the track during a meet against Tufts. The next fall, the Class of 1932 tried to pass off a doctored photograph to convince others that they had the goat. The goat has been thrown off Earle Bridge into a moving convertible, hung from the ceiling of Alumni Gym, and even "shown" on videotape by the Class of 1997.

This form of rivalry, in which the goat was stolen and hidden by the freshmen and sophomores, was soon replaced with an interclass competition that included the Rope Pull, Tech Carnival and the Paddle Rush, as well as several sporting events. The Goat's Head was awarded to the class with the most points at the end of the year.

Under this system, the Goat's Head spent most of its time locked in a trophy case in the gym. But in 1939, it was stolen and temporarily stashed in a cemetery. A group of boys stumbled on the statue and tried to sell it to a junkman, who luckily recognized its value and refused to make the purchase. Fortunately, the Goat was later spotted by an alumus of the Class of 1915, who saw that the mascot was returned to WPI.

The Goat's Head chase was revived in the 1950s and has fallen in and out of favor several times since then. It was recognized that the competition engendered school spirit and class bonding, but the increasingly violent chases were considered a danger to the students and the now-valuable goat. Student interest in possessing the trophy has never died out entirely, however. No matter where the Goat's Head was hidden during its periods of retirement, enterprising students have always found a way to steal it.

This article is a condensation of a presentation compiled for Traditions Day in 1993 by former members of the Student Alumni Society, including Matthew Friend '93, Sam Tetlow '93 and Brian Prunier '93. Source materials included "History of the '93 Goat," the definitive account by Arthur C. Comins of the Class of 1893, which was published in the WPI Journal *in July 1928.*

The Case of the Purloined Goat's Head

(Continued from page 23)

Monday morning, Boffoli got up, retrieved the goats from his garage, and left for work. On the way in, with the statues sitting side by side on the floor of the back seat, he went over in his mind how he would carry them in and hand them over for a photo session with the Alumni Association and the WPI News Service. He pulled into the Higgins House circle shortly before 9 a.m. and parked behind the building.

Phil Gunning '96 appeared from nowhere and grabbed at the handle of the car's rear door. It was locked. The would-be thief shrugged and walked off. "I though nothing of it," says Boffoli, who is accustomed to the antics of fraternity members who often cut through the grounds of Higgins House. "It didn't go through my thick skull that something was really wrong."

He unlocked his car, hoisted a heavy bronze statue under each arm, and headed for the Higgins House door. He didn't get far before he was ambushed by Jason Averill '96 and Holwell. The seniors made off with the goats without a hitch. "I had heard stories about how people schemed to get the goat, but I had no idea the students would pull something like this," Boffoli says. "It made no sense to struggle or give chase; I was afraid that the goats would be dented or damaged."

Reluctantly, he marched upstairs to inform Sharon Davis, director of alumni programs, of the theft. "It was my duty to bring the goats back safely, and I failed," he says. "I felt betrayed. It was humiliating to have disappointed Sharon by dropping the ball."

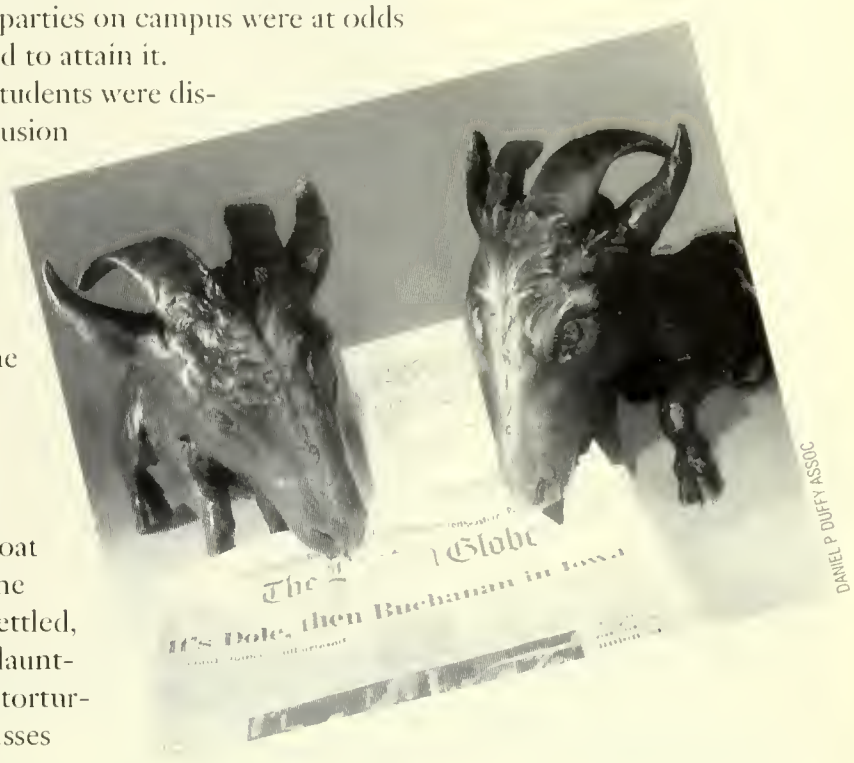
After some tense phone calls, an emergency meeting was convened. The seniors' position was that they were carrying out a time-honored tradition, one not subject to administrative control. The administration voiced concerns about the historical value of the goats and WPI's liability in an unregulated chase. There was also some controversy over which set of rules was in effect at the time of the robbery—the original, decades-old code or the new rules being developed by the Goat's Head Committee.

After much discussion, a new set of rules was quickly drawn up and officially adopted by the Executive Committee of the Alumni Association at Homecoming. It forbids transporting the goat by motor vehicle, confines chases to campus, and requires that classes report the goat's whereabouts to the Goat's Head Committee each time it is moved.

By the evening of the day of the heist, the seniors returned the old goat to the Alumni Office, but not before having their class year engraved in a conspicuous manner on the animal's rump. They kept the new goat to display at a time and place of their choosing.

Thus, the kick-off of the revived Goat's Head rivalry took place at Homecoming, as planned, but not in the ceremonious manner that the Alumni Office and the Student Alumni Society had intended. The seniors enjoyed their moment of glory, but some parties on campus were at odds with the tactics used to attain it.

"A number of students were dismayed by their exclusion from the events surrounding the Goat's Head," Boffoli says. "I liken it to grabbing the football from the ref and running down the field for a touchdown before anyone was ready."



DANIEL P DUFFY ASSOC

Once the old goat was returned and the rules controversy settled, the seniors began flaunting their prize and torturing the younger classes with bogus clues that sent them pointlessly digging through a mound of fresh dirt by Skull Tomb and rising at the crack of dawn to search local landmarks. "The Class of '96 really did do a good job of exciting the student body and engaging the underclassmen about possessing the goat," Boffoli says.

"I wanted the students to have a good time and learn something about WPI history," says Klauber. "We told them that if they truly knew the Goat's Head history, the trophy's location would become so apparent, it would just unfold right before their eyes.

"That was completely false, but the good thing was, they were sitting down and reading the literature—learning WPI history." Reference works, such as the late Mildred Tymeson Petrie's *Two Towers* and *Seventy Years of the Worcester Polytechnic Institute* by Herbert F. Taylor '12 are much in demand these days.

With the Goat's Head back in circulation, the campus is alive with signs of the chase, from colored-chalk graffiti on the sidewalk, to rumors of a live goat in the dining commons, to letters and editorials in *Newspeak*, the student newspaper, to e-mail bulletins on the status of the mascot. The goat has also been a philanthropist, raising money for charity when Alpha Tau Omega fraternity auctioned off a chance to touch the bronze animal.

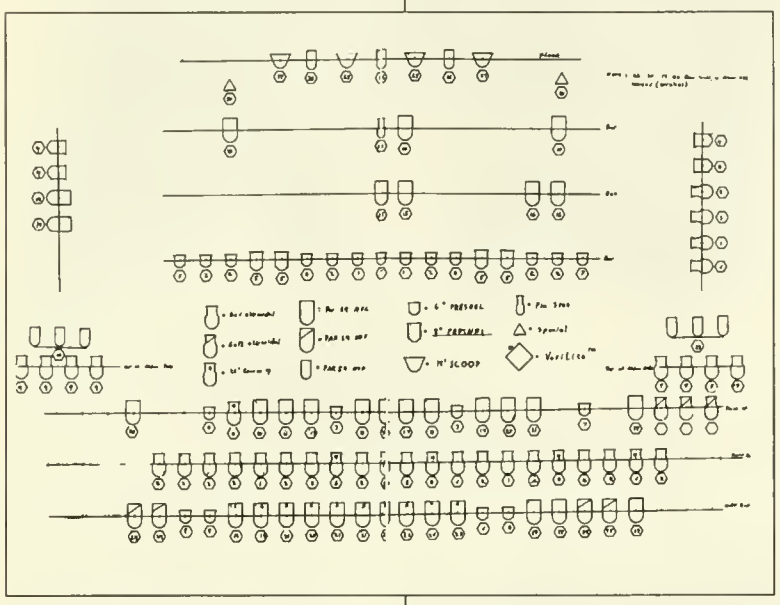
After their triumphant showing at the Homecoming football game, the seniors put their trophy up for grabs in a treasure hunt held after the rope pull on Homecoming Day. The juniors won. But when Klauber went to award them their prize, it wasn't in its hiding place. Some enterprising freshmen had stumbled upon it and, in the true tradition of the chase, stolen it from the thieves. ■

"I had heard stories about how people schemed to get the goat, but I had no idea the students would pull something like this."
–Christopher Boffoli

Digital Drama

(Continued from page 11)

hand knowledge is by creating technology for an actual production. WPI's active theater program affords students many opportunities during the year to do just that. Masque, WPI's dramatic arts club, mounts two major productions each year. The New Voices festival, now in its 14th year, is a weeklong celebration of new plays written, staged and performed by members of the WPI community. And the MW Repertory Company, founded by students in 1988, puts on frequent productions in various performing spaces around the campus.



One of four students who designed the technical components for a major production of *Henry V* last fall for their MQP, Daniel Afonso created an elaborate lighting design, above, and used computer modeling to help engineer effects like those shown on the opposite page.

Students who participate in Masque productions and New Voices can get credit for their work by registering for an independent study. Last fall, the WPI faculty approved several new theater courses within the Humanities and Arts Department that enable students to earn credit for their work as actors, dramaturges, directors or theater technology designers.

The first opportunity for students to enroll in these new courses came last November with a major production, directed by Vick, of Shakespeare's *Henry V*. The production was also the focus of an IQP, "Theater Technology Options Explored and Expanded for the 1995 Production of William Shakespeare's *The Life of King Henry the Fifth*," conducted by seniors Daniel Afonso, Christopher Mangiarelli, Daniel Martins and Noah Weisleder. The project was co-advised by Vick and Dean O'Donnell '86, visiting instructor of drama at WPI.

The students designed the versatile set for the play, created the designs for the lighting and sound, and developed a schedule that would enable the complicated production to proceed in an orderly manner toward opening night. They also edited the lengthy historical play to keep the running time for the performance to a reasonable length—from what may well have been a three-hour show to a two-hour production. The process required deleting 1,200 lines of text. The cuts got to the heart of the story and left the play unhindered by repetition and unnecessary characters, Vick says. As they edited, the students developed an overriding theme for the play, which helped them make decisions about which scenes to shorten or eliminate and which characters to leave on the cutting room floor.

"Before we could start the editing process," the students wrote in their final report, "we had to ask ourselves, 'What is this play about?' We decided it is definitely a play about conflict. It is also a play about the growth of Henry's character, but more than that, it is a showcase of Henry's attributes. In the end we decided the most important thing about the play—what it is really trying to say—is, 'Henry is cool.'"

After working as a team to trim the script, the students split up to tackle the technical aspects of the production. Afonso, an electrical engineering major, worked out the lighting design. He made extensive use of side lighting and back lighting, as well as deep colors, to create "an atmosphere of darkness and fear" during important scenes. Among the lighting effects he developed for the production was a display of moving clouds and stars that the audience viewed before the play began and during intermission. The effect was accomplished through the use of a rotating mirror placed above a light projecting the image of a cloud.

Afonso developed and tested concepts and designs with a computer modeling program that enabled him to see how various lighting effects and the placement of lighting instruments would work with the set and with the progression of the play. The software even enabled the designer to animate scenes as an aid in determining how to change the lighting during scenes and in using lighting to help make transitions between scenes.

The scenic design was completed by Weisleder, a biotechnology major. The design involved extensive use of Alden Memorial's counterweight fly system, used to bring set pieces in from above and on the sides of the stage. The final design incorporated four rotating wall components called Mielziners. The walls could be opened to enable actors to enter and exit the stage and then closed to form seamless surfaces. Vick says Weisleder's design was the most complex set ever used in a WPI theater production.

Using computer-aided design software, Weisleder was able to render various solutions to the many locations Shakespeare created for *Henry V* and to see how set changes and movements might work within the confines of Alden Memorial. The software was also an aid in designing a new type of set element—the Multi-Purpose Performance Staging or MUPS—which Weisleder developed for the production. An open box measuring three feet on a side by one foot high, with muslin attached to the insides, the MUPS could serve as a raised platform, as a base for a tent, and as a hiding place for a soldier during the battle scenes.

Mangiarelli, another electrical engineering major, designed the audio system for the show, as well as a script for the sound effects needed to complete the transformation of Alden Memorial into the world of King Henry. He used acoustical barriers to contain the sound, microphones strategically

placed to improve the acoustics of the hall, and digital sound effects stored on a computer. With the aid of computer modeling, he designed an elaborate system of speakers that surrounded the audience—including speakers placed above the stage.

The system, combined with a computer-controlled sound board, let the designer create realistic sound effects and use them to generate complex soundscapes to enhance the drama of the production. The production also made use of ambient audio effects that created realistic sounds for specific locations in the play. For example, as a scene opened in a church, the audience experienced the resonance and reverberations typical of a large stone church. This audio technique was suggested in the IQP and further developed by students in the Theater Technology course.

Electrical engineering major Martins brought everything together by constructing the timeline for the many activities required to mount this complex show. He created schedules for everything from set construction to lighting, to the set-up of the seating area, to publicity. Martins also drew up a preliminary budget for the show. As production manager, he also helped find students to serve as crew chiefs for the various technical areas, as house manager and as publicity manager.

While each had his own focus area, the four students interacted frequently to be sure that all of the technical aspects of the show worked together smoothly, and that everything came together on schedule. "The best part," Mangiarelli says, "was having everything organized before rehearsals even started."

The production of *Henry V* offered a preview of how the Theater and Technology program will likely develop in the years ahead, Vick says. Similar theater projects will offer opportunities not only for IQPs, but for Major Qualifying Projects for humanities and arts majors and double majors. Vick hopes the success of the program will make it possible to hire theater professionals to serve as teachers, project advisors and directors, roles she now fills with the help of O'Donnell.

The high-tech rendition of *Henry V* also provided a glimpse of how the computer is transforming the world of traditional theater performances. In future work, Vick says, students may take that one step further and find ways to take the designs they create with the computer and project them directly into the performing space. "Dean O'Donnell has already started working on ideas for using virtual reality, not only to create theater performances within a computer—something that others are also experimenting with—but to develop a new tool for creating virtual sets within a real performing space. That's pretty exciting." Vick hopes they might someday be able to create a dedicated laboratory for student project work in virtual reality theater.

PHOTOS BY NEIL NORUM

Another hope she has for the theater technology program is that it will help broaden the popular perception of what constitutes the humanities and arts. "The humanities traditionally has been seen as a field quite distinct from the technical fields of engineering and science. But today, that distinction is blurring. Technically oriented people need to know something about the humanities and arts, and people in nontechnical professions—particularly theater—need to understand and know how to use modern technology. Perhaps programs like ours can serve as a bridge between these two worlds." ■

The WPI Theater and Technology program is on the World Wide Web at http://www.wpi.edu/Academics/Depts/IFD/TT/. *For more information about the program, contact Lisa Johnson, theater technology administrator, at 508-831-5946 or e-mail* ljohnson@wpi.edu.

Plack is a technical, scientific and professional communication major with an interest in biology. She is also secretary of the Student Government Association, associate editor of Newspeak, *the student newspaper, and a member of the senior class board of directors.*

"Dean O'Donnell has already started working on ideas for using virtual reality, not only to create theater performances within a computer... but to develop a new tool for creating virtual sets within a real performing space."
—Susan Vick

Hey, Joe!

(Continued from page 13)

Joe was sent to Manila on a Liberty freighter as part of Casualty Group 6862A. "That designation was just a code," he recalls, "in case a radio transmission was intercepted by the enemy." Bad luck struck—literally—when the freighter was hit broadside by another American ship. Ever the optimist, Joe says that once it was clear everyone was okay, "It was the thrill of a lifetime. We ended up in Guam for 67 days while the ship was repaired, so I was there when the atomic bomb came in on the *Indianapolis*."

Joe's unit arrived in Okinawa on the day surrender papers with the Japanese were signed. "We were some of the first troops on the ground," he says. "I still get letters from the other members of the Casualty Group."

The war over on both fronts, his military service at its end, and with A.J. Knight's "edict" thrown down, Joe did what so many other Gales have done: he went to work at WPI. His grandfather, father and two uncles all worked for the school in various capacities, and for extended periods of time. Joe's son Jack, following a slightly different path, graduated from WPI in 1970. As a WPI employee, Joe has outlasted all the other Gales.

Most graduates have a static mental snapshot of the WPI they knew during their brief stay on campus. By comparison, Joe's view is a time-lapse film in which buildings suddenly pop up where before there were houses or empty spaces.

Joe on the changing WPI campus:

"Since I came here, on the east side of campus they've built Kaven, Gordon Library, Founders, and Fuller Labs—the new computer building. On the west side they added Olin, Goddard and Harrington. Plus, all of the dormitories on the south side of campus, Morgan, Daniels, Stoddard, Ellsworth/Fuller..."

It's striking to consider just how different WPI looked 50 years ago. As Joe ticks off buildings that have been constructed during his tenure, one gains a tremendous sense of perspective. Most graduates have a static mental snapshot of the WPI they knew during their brief stay on campus. By comparison, Joe's view is a time-lapse film in which buildings suddenly pop up where before there were houses or empty spaces.

But it's not just the physical plant that has changed over the last half century. In fact, there are so many markers of Joe's longevity that the list begins to read like those the news media cranked out when Cal Ripken broke the major league record for the most consecutive games played. "I've worked for every athletic director WPI has had, starting with Percy Carpenter," Joe says. He's also seen nine presidents come and go. ("I've met the new guy, Ed Parrish," he says. "I got him coffee and a sandwich.")

Over the last 50 years, WPI's faculty and staff has grown from around 100 to 680. Undergraduate enrollment has increased nearly tenfold, from around 300 to 2,600. WPI's endowment has jumped from about $8 million to $142 million. And on and on.

The school that Joe went to work for in 1946 was vastly different in many ways from the one we know today—right down to the way most people referred to it. In Joe's time, the now familiar and virtually automatic initials "WPI" were not typically used. Instead, it was "Worcester Tech" for short, "Tech" for even shorter. Joe himself still uses the latter in conversation; yet another reminder of the bridge he provides between then and now.

Joe on shopping for work clothes:

"I needed civilian clothes when I got back. So I went down to Ware & Pratt's—where the Burger King on Main Street is now—to get some white shirts. I ended up with a suit—two suits, in fact—and a camel hair sport coat."

Properly spiffed up, Joe reported to A.J. Knight. For his first year at WPI, Joe was the athletic field groundskeeper. He was then transferred to the Mechanical Engineering Department, where, in WPI's newly established weld shop, the late Professor Carl G. Johnson taught him how to weld.

"I was just as green as grass," Joe says. But Johnson brought him along, and soon asked Joe to return the favor by teaching students to weld. "Carl said, 'I'll teach this course, but sometimes I'll have to be out of town,'" Joe recalls. "He gave the first lecture and the second day he said to me, 'If you're going to work with me, you're going to have to do it.' So he just gave me the instructions and I prepared the lecture and did it. I liked it and it was interesting, and I inherited the job later on." From that time on, Joe has instructed students in general machine shop operations, casting and welding.

With much respect and a touch of sadness, he adds, "Carl died in 1966. He was one of the greatest guys I ever worked for. He was a great, great gentleman."

On wheelbarrows, novel uses for:

"My favorite memory of Joe occurred at a football game. We were playing UMass and we had won by a point. After the game I was so tired and sore from some banged-up ribs that I couldn't make it back up the hill. Joe came down with a wheelbarrow and rolled me up the hill."
—Richard Ferrari '51

Joe's involvement with WPI and its students only begins in the Washburn Shops. A fervently loyal supporter of WPI athletics, Joe is a constant presence at basketball and football games, wrestling meets and other athletic contests. "I've been the manager of the press box since it opened," Joe

says. "I traveled with the football team for 15 years. I work the basketball games—especially the tournaments. Someone once said I was like an ambassador for the sports teams."

The Department of Physical Education and Athletics has a lot more to say on the subject of Joe: "We truly enjoy Joe and appreciate him for the job he does," says director Raymond Gilbert. "He really has served as an ambassador for athletics at WPI. We frequently get compliments—all unsolicited—from visiting teams about Joe and the way he treats everybody. He's quite professional and personable. We need more people like him."

To thank him for all that he has done for so many of WPI's athletic teams—and for so many people—the department chose Joe to receive the Frank C. Harrington Award in 1990. The honor, named for a student athlete from WPI's Class of 1898 who is also one of the namesakes for Harrington Auditorium, is presented to individuals who have made significant contributions to intercollegiate athletic programs at WPI.

Joe on the importance of job titles:

Q: *What is your official position now, Joe?*
A: *"[pauses, laughs.] Ah, now you've got me stuck. [Leafs through some papers on his desk, comes up with the right one.] Principle Lab Technician."*

Joe is more concerned with what he does than with what his job happens to be called. This is one of the secrets of his charm. People find him endearing because he likes what he does so much, and because he is enamored of them right back. It is said that all you really have when you look back on your life are the experiences and relationships you've had and your memories of them. If that's true, then Joe has more than most.

He is a consummate storyteller, with his easygoing manner and his gravelly, New England-accented voice that dissolves easily and often into a chuckle at a fond memory. His mind seems to work like a huge, meticulously cross-referenced catalog, and he effortlessly jumps from section to section, finding connections where there seemed to be none at all.

When the town of Clinton, Mass., is mentioned—quite incidentally—in a conversation with Joe, an association clicks in and the wheels start turning. "You know, last Saturday Clinton happened to play in the [high school] Super Bowl here. I had a kid walk up to me—had sunglasses on—and he said, 'Hey, Joe.' I said 'Hi.' He said, 'You don't remember me, do you?' I said, 'Yes I do, you're Kerrigan. Where's your father?'

"See, Pauly Kerrigan graduated in '57. He once ran 92 yards down the football field. That's when they played both ways—offense and defense, you know; we didn't have many players those days. And his boy worked with me. See, we renovated this building [Washburn] in 1983, and we had to move all of the classes down to Worcester Industrial Technical Institute. And he worked work-study for me for a whole year. Nice kid. He's working with his father now; they have a place down in Marlboro, distributing electrical components and things to various companies and so forth...."

Some people can hold your attention through the brute force of their personality; it often matters less what they're saying than how they're saying it. Joe pulls you in more subtly, but just as strongly, because what he's saying to you resonates with the pure simplicity of one man's thoughts and memories. In talking to him, you get the impression that if you could spend enough time with him, you would learn every detail of his life—albeit in an almost hopelessly intertwined sort of way.

JONATHAN KANNAIR

For some 30 years, Gale has been giving students like Robert Tuccillo '98 hands-on experience with materials by having them actually manufacture a small metal spool.

Joe on students today:

"Well, I think they're a little younger. When I first came here the GI's were here under the GI Bill of Rights, so they were older when they started. And, of course, we had girls here starting in 1968. But overall...I think they're pretty much the same. The only thing is you meet a lot of kids now that have had some money—money was tighter in those days. But I get along with them all. They all respect me—you treat 'em well, they like you, and you like them."

Over the years, Joe's relationship with WPI students has necessarily changed. Progressing from a peer to a father figure to, now, a grandfather figure, Joe has become more and more an "elder" to those he instructs. But while the gap in their ages

(Continued on next page)

He is a consummate storyteller, with his easygoing manner and his gravelly, New England-accented voice that dissolves easily and often into a chuckle at a fond memory.

Hey, Joe!

(Continued from previous page)

Joe has watched a huge percentage of WPI's students come and go over the years. Chances are you'd remember the kindly, helpful man (who could be gruff if you were doing something stupid) in the machine shop who seemed to know everything.

has widened, his connection to his students seems to have changed not at all.

"We all remember him as an ardent sports fan—one of our biggest supporters," says Ferrari. "He was really loved by many of the students who knew him." Says Paul Crivelli '92, "Joe seems a little rough on the surface, but he's friendly and talkative once you know him—and with more history than you can shake a stick at."

In 1971, WPI's students made clear their strong bond with Joe by selecting him the first staff member ever inducted into Skull, WPI's senior honorary society and one of its most exclusive organizations. "I wasn't expecting it," Joe remembers. "I was working a high school basketball game and I was tapped outside the side door of Harrington Auditorium. Charlie McNulty, the basketball coach, and Professor Bob Pritchard, the athletic director, told me to go ahead and they'd take care of things. That was really great. Each year we have a banquet for any of the old members who can make it and the new candidates to meet each other. It's quite interesting to see where everyone has gone and so forth."

In 1992, the Institute also paid tribute to Joe by presenting him with the William R. Grogan Award. Named for WPI's dean emeritus of undergraduate studies, who incidentally completed his undergraduate education at WPI less than a year before Joe reported to work, the award honors extraordinary service to the Institute and its students. When Grogan learned that Joe would receive the award, this is what he wrote to him: "I want to tell you how proud I am that you will receive the award named for me. I cannot think of anyone more appropriate to receive it, or anyone who I would rather see receive it. Joe, you have been a great contributor to WPI and its students over the years."

Joe on hands-on experience:

"We've been making that spool [in ME1800] for about 30 years. There's usually a waiting list to get in the class. Some of them will take it in their senior year, not necessarily for credit but just to have the experience, to see how things are made. Because you can read all the books, see all the pictures, but you've got to get your hands into it."

The main thing Joe imparts to the fledgling engineers who pass briefly under his wing is an appreciation for the actual work done to materials and parts by some of the processes they learn about. He shows you where and how the theoretical knowledge gained in the classroom merges with the practical, tangible aspects of manufacturing—for the first time, in the case of many students.

In ME1800, Materials Selection and Manufacturing Processes—or just "Grunge" in student lingo—students are exposed to a variety of hands-on processes. "We start off with casting," Joe explains. "We have them put the Styrofoam parts

NEIL NORUM

In 1992, when he received WPI's William R. Grogan Award, Joe posed with his family for this portrait. Counterclockwise, Joe, his wife Phyllis, daughter Joanne DiPinto, son Jack Gale, grandson Joey Gale, daughter-in-law Mary Carr Gale, and twin grandsons Dan and Mike Gale.

together, but we pour the metal, for safety reasons. When the castings are ready, they cut off the excess gating system and then each student has one. They've actually seen the thing made.

"Half the class then goes to the machine shop to do their turning, milling, drilling, tapping and so forth, and the other half starts on welding. Then they switch. We only have so many contact hours with them to get it all done, but a lot of them end up getting interested in materials and switch to that later on."

It is in this class, which is extremely popular, that Joe has watched a huge percentage of WPI's students come and go over the years. Chances are, even if you couldn't remember his name, you'd remember the kindly, helpful man (who could be gruff if you were doing something stupid) in the machine shop who seemed to know everything, and who could launch into a fascinating story at a moment's notice.

Joe enjoys the class so much because he believes you have to teach people to do, not just to know. And it heartens him when he hears that it has helped someone. "We had a student here maybe five or six years ago who went to work for GE in Pittsfield," Joe says, relating the story she told to him. "They were doing some kind of silver soldering, and she said, 'I can do that—I've done that.' So one day one of them told her to go ahead and try it—and she did it. They were standing there with their mouths open. She became a supervisor in six or seven months—they just singled her out."

You might think that, having been at WPI for 50 years, and as comfortable as he is here, and as much as he loves the place, that Joe would never retire. You'd be wrong. "No, I'll retire before too long," he says. "We'll see how it goes."

Joe and his wife, Phyllis, will celebrate their 49th wedding anniversary in June. Joe says they'd like to do a little traveling. "We'll probably go down to Florida, though not to stay," he says. Joe says he has some good reasons to remain in the Worcester area. His son, Jack, has been the golf pro for the Tatnuck Country Club in Worcester for many years; he is also one of only a small number of Master Professional Golf Pros in the country, an honor bestowed on him four years ago by the Professional Golfers Association. Jack and his wife, Mary, have three sons. Joe and Phyllis' daughter, Joanne DiPinto, and her husband, Alfred, live right next door; Joanne owns and operates the J.P. Cutter Hair Salon on Park Avenue in Worcester.

Joe is also as much a part of the greater Worcester community as is he is the greater WPI community. He was the commander of the Worcester Auxiliary Police Force from 1949 until his retirement in 1986. With the rank of captain, he was in charge of a force of 75 officers. He says he helped keep the peace at more parades than he can remember, but his most vivid memories are of the many hours he worked in the aftermath of the devastating tornado of June 9, 1953, which tore a deadly swath through central Massachusetts. Joe is also past commander of VFW Post 6907 in West Boylston, Mass.

JONATHAN KANNAIR

Early in his WPI career, Joe learned to weld from Professor Carl Johnson. Since then he has passed that knowledge along to hundreds of students, including Astrid Gunawan '99.

And when he retires, what about the rest of his many interests at WPI? "I'll still be involved; work it around other things," he says. "A lot of people work here and they go and you don't ever see them again. But, hey, I've been around here since 1927 or '28. One of my uncles was the first watchman they had; I used to come up and make a round from 6 p.m. until 8:30, and my father would pick me up and bring me home. I've watched this place grow. I'd have a hard time divorcing it."

Asked how he would feel should WPI choose to name something in his honor, Joe has this to say: "Oh sure, whatever they wanted to do. The thing is, you'd like to see something done before you pass away. For example, A.J. was still here when they named the field after him. Yes, that would be great."

Envisioning the Joe Gale Machine Shop, or whatever it might be, you can see a picture of Joe working with a student—getting his hands into it—alongside a plaque. Whatever else it says about Joe and his many years of loyal service, the plaque should pay Joe what he must consider the highest compliment of all—that he is, truly, a great, great gentleman. ■

Bert received bachelor's degrees in mechanical engineering and the humanities at WPI before joining Howmet Refurbishment Inc., where he is now a turbine blade engineer. His profile of Professor Jack Boyd, which ran in the Winter 1994 WPI Journal, *was completed as part of his Major Qualifying Project in the humanities.*

Normandin Sisters Thrive in a "Man's World"

BY RUTH TRASK

When Jill Normandin '88, Jody Normandin '90 and Hollybeth Normandin '95 decided to enrolled at WPI, they knew it would not be easy, as women, to succeed in the male-dominated field of engineering. But they knew something else: nothing under the sun could keep them from trying.

"We all have strong, athletic backgrounds, so we were used to competition," says Jody, who was named to the All-New England Women's Basketball Team in 1989. "Also, our mother was behind us all the way." Adds Hollybeth, "Although divorced and physically challenged, she was always there for us. She was our strength."

The Normandin sisters say their mother was astonished, at first, at their choice of professions. Still, their decisions did not come completely out of the blue. Their father and most of their uncles are in engineering-related fields. But they gave no indication that they might follow in those footsteps until they were in their teens.

As a child, Jill invented her own language, which she shared with her sisters and friends. She also rode her horse in regional competitions. "I thought she might become a linguist or a veterinarian," Sandy Normandin says.

"But there was one clue that she might do well in engineering," she adds. "As a teenager Jill worked as a cashier at a supermarket, and she could compute the running totals faster in her head than she could with the cash register."

According to Hollybeth, Jill also showed mechanical ingenuity by coping with little disasters at the family farm in Westminster, Mass. "Once, she thawed out the water pump. Another time, she diverted rainwater streaming down a nearby hill so it wouldn't erode wide trenches in our barn floor. She could also fix cars."

"It was Hollybeth who really astounded me," her mother recalls. "I never thought engineering would be of any interest to her. As a young girl, she loved literature and would stay up all night reading."

Though they had backgrounds and interests that might well have led them in other directions, all three sisters enrolled at WPI, with Jill leading the parade in 1984.

"I love my job, but I would probably never have gotten into engineering if it hadn't been for the support of my parents. My high school guidance counselor made it quite clear that engineering was no place for a woman."

—Jody Normandin

"After graduating from high school, I visited several colleges," she says. "WPI really turned me around, as far as being a veterinarian was concerned. As an engineer, I decided, not only would I have a rewarding career, I could afford to own and maintain my own horse."

Jill Normandin graduated with a B.S. in electrical engineering and then completed her M.B.A. at Northeastern University. During the past few years, she worked as a senior sales engineer for Lambda Electronics, a large international company. She was recently promoted to marketing manager at the firm's Long Island, N.Y., headquarters.

"Lambda Electronics manufactures DC-DC and AC-DC converters and power supplies," she says. "The company is heavily male-dominated in the areas of design, systems and sales."

Jill says her electrical engineering classes at WPI prepared her well to work in that environment. "I was one of three females in a class with more than 100 males. I'm in a similar minority when I attend my company's national conferences."

Sometimes it can be an advantage to be a woman in a man's world. All three sisters say women are sometimes sought out for engineering jobs, although once they are hired, all engineers—male and female—must prove that they have the necessary skills to succeed. In sales, Jill says, "it's not necessarily terrible" to stand out.

"But I still have to contend with credibility problems. I have to speak more technically, better and faster than my male counterparts when I meet customers. The credibility problem is even more acute in the international scene. Sometimes women engineers are not taken seriously overseas."

Jill is considering expanding her technical horizons by pursuing a Ph.D. in historical architecture. "It's a far cry from my introductory EE courses," she says "but it would add to a solid engineering education." She is encouraging her sisters to also pursue graduate degrees.

Jody Normandin, who followed Jill to WPI in 1986, received her B.S. in biomedical engineering with high distinction. She works for GE Electrical Distribution and Control Products in Plainville, Conn., where she is a team leader responsible for seeing several product lines from design

PHOTO COURTESY OF WORCESTER *TELEGRAM & GAZETTE*

From left, Sandy Normandin and daughters Jill, Hollybeth and Jody at Commencement in 1995.

through delivery. "I head a team of nine male enginecrs," she says. "We focus mostly on items likc motor starters and pilot devices."

Jody says her job has required hcr to becomc an expert in intcrnational standards, since virtually cvery foreign company has its own standards for quality. She makes frequent trips to Europe, especially Italy, to mcet with customers. "The Italians were astonished whcn they first saw me," shc says. "It seems there are no young female engineers in Italy.

"I love my job," she says, "but I would probably never have gottcn into engineering if it hadn't been for the support of my parents. My high school guidance counselor made it quite clear that engineering was no place for a woman. Now I go around speaking to young women, telling them they can be whatever they want to be, even in a so-called man's world."

Jody says she has an excellent working relationship with the all-male group she supervises. She gets along so well with the men around her because she refuses to be intimidatcd. "Playing sports has helped me overcome all sorts of fcars," she says. "Today I play more basketball than I did when I was at WPI. I'm trying to get a semi-professional league for women started. I even play on coed teams."

Inspired by her sisters' successes, Hollybeth Normandin enrolled at the Institutc in 1991. "My friends who went to liberal arts colleges rarely found jobs when the economy started to go downhill," she says. "But Jill and Jody did."

But the real reason she settled on WPI was her mother's inability to find corrective shoes suitable for her feet, which have bcen impaired by spina bifida. "It was apparent that she could have been helped by new materials and new shoe designs that were in use in other countrics, but that had not yet gained medical recognition in this country. Her problems finding the right shoes led me into biomedical engineering."

As a mechanical engineering major, Hollybeth pursued a biomedical engincering specialization, completing several independent study projects and her Major Qualifying Project in that area. Shc also took advantage of WPI's Global Perspective Program, trayeling to Venice in her sophomorc year as part of a projcct team that helped the Italian government deal with flooding problems in the city's canal system. Interested in the theater, she wrote a play for her Humanities Sufficiency project.

She is now a manufacturing engineer at HemaSure Inc., in Marlboro, Mass., a start-up company that makes blood-filtering devices. The company's first product filters leukocytes from blood.

Although she is the only woman in a five-person department, she says that has been a problem only when dealing with people outside the company, who sometimes don't take women engineers seriously. "This is a challenge to me professionally and personally," she says. "The only criticism I respect is criticism of my actual pcrformance."

Now that all thrce Normandin sisters have established successful engineering careers on their own, they're thinking of collaborating on a joint venture. "We hope to pool our family resources and start our own business," Jill says. "It would be intcresting to see all this energy harnessed!"

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