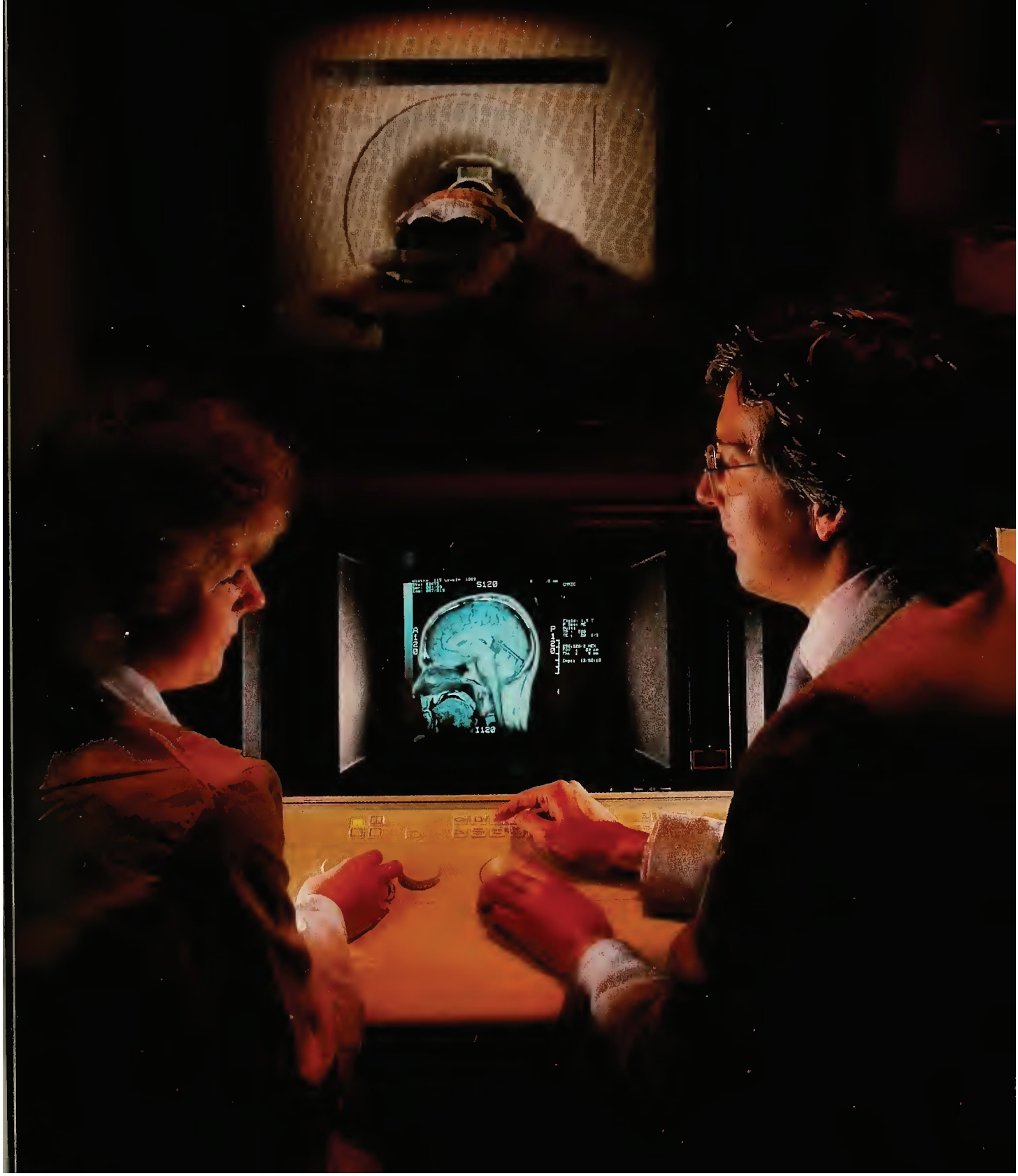
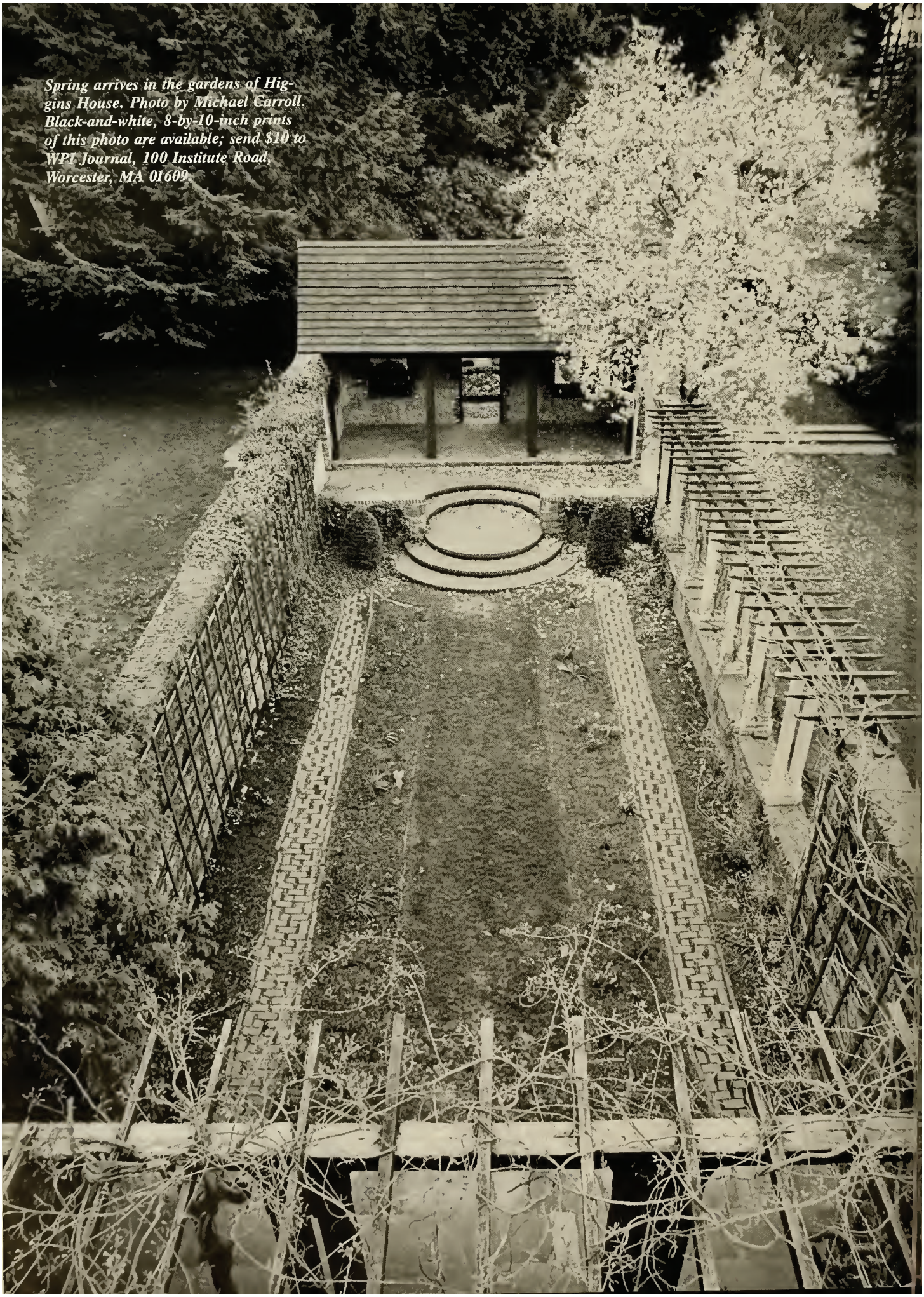
Biotechnology in Worcester ◆ A Medical Revolution

# WPI Journal

ORCESTER POLYTECHNIC INSTITUTE SPRING 1988





*Spring arrives in the gardens of Higgins House. Photo by Michael Carroll. Black-and-white, 8-by-10-inch prints of this photo are available; send $10 to WPI Journal, 100 Institute Road, Worcester, MA 01609.*

**WPI JOURNAL**

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VOLUME XCI NO.4
SPRING 1988



The WPI Journal (ISSN 0148-6128) is published quarterly for the WPI Alumni Association by Worcester Polytechnic Institute in cooperation with the Alumni Magazine Consortium, with editorial offices at the Johns Hopkins University, Baltimore, MD 21218. Pages I–XVI are published for the Alumni Magazine Consortium [Franklin and Marshall College, Johns Hopkins University, Villanova University, Western Maryland College, Western Reserve College (Case Western Reserve University), Worcester Polytechnic Institute] and appear in the respective alumni magazines of those institutions. Second class postage paid at Worcester, MA, and additional mailing offices. 



**Acknowledgments:** Typesetting, BG Composition, Inc.; Printing, American Press, Inc.





## DEPARTMENTS




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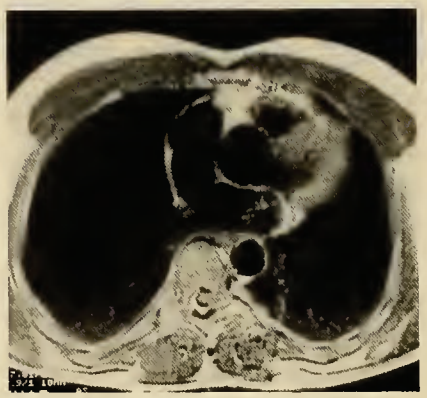
Cover: Magnetic resonance imaging (MRI) technologist Terry Redgate scans a patient at Worcester's Biotechnology Park as WPI Professor Stephen C. Moore looks on. Story on page 12. Photo by Michael Carroll.

# ADVANCE WORD

## A Special Issue of *WPI Journal*: From Basic Science Comes a New Industry

It was just before midnight on July 3, 1977. In a laboratory at the Downstate Medical Center in Brooklyn, N.Y., Lawrence A. Minkoff '69 removed his shirt, slipped a cardboard vest wrapped with copper tape around his chest and sat down on a plank in the middle of a large circular magnet. Fighting fatigue and chill, Minkoff sat still for nearly five hours while radio signals scanned his chest. The result, pictured at right, was an amazingly detailed image of the structure of Minkoff's internal anatomy, the first human image ever obtained with a magnetic resonance imaging (MRI) scanner.



*The first-ever MRI image: a cross section of the chest of Larry Minkoff '69.*

By Michael W. Dorsey

Today Minkoff is executive vice president of FONAR Corporation. Founded by Raymond Damadian, a professor at Downstate with whom Minkoff did his graduate work in MRI, the company is a leading manufacturer of medical MRI machines. The technology developed by Damadian, Minkoff and other Downstate students is being used by thousands of doctors to detect abnormalities of the soft tissue, including multiple sclerosis and cancer. It is one of a host of revolutionary technologies—the products of basic research in biomedical engineering and biotechnology—that are transforming medicine, pharmacology and agriculture and giving rise to a brand new industry.

At its 120th Commencement exercises this spring WPI is paying tribute to this new industry. Among its shapers is Leo J. Thomas, WPI's 1988 speaker and one of four honorary degree recipients.

As senior vice president and general manager of the Life Sciences Division of Eastman Kodak Company, Thomas presides over a major research effort that may lead to whole new classes of drugs for use in the diagnosis and treatment of ailments of the immune, cardiovascular and central nervous systems.

The three other honorary degree recipients are also being recognized for their achievements in this new industry. They are Walter L. Robb, senior vice president for corporate research and development at General Electric Company; Gabriel Schmergel, president and chief executive officer at Genetics Institute Inc.; and Larry Minkoff.

By choosing this commencement theme, WPI is acknowledging not only the amazing accomplishments of this young industry, but the role WPI has played in creating it. Several of WPI's faculty members, students and alumni have, through basic and applied research, played a role in the revolution that is transforming our world.

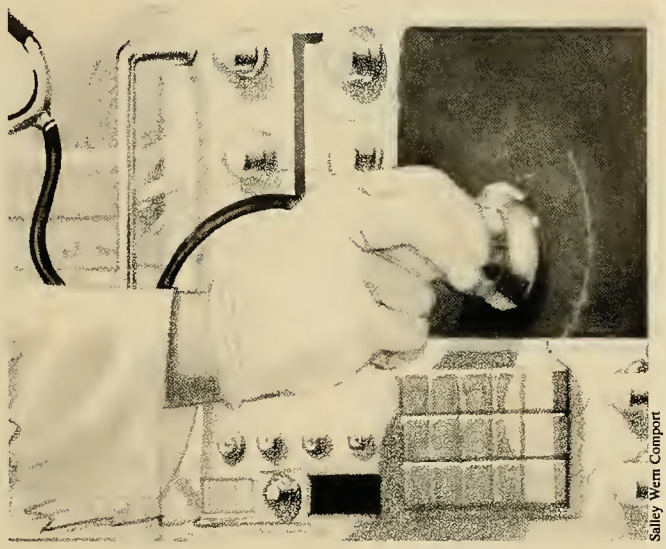
It is to these achievements that we devote the first 16 pages of this edition of the *WPI Journal*. You will read about several alumni whose work in biology and biomedical engineering has helped transform medicine. You will also find a profile of the Massachusetts Biotechnology Research Park in Worcester, a focal point for advanced research and state-of-the-art commercial applications in biotechnology.

Also included is a small sample of the wide variety of research and student project activity under way at WPI that is helping to fuel the new industry. In the laboratories of WPI's Biomedical Engineering Program, students and faculty are engaged in research in noninvasive medical sensors, medical imaging and cardiopulmonary physiology. Researchers in the Biology and Biotechnology Department are tackling fundamental questions in genetics, cell biology, molecular biology and neurobiology, and advancing such applied fields as cell culture, fermentation and bioprocess engineering. In such departments as Chemical Engineering, Electrical Engineering and Mechanical Engineering, work is under way in biochemistry, enzyme engineering, neurophysiology and biomechanics. And in WPI's Humanities Department, ethicists are exploring the implications of this revolutionary work on our society.

I hope you enjoy this special issue of the *WPI Journal*.

# INPUT

## High-Tech Medicine: The Change from Caring to Curing


Salley Wern Comport

By Thomas A. Shannon

The science and practice of medicine have progressed dramatically in recent decades. Thanks to the discovery of vaccines and significant improvements in public sanitation, water quality and diet, diseases that were rampant even 50 years ago—polio, measles, mumps and smallpox—are essentially maladies of the past.

We have also seen a genuine revolution in health care and in the ability of physicians to intervene beneficially in the lives of their patients. In many ways this is a golden age of medicine. Or is it?

Despite the blessings of modern medicine, important questions are being raised about it, some focusing on its very successes.

For example, the progress we have seen in medicine has, in many cases, altered the relationship between physicians and their patients. Traditionally, most of us went to a single physician who attended to all of our health needs. While the "old-fashioned" family doctor has been romanticized, he or she did treat patients in a holistic fashion and was frequently as attentive to the psychosocial dimensions of a patient's life as the physical.

But while these physicians had a good "sense" of their patients, there was often little they could do for them because of the undeveloped state of medicine.

Things are different today. With the rise of HMOs, clinics and group practices, and with the increasing mobility of the population, Americans are less likely to be seen by the same physician over an extended period. They are also more likely than ever before to be referred to specialists who, despite their advanced training and competence, share no common history with their patients. When medical emergencies strike, patients can find themselves in the care of physicians they have never met before.

While today's physicians can usually "do something" for their patients, they may have little sense of the impact of such interventions on their patients' lives.

Another major change in medicine, also a function of specialization, is the shift from caring for patients to curing them. The job of the specialist is to administer a particular treatment, to perform a particular operation, or to deal with a particular disease or pathogen. His or her focus is on the disease and not the patient.

When the cure doesn't work—when the specialists' valued skills fail to bring about the desired results—physicians may be at a loss for what to do. AIDS is a particularly poignant example. While there is no cure for AIDS, its victims need exceptionally high levels of care. But those who are trained primarily to cure are often frustrated and unsure how to intervene when faced with patients for whom no cure is possible.

At issue is not whether these specialists are caring individuals; of course they are. But their training has focused on the techniques of curing rather than the skills of caring.

Contemporary medicine is also extremely costly. Bringing a new drug to market involves years and millions of dollars worth of research, testing and documentation. The introduction of new medical equipment can be even more expensive.

New drugs and equipment enhance the focus of modern medicine on curing illnesses or compensating for the loss of a patient's capacity. These goals have driven the development and use of life support systems, artificial organs, sophisticated diagnostic tools like magnetic resonance imaging and ultrasound, and high-tech treatments, such as the variety of devices used to unblock arteries.

But these technologies come into play only after a problem has developed. They are the product of a system dedicated to research and development, not prevention.

Certainly no single decision set medicine on this course. Still, high-tech medicine is more flashy, more impressive and more income-producing than the frequently boring and often frustrating efforts to help individuals change their lifestyles to prevent diseases from developing in the first place.

Yet a shift to preventive medicine would, in the long run, be less expensive. If a disease does not occur, one does not need to cure it. Clearly, more attention must be paid to the social context in which medicine is practiced before we plan the next generation of medical technology.

*Dr. Shannon is professor of religion and social ethics in WPI's Department of Humanities.*

# INVESTIGATIONS

## One step closer to an insulin pump

One of the dreams of researchers who study diabetes is to develop a closed-loop insulin pump, which could free many diabetics from the tedious daily routine of self-injection. But the development of such a device depends on finding a way to continuously monitor glucose in the bloodstream, since this information is essential for regulating the delivery of insulin.

While progress has been made on various insulin pumps, it will be some time before a reliable glucose sensor is ready, according to Robert Peura, director of WPI's Biomedical Engineering Program, and Yitzhak Mendelson, assistant professor of biomedical engineering.

With funding from the National Institutes of Health, Mendelson and Peura are taking a step toward that goal by developing a fiberoptic glucose sensor. The work is based on research they conducted over the past two years with WPI master's students Allen C. Clermont (who began the work as an undergraduate) and Been-Chyuan Lin.

Using a technique known as attenuated total reflection, they showed that it is possible to measure continuously the concentration of glucose in blood. The technique involves passing the beam of a carbon dioxide ($CO_2$) laser through a zinc selenide prism that is in contact with blood, and then analyzing the laser beam to see how much light of a specific wavelength the blood absorbs.

The next step will be miniaturizing this bench-top system. Mendelson and Peura say their goal is to develop a fiberoptic device made from the same material as the prism that can be inserted into the bloodstream through a catheter. The fiber will guide the carbon dioxide laser beam to the blood and then carry the reflected light back to an optical detector.

Mendelson says other researchers are working on glucose sensors, though most sensors use some form of chemical analysis, in which a chemical reaction with glucose causes a detectable color change.

"Our approach is unique in the sense that we are trying to avoid indirect detection," Mendelson says. "Instead of an intermediary chemical reaction, we are looking directly at the infrared absorption properties of the blood itself."

Though the long-term goal is to create a glucose sensor that can aid the development of a permanent insulin pump, Mendelson says a reliable glucose sensor may have more immediate use in monitoring diabetic patients and screening healthy individuals.

Robert Arnold

*Allen Clermont (far left), Robert Peura and Been-Chyuan Lin with glucose sensor.*

## To catch a cough

Coughing is among the most common reasons people seek medical attention. It's also big business. Currently, pharmaceutical companies market 900 prescription and nonprescription products for controlling coughs. Over-the-counter cough suppressants alone accounted for half a million dollars in sales in 1981.

In spite of this, little is known about which medications, if any, truly control or eliminate coughing. The problem is that standard tests for cough medicines ask subjects to keep track of how many times they cough over a period of several hours. This self-reporting method is subject to significant error.

To help correct this, Frederick M. Bennett, assistant professor of biomedical engineering at WPI, and Dr. Richard Irwin, director of pulmonary medicine at the University of Massachusetts Medical Center, are at work on an electronic cough detector and counter.

Bennett and Irwin, in collaboration with WPI graduate student Thomas Webler ('87 M.S.),first studied the types of sounds that are associated with the physiological changes that occur during coughing. Using microphones placed at the trachea and the top of the sternum, they recorded coughs and other sounds made by several patients suffering from chronic coughing.

Because some of the sounds made during coughing are produced by the vocal chords in a process similar to speech, Bennett and Irwin analyzed the tape recordings with standard speech recognition software to see if these programs could discriminate between coughing and other sounds, including speech, made by the patients.

The results were promising, Bennett says. The next step will be to improve the algorithms in order to determine with greater accuracy the difference between coughs and speech, and to be able to recognize—perhaps even distinguish among—the wide variety of human coughs.

The algorithm will be tested on a large sample of patients at the University of Massachusetts Medical Center. The final step—still a few years away, Bennett says—will be incorporating the algorithm into a miniaturized device that can be comfortably worn by test subjects.

In addition to providing an unbiased method for assessing new cough formulas, a cough detector would also be a valuable tool for pulmonary physicians who need to know the frequency and severity of coughing in patients who suffer from chronic coughs. Such patients account for about 10 percent of all people seen by pulmonary specialists.

# EXPLORATIONS

## Project BODYWORKS: Using Interactive Video to Make Hospitalization Less Stressful for Adolescent Patients

**Major Qualifying Project by James D. Goodell '87.**
*Advisors: James S. Demetry, associate head, Electrical Engineering Department, and Helen G. Vassallo, associate professor of management*

**Interactive Qualifying Project by Karen L. Reichenbach '88, Carleen F. Maitland '88, Natalie A. Lucas '88 and Joan Goodell of Worcester State College.**
*Advisor: Leonard Goodwin, professor of social science and policy studies*

**Sponsor: St. Vincent Hospital, Worcester, Mass.**

A hospital stay can be an unpleasant experience for anyone. But for adolescent patients in particular, the hours spent confined to a hospital bed can be filled with frustration, fear, anger and just plain boredom.

Helping adolescent patients overcome the stress of hospitalization is the goal of Project BODYWORKS, a collaborative effort of students, faculty and staff at WPI, Worcester State College and St. Vincent Hospital.

Over the past three years, this consortium developed and tested an interactive videodisk program designed to be used by teenage hospital patients. Trials with the program confirmed that interactive video can indeed reduce stress and make patients feel more positive about their experience in the hospital.

Project BODYWORKS was the brain child of James Goodell '87. Goodell launched the program after another WPI undergraduate, Brian Witkowski '84, did a pilot study that showed that adolescents who played text-based computer games had a better attitude about hospitalization than those who spent their time with more passive forms of entertainment, such as television.


Michael Dorsey

***Left to right: Seniors Karen Reichenbach, Natalie Lucas and Carleen Maitland.***

While the games were effective, the patients, who were generally confined to bed, sometimes had trouble reading the text on a computer screen and were not able to type extensively on a keyboard. Goodell decided that an interactive video presentation that required a minimum amount of reading and typing would be a better solution.

He also recognized that producing such a program would take the talents and resources of many people. So he established the Project BODYWORKS consortium in 1985 to plan, produce and test a prototype video system.

Over the next 15 months, Goodell worked with a writer, a video producer and computer science students from Worcester State College; actors; and faculty advisors to create a program that uses a computer to merge video footage, sound, music, graphics and text into an interactive game.

The presentation was based on a concept of Dr. Sean Palfrey, chief of pediatrics at St. Vincent Hospital and a member of the Project BODYWORKS board of directors. St. Vincent also provided the funds for the program's production.

In Palfrey's program, adolescent patients play the role of a physician and attempt to diagnose the cause of a child's stomachache and fever. By using a touch-sensitive TV screen or typing simple commands on a computer keyboard, the patients can ask the child questions, do a physical examination and look up information in a "medical guidebook."

In response to the commands, a computer selects video footage or displays informational screens from a videodisk and merges them with titles and other text and graphics stored on the computer. The result is a simple story controlled entirely by the user who, after gathering sufficient data, asks the computer to verify his or her diagnosis.

The completed program was tested at St. Vincent Hospital by the team of Karen Reichenbach '88, Carleen Maitland '88, Natalie A. Lucas '88 and Joan Goodell, mother of Jim Goodell and an undergraduate at Worcester State College.

The evaluation team used a variety of questionnaires to gauge patients' feelings about hospitalization and their success with and opinion of the videodisk program. They even used biodots—small chemical thermometers that attach to the skin—to measure the patients' stress levels while they played the video game.

They found that the program does make patients who use it feel more positive and less stressful about their hospital stay, feel better about medicine in general and even develop better problem-solving skills. They declared the project a success, though they suggested further development of the video program and additional field testing.

This year, a new IQP team, working with Leonard Goodwin, will take on the task of expanding the testing program for the BODYWORKS videodisk. Another team, consisting of Philip A. Buttacavoli '88, Barbara J. Grimm '88, Daniel O. Olsen '87 and Karen E. Valentine '88, used the experience gained by the BODYWORKS team to complete a new interactive video program that simulates a chemistry laboratory taught at WPI.

**The stories of five WPI alumni and how their careers have helped change the face of modern medicine**

# The Making of a Medical Revolution

By Michael V. Shanley and Paul Susca

IN THE LAST FEW DECADES, the practice of medicine has undergone a remarkable technological revolution.

Lasers that substitute for scalpels in delicate operations, machines that probe the interior of the body with magnets and radio pulses, scanners that use high frequency sound to monitor fetuses or detect heart ailments, devices that help the disabled overcome the limitations of their impaired senses, mobile intensive care units that can carry a hospital's emergency room to accident victims in the field—medical practitioners today have an arsenal of new and sophisticated tools with which to practice their art.

Here are stories of five WPI alumni who have made fundamental contributions to this medical revolution. This series was reported by Michael V. Shanley of Princeton, Mass., and Paul Susca of Rindge, N.H., both frequent contributors to the *Journal*.

# Hearts Too Good to Die

A woman in her 20s is trapped, bleeding and gasping for breath, in the twisted wreckage of her car following a highway collision with a pickup truck. Rescue workers labor to cut away the mangled metal, but it may be an hour before she arrives at the emergency room.

A construction worker in his 50s suffers cardiac arrest on the job and falls off a scaffold, breaking his arm. His co-workers rush to begin CPR, but he doesn't respond well and is bleeding from his arm.

Thirty years ago the outlook for these two patients would have been dim, perhaps hopeless. Many victims of trauma and heart attacks—patients with very little actual damage to the heart muscle—were dying en route to the hospital because most people didn't know about CPR, and because ambulance crews were not equipped to recognize and treat heart problems and other life-threatening emergencies.

The situation has changed. For one thing, says Dr. John J. Gregory '53, we know more about heart attacks. And since heartbeat "rhythm disturbances" are better understood, doctors have available drugs and other treatments for getting the heartbeat back to normal. But even more important for such patients, who 30 years ago would have died in the ambulance, is the practice of taking intensive care "on the road."

Gregory directs the Cardiopulmonary Department at Overlook Hospital in Summit, N.J., in addition to its mobile intensive care unit (MICU) program. Overlook's program is typical of many worldwide: A pair of emergency medical technicians (EMTs), equipped with a van full of medical and communications gear, are in effect able to bring the hospital's intensive care unit to victims, stabilizing them before they are transported to the hospital.

Gregory was instrumental in shaping Overlook's program, which is equipped to defibrillate (apply electric shocks to the chest wall to get the heart back to its normal rhythm), support the patient's breathing, treat serious bleeding and begin IV therapy. On-site treatment by EMTs is completely under the direction of a specially trained physician at the hospital who keeps in constant radio contact with the emergency team. The radio hookup even sends the patient's electrocardiogram (EKG) directly to the hospital's emergency room.

Gregory didn't set out to specialize in emergency medical care. He studied chemical engineering at WPI, then worked briefly at Hurlbut Paper Company in his home town of Lee, Mass., before joining the Navy. After being discharged from the submarine service, he attended medical school under the GI Bill. Four years at Albany Medical College were followed by an internship, residency and cardiology fellowship at St. Vincent's Hospital in New York. Later, Gregory became assistant director of the hospital's Cardiology Department.

Co-author of the classic text *Cardiology: A Clinico-physiological Approach*, he has been involved in original research since his undergraduate days at WPI. As a medical resident at St. Vincent's, he participated in some of the early clinical work on the development of techniques for permanent pacemakers, and has conducted clinical work with pacemakers since then.

In early 1964, he was one of several St. Vincent's physicians featured in a *Life* magazine story that dramatized the pioneering work the hospital was doing with the resuscitation of heart attack patients. At that time, bringing someone "back to life" after heart stoppage was nothing short of miraculous.

Today he conducts research into the efficacy of various drugs used to reduce cholesterol levels and prevent heart attacks. And while he works to put mobile ICUs on the scene to save lives, he is also taking on the difficult job of helping doctors and families decide when not to resuscitate patients.

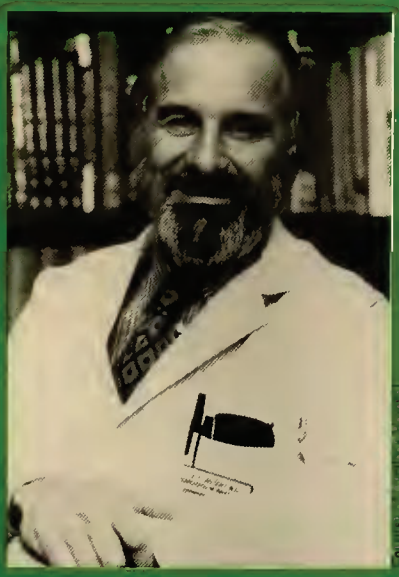
As a member of Overlook Hospital's bioethics committee, Gregory has studied the DNR (do not resuscitate) policies of other hospitals and drawn up guidelines to help doctors, in consultation with patients and their families, decide when a DNR order is appropriate.

"When [DNR policies] first started there were situations in which patients had been treated extremely vigorously and were living in ICUs [intensive care units]. The fact that life could be sustained and prolonged by the use of respirators and various other technologies is what brought the ethical questions to the forefront," Gregory explains.

So the rapid advance of medical and bioengineering technology has given rise, directly or indirectly, to the need for bioethics studies: "I think every hospital has to be very much involved in [bioethics] to be humane."

There is more to bioethics than deciding when to say "enough" when life in an ICU may be worse than an end to life. The monumental cost of state-of-the-art medical care and the issue of rationing care are also of great importance.

"Here's another area," Gregory says, "where the technology has improved the potential for care, and yet it brings about cost—and ethical—considerations that are very important." —*Paul Susca*



John Gregory devised a way to make intensive care units mobile.

Larry Israel '61

# High Tech for the Disabled

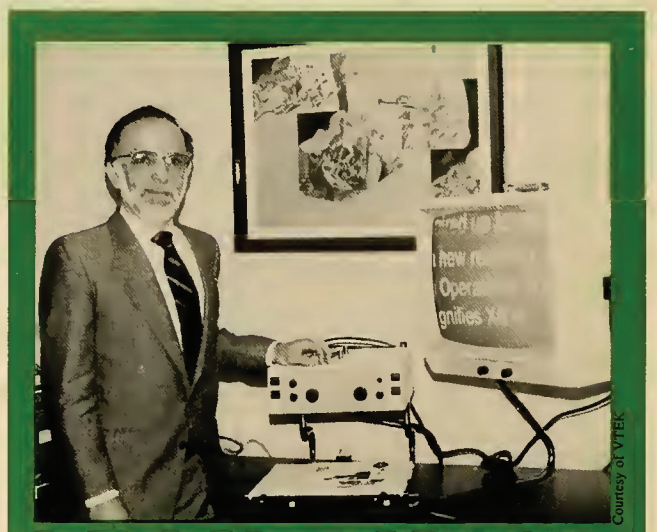
Larry Israel '61 couldn't have picked a better time to start his own company. After nine years at Xerox Data Systems, he raised some startup capital among friends and associates and, together with a neighborhood acquaintance, started a new company to manufacture electronic aids for the visually handicapped.

It was 1971, and the nation had not yet awakened to the plight of the disabled. But Israel's partner was a scientist who had conducted federally funded research at the RAND Corporation aimed at applying high technology to the problems of the disabled. He was interested in pursuing one of the results of that work—a system designed to help partially sighted people to read and write.

With Israel as the business and marketing half of the team and his partner as the technical expert, they took the plunge.

In hindsight, Israel scarcely realized how opportune his timing was. "There was really no such thing as a high-tech product for disabled people until about 1970 or 1971," Israel says. That was soon to change. People were beginning to see, he says, "that disabled people are entitled to be treated as individuals, not to be labeled and stereotyped and branded because of some perceived—and usually misperceived—characteristics attributed to the group."

The Rehabilitation Act of 1973 and 1974 "established principles of nondiscrimination based on disability that could be enforced in the courts," says Israel, who later studied law and is now a member of the California Bar. More importantly for his business, the act also provided money to help pay for products to aid the disabled in compensating for their disabilities.



Courtesy of VTEK

One of Larry Israel's "sensory-medical" devices helps partially sighted people read by magnifying type.

When Israel started Visualtek (now VTEK), much work still needed to be done on the device's read-write system. The RAND work, he explains, did not provide a specific system design, although it did demonstrate several key elements, among them the importance of a reverse image: white letters on a black background. It discovered that a moveable viewing table on which a book or paper could be placed was preferable to a moveable scanner or camera. And it demonstrated that 16 millimeter camera lenses were better than fixed magnification because they enabled the system to be more flexible.

Visualtek's first product, a read-write system comprising a video camera, monitor, moveable viewing surface and electronics for processing the image, was soon followed by a portable system. In the next 17 years, Israel's company sold about 30,000 of the systems to individuals, the Veterans Administration, state agencies, schools, libraries and nursing homes. They still had a long way to go: Of the estimated 500,000 legally blind people in the United States, 75 to 80 percent are partially sighted, according to Israel. "We suspect that at least half of them could benefit from our products, but there are other issues related to how motivated they are," he says. "For instance, many older people lose their sight after retirement and no longer have a need to use their sight for working."

Since their introduction, Israel says, VTEK's read-write systems haven't changed very much conceptually, but the company has added several personal computer peripheral devices for the blind and partially sighted. One is essentially a computer monitor with print that is five to ten times the usual size. Others include a braille printer and a "paperless braille" computer monitor. Today, Israel says, VTEK is the "world leader in providing electronic aids for the visually impaired."

Israel uses the term "sensory-medical" rather than biomedical to refer to his field, since the products don't affect or interact with biological functions.

That distinction is more than a semantic one. Sensory-medical products, he says, cannot be tested in the same way as most biomedical technology. Biomedical products can be tested using animals, for example, but sensory-medical trials have to involve people. "If you look at most biomedical testing," Israel says, "the human being who's going to benefit from it is a subject, rather than being a part of the solution to his own problem."

In addition to having a different relationship with the users of the products, the sensory-medical field also has a different relationship with technology, one that may put sensory-medical applications on less-than-equal footing with other biomedical developments. "The sensory-medical field doesn't get as much attention as biomedicine," Israel says "because there's not a clear marriage between the capabilities of technology and our human sensory mechanisms. The sensory mechanisms are among the most difficult areas of function for us to do something about."

But that certainly hasn't stopped Israel from making a successful business from sensory-medical products.

*—Paul Susca*

**John T. Hart '65**

# State of the Heart

■ It looks a little like the robot R2D2 of *Star Wars* fame, this Hewlett-Packard portable ultrasound imaging system.

And it's equally likeable and benign, helping as it does the elderly, the infirm and even the unborn.

As much as anyone, John Hart '65 has been responsible for bringing this product, which provides doctors with clear, accurate images of blood flow in and around the heart, to the marketplace. Hart, director of research and development for the HP Medical Products Group in Andover, Mass., oversees the efforts of 130 people who constantly refine and upgrade the imaging system.

So far, their efforts have clearly been a success. HP has more than 50 percent of the country's cardiac imaging business and about 40 percent of the business worldwide. Since its introduction in 1981, sales have grown by an astounding 50 percent a year.

The device that caused such dramatic change was slow to develop. "It took five years—and the equivalent of 100 R&D man years—to bring the system to market in 1981," Hart says. The system uses a variety of specialized transducers to detect even minute blood flow abnormalities. The original black and white model looks only at the heartbeat itself. As the system evolved, options such as Doppler capabilities (to detect blood velocity) and full color imaging were added. The colors allow doctors to make sophisticated determinations regarding such variables as flow direction, relative velocities and degrees of turbulence.

And that's just the beginning. "We keep finding new things to do with ultrasound," Hart says. "The information it's capable of providing is amazing. I can see where we can add a lot more things to this technology over the next five to 10 years. Color flow is really just starting, and beyond that I see 3–D and the ability to characterize the tissue in the heart and elsewhere in the body. It's possible to sort the ultrasound data to determine what class of disease a tissue contains."

A recently introduced HP system provides images of the carotids, the two great arteries of the neck. "If you have atherosclerosis, it's not only in your heart, it's also in your kidneys, and your arms and legs. It travels up to your carotids and into your brain. There's a strong need to find out if the vessels leading to the brain are occluded."

While the HP Medical Products Group's primary focus since 1961 has been cardiology, Hart says such fields as radiology, vascular surgery and obstetrics are seen as sources of potential new business. "We feel we can take the ultrasound technology into those fields and make a contribution there too."

The company's sale of medical products nationwide accounts for a little less than 10 percent of its overall $8-billion business. That $750,000 million or so represents the efforts of several related branches: ultrasound imaging, patient monitoring, diagnostic cardiology (EKG machines, for example) and obstetrical care.

In addition to managing the ultrasound imaging R&D effort, Hart is chairman of the R&D council for the entire medical products group. "It's my job to ensure that there's a synergy to the entire effort," he says.

Hart was recruited into the HP fold by Wilfred Houde '59. He had planned to get his master's at Yale, Hart recalls, but Houde convinced him to give HP a try.

"I hadn't even heard of HP at that time," Hart says, "but Wil convinced me. I signed on and they sent me to MIT to get my master's."

After working his way up from the HP lab, Hart was selected to form and then direct the ultrasound group when it began to take off in the mid-1970s.

Hart has now taken the recruitment effort full circle, serving as a member of the EE advisory committee and fostering the relationship between HP and WPI.

Returning to WPI, Hart found that EE Professor Reinhold Ludwig had an interest in ultrasound. HP is now sponsoring a dissertation at WPI aimed at furthering the development of new ultrasound transducers, which are a key element in the production of high-quality images. They are also complex and difficult to build.

"Dr. Ludwig and the doctoral student are working to improve the performance of the transducers," Hart says. "Then when we spend the million dollars or so it takes to build a new one, we can be sure we will advance the image quality. It's a breakthrough program, so we provide them with equipment and financial support. It's the kind of arrangement where both HP and WPI benefit."

*—Michael V. Shanley*

**John Hart with ultrasound scanners undergoing testing. At Hewlett-Packard, Hart helped develop an imaging system that tracks blood flow to the heart.**

Janet Woodcock

**Lawrence A. Minkoff '69**

# Where the Research Takes You

Dr. McCoy, the sympathetic physician on "Star Trek," could diagnose almost any ailment in seconds with his hand-held body scanner. Exactly how the device worked was left to the imagination, but today's biomedical technology may suggest to some that "Star Trek" medicine is not so farfetched.

Magnetic resonance imaging (MRI), developed by a team that included Larry Minkoff '69, already yields far more information about the body's internal state than physicians know how to use.

Versatility has been the key to Minkoff's contributions to the biomedical engineering field. In high school he built a closed ecological system in his basement in which algae produced enough oxygen to support a mouse—sealed in an airtight fish tank—for more than a month.

His undergraduate physics work at WPI focused on fish that use weak electric signals for sensing. His interest in biology then took him to the graduate school of the State University of New York's Downstate Medical Center in Brooklyn, where he went to work on a Ph.D. in biophysics and physiology.

Although there was a lab at Downstate involved in electric fish research, Minkoff became more interested in a problem posed by Dr. Raymond Damadian, a physician pursuing an unconventional theory about ion transport in living cells. The accepted view held that a "sodium pump" in the outer membrane of a living cell controlled the ion concentrations of the internal fluid by actively moving sodium ions out of the cell and potassium ions into the cell against their concentration gradients.

"When [Damadian] started studying ion transport in the cell, the question became, How are the ions bound within the cell? What holds them in there?" Minkoff recalls. His initial work with Damadian showed that the sodium pump was not thermodynamically feasible—in other words, cells just don't burn enough fuel to make a membrane pump work.

The next step was to show that the "structure" of water molecules inside the cell was different from that outside the cell. For this the Downstate team used a technique well known to organic chemists, nuclear magnetic resonance (NMR), which provides information on the chemical environment around the cell.

Since it was widely known that cancer cells contained more potassium ions than normal cells, Damadian tried applying NMR to the identification of these abnormal cells. It worked. From that moment, he was consumed with the idea of building a whole-body scanner that would use NMR to pinpoint and image cancers in human patients, a technique that came to be called magnetic resonance imaging (MRI).

Minkoff was very much a part of that quest. He obtained the first crude image of a tumor in a mouse, an image that was chosen to appear on the cover of the December 24, 1976, issue of *Science* because it resembled a Christmas tree ornament. Minkoff also served as the guinea pig when the research team created the first image of a human chest.

By collecting chemical information about the body, MRI can differentiate between normal and abnormal tissues, enabling doctors to identify tumors and other tissue alterations (hemorrhages, multiple sclerosis and so on) that could not previously have been detected in their early stages with other imaging techniques, including X-rays and CAT scans.

Larry Minkoff at FONAR Corp., the company formed to make MRI scanners.

Today, as executive vice president and director of FONAR Corporation, the company that Damadian formed to manufacture MRI scanners, Minkoff is actively pursuing research at New York's Beth Israel Medical Center. He has already demonstrated the value of nuclear magnetic resonance in objectively detecting conditions like emotional depression and premenstrual syndrome. Minkoff's research, which may prove useful in evaluating treatments for those conditions, may be only the beginning of expanded diagnostic uses for MRI.

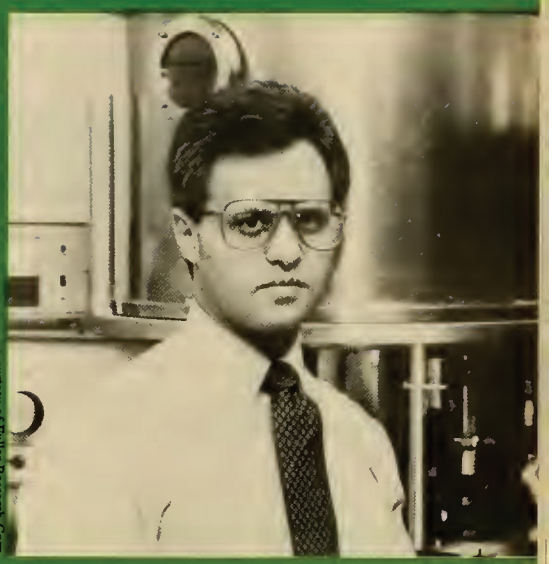
Minkoff sees automated diagnostic techniques like MRI becoming increasingly important in future medical practices. Some day, he says, a patient may be able to walk into a medical office and be scanned by an automated array of equipment that will then diagnose the problem and even prescribe treatment.

New medical technologies like MRI can help make diagnosis more accurate and efficient, Minkoff says, but their reliance on nonmedical disciplines like nuclear physics, electronics and computer science intensify the need for people with the multidisciplinary backgrounds.

Another argument for versatility, Minkoff says, is to be able to "go where the research takes you." The landmark success of the MRI team at Downstate was a consequence not only of their tenacity but of their ability to shift from cellular physiology to the engineering of a massive magnetic scanner—a gulf few scientists are able to bridge. *—Paul Susca*

## Terry A. Fuller '72 M.S., '75 Ph.D.

# Light over Scalpels




Terry Fuller's laser techniques have replaced major surgery for many patients.

■ Doctors at Sinai Hospital in Detroit had anesthetized a female patient for diagnosis of a reproductive problem that was causing infertility. By inserting an endoscope, an instrument used to look inside the body, they discovered that she had an adhesion that was blocking the Fallopian tubes.

Under normal circumstances, she would have been awakened, told of the condition and re-anesthetized so that the doctors could make a large incision and remove the adhesion. The result would have been a long hospital stay and a large bill.

"Instead, we made a minor incision, and used one of my experimental laser fiberoptic procedures to remove the adhesion right then and there," says Terry A. Fuller, president of the Fuller Research Corporation of Vernon Hills, Ill., a worldwide leader in the research and development of infrared transmitting fiber optics.

"In human terms, she was saved the trauma of major surgery and was home within 24 hours of treatment. In financial terms, our procedure cost about $1,500, versus the $8,000 or $9,000 it would have cost using traditional methods."

Fuller, who is considered one of the leading researchers in the field of laser medicine, developed many of the medical procedures that are being used in state-of-the-art laser surgery today. He holds one major patent with four others pending, and is the editor and co-author of the book *Surgical Lasers: A Clinical Guide*.

Among his many accomplishments was the introduction of what's known as an Nd:Yag laser to the treatment of uterine bleeding, which won him an award from the American College of Obstetrics and Gynecology.

Fuller's interest in laser medicine started at WPI, where he earned master's and doctoral degrees in biomedical engineering, the latter in 1975. He took that interest with him to Sinai Hospital, where he became involved in the use of ruby lasers to treat eye diseases.

In 1976, after winning a number of grants from the National Institutes of Health and other agencies, he formed the Laser Surgery and Photobiology Institute at Sinai. Over the next eight years, he turned it into the largest surgical laser facility in the world, both in terms of clinical procedures and research dollars.

He left the hospital in 1979 to form his own company, Medlase, which sold carbon dioxide ($CO_2$) and ruby lasers to the research and clinical communities. He also began developing fiber optics for use with $CO_2$ lasers. He was so successful that in 1984 he formed Fuller Research Corp. to commercialize the fibers. Fuller Research, a joint venture with Abbott Laboratories, a $4-billion health care company, developed the only fiber in the world that can transmit energy from a $CO_2$ laser through an endoscope.

Fuller says the laser "eliminates the need for a major incision to reach a diseased site in the body." For example, to remove a tumor inside the bladder, laser light can be directed along a fiber inserted through a cystoscope to vaporize the tumor. Thus far, that procedure has been used only on animals, and on humans only through a normal incision, but Fuller is gearing up for clinical use by the end of this year.

He believes that within five years there will be a $60-million-a-year market for devices that perform such procedures.

While laser surgery has become more widespread in recent years, the introduction of Fuller's new fibers will increase applications in such fields as gynecology, otolaryngology (ear, nose and throat), urology, orthopedic surgery and cardiovascular medicine.

Fuller Research currently operates with a staff of 17, including engineers in such fields as optics, materials engineering, physics, electronics, biophysics and mechanics. The company's 8,000-square-foot headquarters has optics, chemistry, fiber processing, electronics and polishing labs.

"Our intent right now is to expand our production capacity so we can meet the coming demand for these disposable fibers and for the fiber logic controller, a device that connects existing $CO_2$ lasers to our fibers so people don't have to go out and buy a new laser," Fuller says.

Later this year, Abbott Laboratories will be handling Fuller Research's initial market entry. After that, Fuller says, the company will be looking to expand the surgical applications of its fibers and, since they can detect heat energy as well as transmit it, exploring their use as sensing devices.

"My real love is clinical research," says Fuller, who still spends at least half his time in the lab. "I get turned on by the application of engineering and physics to medicine, and I really enjoy seeing my devices and procedures used in the way that they are."

Fuller remains on the staff of Sinai Hospital, as well as Ravenswood Hospital in Chicago, and is a faculty member at Northwestern University. He hopes one day to teach full time. "As much as I love industry—and the last four years have been the most exciting of my career—I really miss the frequent contact with grad students."

*—Michael V. Shanley*

By Michael V. Shanley

# Biotechnology Meets the

The founders of the Massachusetts Biotechnology Research Park wanted to build a vehicle that would cruise into the 21st century—under its own power.

Michael Carroll

**Worcester dentist Abraham Haddad was a driving force behind efforts to build the park.**

It's an impressive list of acronyms: MBRI, MBRP, WBDC, MCEC, CBI and, in the middle of it all, WPI.

The Massachusetts Biotechnology Research Park is off and running, but unless you're involved in the action, you'll need a scorecard to identify all of the players.

What the list of names and letters adds up to, however, is a unique biotechnology venture. With its combination of city, state and federal support; profit and nonprofit agencies; and commercial and educational goals, the park is an example of what can be accomplished when disparate groups with common interests band together to battle the forces of bureaucracy, skepticism and the status quo.

What many called an unrealistic dream now consists of one gleaming research laboratory/office building (with a second under construction and a third on the drawing board), a fully operational Magnetic Imaging Center and, under construction, a hotel that will house a restaurant, retail space, a bank and other business services.

But more impressive than the real estate development, more impressive even than the willingness of premier start-up companies to cast their lot with Worcester, is the extraordinary cross-fertilization of ideas that is taking place. It's what science and engineering are supposed to be all about. The Biotechnology Park is truly a visionary enterprise, a testimony to the foresight and perseverance of a diverse group of Worcester residents. And from the beginning, WPI has been a part of the effort.

To understand what the park is today, it's important to go back to the beginning and hear the story of the park that could easily have died, but simply wasn't allowed to.

"The park is the brainchild of the Worcester Business Development Corporation (WBDC), an arm of the local Chamber of Commerce," explains Abraham W. Haddad, a Worcester dentist credited by many as being a driving force behind the park effort. (Other key figures include John Hunt and Paul O'Connell, each of whom served as WBDC president, and Wyman Gordon chairman Joseph Carter.)

It all began, Haddad says, when a blue-ribbon panel of community leaders from business, politics, health care and education convened in the early 1980s to look at the role Worcester, with its diverse industrial base, 10 colleges and universities, several research and teaching hospitals, and 35,000 students might play in the science and technology of the future.

The panel, whose members included former WPI president Dr. Edmund T. Cranch, unanimously agreed to pursue the establishment of some sort of research park.

It's no coincidence, Haddad notes, that colleges and universities nationwide jumped on the technology transfer/innovation center bandwagon seven or eight years ago. "It was about then that the licensing and patent laws changed regarding federally funded research." The changes enabled researchers and their institutions to participate in royalties and licensing agreements with fewer restrictions.

"So when we approached the Worcester institutions, there was a definite electricity in the air, because they realized the opportunities," he adds. The WBDC then committed its resources to strategic planning and self-assessment. Representatives from the panel visited research parks throughout the country. They realized that, since their park would be smaller than many, they would have to find a niche. Given the strengths of area institutions in the life sciences, biotech-

# Perpetual Motion Engine

nology was the obvious choice.

"We zeroed in on the University of Massachusetts Medical Center as the hub," continues Haddad, "with research institutions like WPI, the Worcester Foundation for Experimental Biology, Tufts University Veterinary School, Clark University and Holy Cross as spokes."

When organizers began to look at common interests, they were surprised to find that area businesses, hospitals and academic institutions were already conducting between $70 and $100 million worth of research.

Haddad and others came to realize that one ingredient was missing: neutral ground where scientific entrepreneurs could come together to share expensive equipment, pursue industrial liaisons and apply their research. While Worcester was moving ahead with its agenda, Massachusetts Governor Michael Dukakis was in the process of establishing the Massachusetts Centers of Excellence Corporation (MCEC) to maintain the state's competitive edge in emerging technologies. Because of Worcester's groundwork, it became the focus of the state's biotechnology efforts.

This tie-in became crucial as the Worcester Business Development Corporation began to pursue ownership of the proposed site for the park, a choice 100-acre tract of surplus state land adjacent to the Medical Center. The land was owned by the center and Worcester State Hospital, but the governor's office worked to transfer ownership for a nominal sum.

It was a long, tiring process, one that presented the proposed park with its first major obstacle when the trustees at the State Hospital filed a lawsuit to block the transfer. Worcester State lost the suit, but the battle dragged on for more than two years.

Despite the delays, WBDC had been proceeding with its plans. "We decided to create several magnets to attract companies here," Haddad explains.

The major magnet was to be a state-of-the-art shared instrumentation facility for new companies that couldn't afford to buy expensive equipment. The second would be an incubator that would provide hands-on management and scientific consulting.

"We realized that with biotechnology you couldn't just go into a garage and come up with a new company, like you could in the '70s with computers," Haddad says.

Another magnet that was already in place was the Worcester area itself. With its research institutions, affordable housing, central location, cultural offerings and fine school systems, Worcester could hold its own in the competition to lure new firms.

Also among the attractions was a City Council-approved set of regulatory ordinances based on NIH guidelines. While other cities and towns were tying researchers' hands with confusing and constraining ordinances, Worcester established a set of clear-cut, up-to-date regulations.

The cornerstone of the Worcester effort was a desire to create what Haddad calls a "perpetual motion engine." "Money would continually be re-infused into the system, and that's vital, since the technology changes so quickly."

This concept was the beginning of the Massachusetts Biotechnology Research Institute, the non-profit board set up to oversee the scientific and intellectual development of the Park. MBRI members include representatives from area research institutions (including WPI's president, Dr. Jon C. Strauss), the Chamber of Commerce and local businesses.

"From viewing other research parks, though, we found that a key to survival was going proprietary early on," continues Haddad, who is now president of the MBRI board. "So while we originally wanted to keep it all nonprofit, it was driven home to us that an intense entrepreneurial posture was only possible by adding a for-profit element."

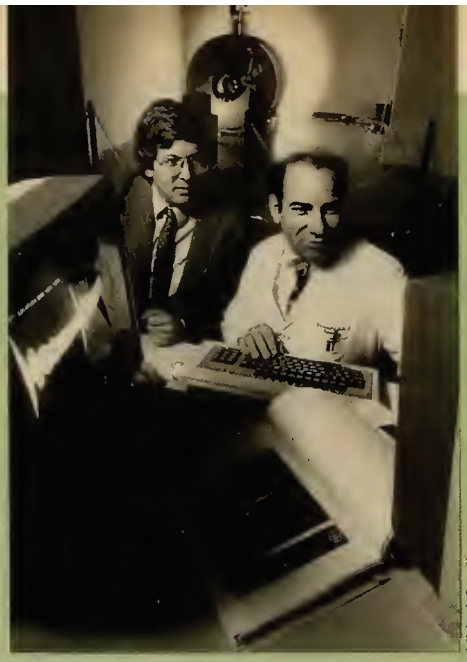
So were planted the seeds of what is now Commonwealth BioVentures Inc. (CBI), a company that combines the financing of a venture capital firm with the management resources and low-cost rental space of a business incubator. CBI is largely owned by MBRI. In return for its services, Commonwealth BioVentures takes a percentage of the start-up companies being funded.

The state helped establish CBI, in the

Janet Woodcock

**President Jon Strauss predicts WPI's ties to the park will increase.**

# Stretching the Limits of a New Technology


Michael Carroll

**Stephen Moore (left) and Michael Davis**

AT THE FAR END OF THE ROOM sits a six-foot-tall magnet that looks for all the world like a massive mechanical doughnut. A student slides a "phantom" that simulates a human brain into the magnet's cavity and, like iron filings under the pull of a child's horseshoe magnet, atomic nuclei in the phantom align with the magnetic field.

Twenty feet away, a researcher types a command on a computer keyboard. Inside the magnet, pulses of high frequency radio waves probe the phantom. With each pulse, the magnetized nuclei absorb the radio energy, then relax, sending radio waves back to receivers in the magnet's cavity.

From this subtle interaction of magnetic field, radio waves and "brain," a computer assembles and paints on a high-resolution monitor a detailed image of the phantom's internal structure.

The technique is called magnetic resonance imaging, or MRI, the latest and most powerful imaging technology available for medical diagnosis. At the Massachusetts Biotechnology Research Park's Magnetic Imaging Center, Stephen C. Moore, associate professor of biomedical engineering at WPI, and Dr. Michael A. Davis, a researcher in the Department of Radiology at the University of Massachusetts Medical Center, are stretching the limits of MRI.

Unlike conventional X-ray machines and CAT (computerized axial tomography) scanners, which use penetrating radiation to probe the density of the body, MRI employs a combination of a powerful magnetic field and radio signals to produce amazingly detailed images of the body's soft tissues.

"MRI is much better than conventional X-rays at detecting soft tissue lesions," Moore says. "While CAT scanning did make it possible to better visualize some of the subtle differences between soft tissue, the sensitivity of MRI is generally much higher. For example, MRI can easily detect multiple sclerosis plaques, something that is more difficult with CAT."

MRI can also reveal a great deal about the chemical and electrical states of the atoms and molecules in the body's tissues—information that can help radiologists locate tumors and other abnormal types of cell growth.

With a research team that includes four WPI graduate students and six undergraduates, Moore and Davis are looking for ways to improve a host of medical imaging systems, including MRI, nuclear medicine and more conventional X-ray techniques.

One of the projects currently underway is aimed at using MRI to measure noninvasively the velocity of body fluids, such as blood and cerebrospinal fluid.

The team will also study ways to compensate for image artifacts that are produced by certain types of tissue and to improve the signal-to-noise ratio in MRI images, making it easier for physicians and technologists to see the vital information they contain.

In another project, Moore and Davis are evaluating a new class of bifunctional chelates made by Viomedics Corporation, a Biotechnology Research Park tenant, that may make tumors stand out more clearly on MRI images.

Despite their rapidly evolving research efforts in MRI, Moore and Davis are relative newcomers to this imaging technique. Davis, who earned his bachelor's and master's degrees in chemistry from WPI, launched the collaboration in 1987 when he convinced the state of Massachusetts to obtain a research magnet for the proposed MRI center at the Biotechnology Park. WPI is currently providing the space in the center for a laboratory and hired Moore, an expert in such medical imaging techniques as nuclear medicine and CAT, to develop a research program from within the college's Biomedical Engineering Program.

This summer, the laboratory will move into a new research wing at the imaging center. The new space will include a chemistry and electronics laboratory and offices. In this expanded laboratory Moore and Davis will continue to test the limits of MRI, a technique which may be capable of telling physicians more about the state of the human body than any other diagnostic tool now available.

"There is still a lot of unexplored territory in MRI," Moore says. "The promise may prove to be more than the reality, but I think there's a lot more to be discovered about this technology."

sense that the Massachusetts Centers of Excellence Corporation financially supported the MBRI effort to develop a vehicle for technology transfer. "Again, we were trying to meld private, industrial, state and academic interests. It was a delicate operation," says Haddad.

CBI, which really got under way last year, was the final Worcester magnet.

In the spring of 1986, construction began on the Park's three-story, 75,000-square-foot first building, One Biotech Park.

"WBDC had lined up a consortium of 10 banks that provided construction and land development financing," explains Raymond L. Quinlan, MBRP executive director and the man in charge of attracting tenants and overseeing construction. "The city had provided off-site improvements, and the state eventually awarded us a $1-million grant to fund on-site improvements."

WBDC had millions of dollars invested in the project, but no tenants yet committed. A deal with Integrated Genetics fell through when the Fra-

mingham firm decided the building wouldn't be ready soon enough to suit their needs.

Making matters worse, an expected $1 million grant from the federal government kept being delayed.

While the WBDC's public posture was one of confidence during this period, Haddad admits it was a trying time: "We always believed in what we were doing, and that we would ultimately be successful, but there were a few cliff-hangers."

The story, of course, had a happy ending. Late in July 1986, Cambridge BioScience Corporation (CBC), a highly respected medical products firm, signed an agreement to lease 50,000 square feet of space. Not surprisingly, CBC chairman Gerald F. Buck cited several of the Worcester "magnets" in explaining the firm's decision.

A few months later the park had its second major tenant when Viomedics, Inc., a start-up company concerned with new approaches to the treatment and diagnosis of such diseases as cancer and arthritis, signed up for 6,000 square feet.

With the ice broken and more inquiries coming in, plans accelerated. In the late summer of 1986, construction began on the Magnetic Imaging Center, a project run by a nonprofit consortium of Worcester hospitals. Soon thereafter, design work and marketing began for Biotech Two, the second laboratory building. At the same time, plans were announced for the hotel complex.

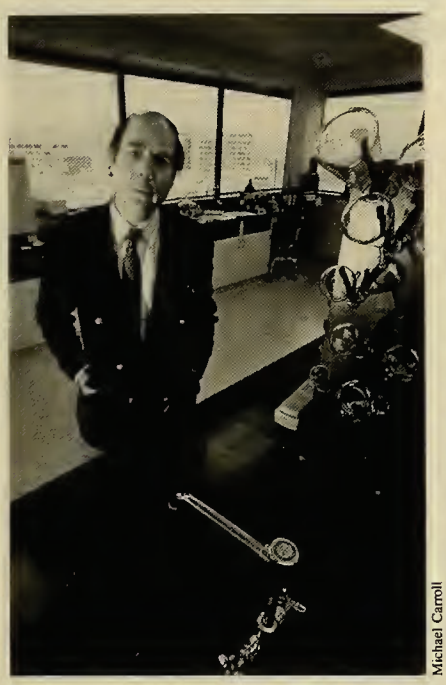
Today, all the acronyms are thriving. CBC has completed clinical trials on a five-minute antibody test kit for AIDS. Pending FDA approval, the company plans to introduce the test commercially later this year. Work also continues on development of an AIDS vaccine, as well as on other products that detect and prevent human and animal infectious diseases. Several WPI graduate students have spent time working at CBC.

CBI, under the leadership of Robert G. Foster (hired following a nationwide search headed by President Strauss), has established its $5-million limited partnership to invest in new biotechnology companies over the next year. (WPI is the only institution to invest as a limited partner.) The first company to receive financing is Transgenic Sciences, Inc., which will conduct research into producing disease-resistant poultry and, ultimately, into the application of transgenic technologies to the treatment of human genetic diseases.

**"Nowhere else is there such concentrated research in biotechnology."**

Massachusetts Centers of Excellence has provided about $500,000 in grants to MBRI for personnel, facilities, shared equipment and program operations. MCEC also provides direct grants to researchers throughout the state.

The Magnetic Imaging Center is in its second year of operation. It houses both a diagnostic clinic and a research facility that use magnetic resonance imaging (see sidebar).



Michael Carroll

**Spiros Theodoropulos founded Viomedics, which became the park's second tenant.**

Viomedics continues its research into diagnostic reagents to be used in the treatment of diseases. Among current projects are the development of new imaging techniques for various organs, and therapeutic drugs for the treatment of rheumatoid arthritis and tumors. Company founder Spiros Theodoropulos has established ties with the MIC and WPI biology and biotechnology chairman Joseph Bagshaw.

If the concern was once whether or not there would be enough tenants to fill the park, the problem now is meeting the demand.

"We figured it would take us 10 years to complete the park," says Quinlan. "But we're well ahead of that timetable. If we have a problem, it's that things are happening too fast. Biotech Two is almost completely 'called for,' so we've hired an architect to begin design on Biotech Three. It's a pleasant problem to have, but it is a problem."

The WBDC's magnets notwithstanding, there is another reason why Worcester is attracting firms.

"Nowhere else is there such concentrated research in biotechnology," says Quinlan. "Scientists have to stay current, especially in this field. And to do that, they need to be part of a research environment, and have access to academic institutions."

Haddad notes the wide scope of area life science research. "We have every level of research applications in the human life sciences, from the molecular level to animal resource facilities to the human populations at the hospitals."

Now that CBI is up and running, MBRI has redefined its role. In addition to being Worcester's representative in all matters concerning the park, it also operates a nonprofit innovation center that supplements CBI's efforts.

"When a scientist simply has an idea and needs the space and the funds to pursue it, that's where MBRI will come in," says Haddad. "It's a homegrown approach, because we anticipate that some of these ideas will spawn start-up companies that will one day be housed in the park."

Adds Quinlan, "Right now, most of the money coming in goes toward paying off our debt and funding future growth. But at some point three or four years down the road, the park will begin to show significant profits—maybe $3 or $4 million a year—and that money will be invested back into the efforts of scientists through MBRI."

This is part of the perpetual motion engine the park's founders had foreseen. And while the engine is still being put together, it's already beginning to purr. MBRI has awarded its first grant—to WPI biology and biotechnology Professor Daniel Gibson (see sidebar).

"There's no doubt that our ties with the park will increase," says President Strauss. "As the park and CBI mature, the rewards will flow through MBRI, and there will be more grants like the

one Dan has. In addition, our faculty will be involved with the companies being seeded by CBI."

As Haddad looks to the future, he too is upbeat, and refers again to the perpetual motion concept. "By the year 2000, there may be a new technology, and the park will shift its emphasis. That's why we've fought to maintain an R&D attitude. We want the park to constantly regenerate itself, replenish its occupancy, spin out people to satellites in other parts of the state where there are mature manufacturing levels."

While plenty of dollars have changed hands as the project has gotten off the ground, it was unpaid work that actually created the park—the hours of free labor and brainstorming donated by Worcester scientists, educators, community leaders and businesspeople as they nudged it from dream to reality.

They rolled up their sleeves to put this engine together, and they can take tremendous satisfaction in watching it hum down the highway, picking up speed with each passing mile.

*Mike Shanley is a frequent contributor to* WPI Journal.

# Modern Science Meets the Living Fossil

Janet Woodcock

**Daniel Gibson extracts blood from a horseshoe crab.**

IT IS ESTIMATED that horseshoe crabs have been quietly foraging along the New England coast for 225 million years. Only recently have these ancient relatives of spiders encountered a serious threat to their existence.

Today, along the beaches and marshes of Cape Cod, they are killed by clam diggers, who see them as competition, and chopped up by eel fishermen, who say they make excellent bait. And in the laboratories of a small Cape Cod company, scientists collect their blood.

It was just a decade ago that researchers discovered a remarkable property of horseshoe crab blood. When exposed to any sort of gram-negative bacteria, amoeba-like cells in the blood set off a clotting process that rapidly turns the crab's blood to jelly. This primitive immune response helps the crab seal off wounds and ward off bacterial infection.

Because the blood cells react to all gram-negative bacteria—a class of microorganisms that cause a significant share of human ills—they can be used as an excellent probe for the presence of bacteria in medical devices, including dialysis machines, and food processing equipment.

The largest use, however, is in the screening of injectable drugs for bacterial contamination, where the only alternative is testing with rabbits, a much more expensive procedure.

Associates of Cape Cod now makes a powdered extract from horseshoe crab blood called LAL (Limulus Amebocyte Lysate). To make the extract, the company collects blood from large, mostly female crabs in the spring when they come ashore to mate.

After they are bled, the crabs are returned to the ocean, apparently without harm. Still, since bleeding began, scientists have observed a significant drop in the horseshoe crab population off the Cape. The cause of this decrease is not known, according to Daniel Gibson, associate professor of biology and biotechnology at WPI. While the impact of the clammers and eel fisherman, along with natural population fluctuations, cannot be discounted, the long-term effect of removing the often egg-laden crabs from their natural environment during the breeding season is not well understood.

That is why Gibson has been working with a team of undergraduate and graduate students on a method of culturing the blood cells of the horseshoe crab in the laboratory. Last year, Gibson received a $20,000 grant from the Massachusetts Biotechnology Research Institute, the first grant ever awarded by this research arm of the Massachusetts Biotechnology Research Park, to continue this work.

If a stable culture can be developed, Gibson says, the makers of LAL would have a year-round supply of blood cells without the need to bleed crabs. This hope has fueled many efforts over the last decade to culture the blood cells. About four years ago, Gibson tried to duplicate the results of some apparently successful efforts only to discover that what most, if not all, of these researchers had grown was not blood cells but a form of marine yeast.

Through trial and error, Gibson was able to establish a stable culture of amebocytes, but he could not get the cells to grow and divide. He decided that the solution was to culture not the cells themselves but the tissue that manufactures the blood cells—the crab's "bone marrow."

Working with teams of undergraduate students completing their Major Qualifying Projects (MQPs), Gibson began the hunt for this tissue, which had not previously been identified. He developed a method in which dissected crabs are infused with antibodies that have an affinity for the crab blood cells. Next, a second antibody, one that clings to the first antibody, is added. Attached to this second antibody are tiny balls of gold. Under an electron microscope, the gold balls serve as beacons, highlighting the exact position of the blood producing cells.

While initial work with this method was under way, Gibson, working with an ordinary light microscope, observed what appeared to be the blood-cell-producing tissue. He extracted the tissue and was able to get it to grow. Further work will be needed to see whether the new cells in the culture will mature into LAL-producing blood cells.

In the meantime, Gibson is talking with Commonwealth Bioventures Inc., the Biotechnology Park's incubator, about the potential for turning the results of his research into a new company.

# Lessons from not long ago


**Courses on recent history offer controversy, context, and a challenge: teaching contemporary events to students who know little of the past**

BY JULIA RIDGELY

When Neil Armstrong walked on the moon on a summer Sunday in 1969, American television viewers were vividly aware that they were witnessing a thrilling milestone in history. So they may be momentarily surprised to learn that their children and grandchildren perceive that triumphant event as little more than a grainy photograph in a textbook. They may wonder, too, when their offspring ask, "What was it like to live in the '60s?"

More students are posing that question, partly as a result of college history courses that teach and interpret recent events. While such classes are still mainly products of the interest of individual teachers rather than of widespread curricular changes, their popularity among students who are often poorly grounded in history of any era shows that the courses are having some success. And the courses show the influence of a generation of instructors who chose teaching as a profession during the '60s, and who regard the study of recent events as a chance to pass on a sense of social and democratic responsibility.

Today's students have been characterized by the press as "conservative"—more likely to vote Republican, more eager to join the corporate establishment, less willing to take an activist stance. In the classroom, that conservatism can translate into a passive attitude toward events and a disapproving, even hostile, view of social change.

To these students, "the world started the day they became conscious of being a human being, maybe when they were 14," says Patrick Dunn, professor of history at Worcester Polytechnic Institute (WPI). "Anything outside their narrow range, or what happened before then, has no bearing today." As a result, Dunn has great difficulty with this group in presenting the '60s as a period of social transformation. "They don't recognize what society was like before the '60s," he says. "I try to get at it by contrasting what WPI was like then—a preplanned curriculum, Saturday classes, suits and ties, no women on campus. They don't realize that the society they live in now is something vastly different; they just take it for granted that it was that way and will always be that way."

Such an attitude is upsetting to teachers both as historians and as shapers of citizens. Teaching recent history

AP/Wide World Photos (all)

*Images from the Vietnam era—a B-52 raid (1966) and a Berkeley rally in memory of students killed at Kent State (1970)—haunt a generation. Yet "for the current undergraduate, the war has become another historical event, like World War II," says CWRU's Morrell Heald.*

## What history books have concluded about their own times

HOW LONG does it take historians to decide what events are important and what they mean? On the following pages are passages from histories written within a few years of the events they cover. They are seen through the filter of the interests, obsessions, and prejudices of each period.

gives them the opportunity to show students that the relationship between individual behavior and history is ever-evolving, a responsibility the teachers treasure.

Recent history—roughly the period after World War II—is not just a valuable area of study in itself, but a way of promoting interest in history as a whole. Christianna Nichols is an instructor in political science at Western Maryland College (WMC) who teaches a class in modern and contemporary European political movements, including those of the Soviet Union. "The enticement," she points out, "is that the course sounds modern, and suddenly all this stuff in *TIME* about *glasnost* and *perestroika* is going to come to life." But then, she notes, "People in my class will ask, 'Why are we talking about Czarist Russia in the 12th century?' " and that gives her the opening to talk about the panorama of events across the centuries.

There will always be misty areas in any adult's memory where the lessons they've studied in history books leave off and the awareness of the era they've lived through begins. And there are generational differences between those who grew up in the shadow of overwhelming events—the Depression and World War II—and current students, born in the late '60s, whose world may seem to be a more diffuse collection of influences. Teachers praise in today's students what they see as a global perspective, a greater awareness of the diversity of culture. Television has tremendously aided that wider outlook. "I didn't have a world view growing up," says Albert Dorley, assistant professor of history at Villanova University. "What came over the television were cute shows. I wasn't watching the war in Vietnam in living color."

The availability and vividness of worldwide TV news is still no competition, however, for the profound impact great events have had on those who lived through them. "The generations of the '30s and '40s had the experiences of the Depression, which formed a drive toward a unified national identity, and World War II, which brought about the highest level ever of national unity," says Lou Athey, professor of American history at Franklin and Marshall College (F&M).

By contrast, the events of the last 40 years are a bewildering catalog of crises—social, political, international, and economic. The longing for a common generational experience may explain, in part, the baby boomers' current fascination with the 1960s as they search for a cultural identity in one of the most contradictory of decades.

The knowledge gap of current students stems not just from how much there is to know about the present but from how little they know about the past. Without background—a sense of history as a story, with identifiable plots, subplots, and themes—they have no context in which to place recent events. A common complaint of teachers is that their charges are bright and hardworking, but lack their parents' firm foundation of historical narrative and facts.

Two trends in the 1960s and '70s help explain the mystery of the weakened foundation. One was the expansion of the curriculum to include more than the traditional "great white men"; the other, a new emphasis on teaching practical "skills" rather than names, dates, and places.

Few would dispute the value of the former. Traditional survey approaches, such as the "presidential synthesis" of American history, stressed politics and war, dividing the centuries into precise four-year chunks of "events." But for the first time, revised curricula added the stories of women, Afro-Americans, American Indians, and immigrants, as well as social and cultural movements. American history became more complete, but also more complex.

Some teachers are concerned that in the great variety of themes and perspectives, crucial facts and a sense of the sweep of history may have been lost. Students "aren't drilled and disciplined as to historical process, time bars, what occurred when, the sequence of events—all that is compressed and confused," says Villanova's Dorley. "There might be a bit of overstressing of social and cultural events, taking society as a whole rather than looking at changes and developments."

But most teachers are equally critical of the "back-to-basics" method popularized by, among others, Allan Bloom (author of the best-selling *The Closing of the American Mind*). Lowell Gustafson, assistant professor of political science at Villanova, calls it a "cafeteria approach." "There is no agreement on broad and sweeping issues," he says. "It's kind of a computer-age version of what cultural literacy is. It reminds me of my high-school history teacher filling the

*WPI's Patrick Dunn must challenge students' preconceptions when he teaches about the Soviet Union under Stalin. "Somewhere they've gotten this idea that he was paranoid," he says. And they want to cling to it, even after Dunn's detailed lecture on Stalin's objectives and Soviet politics of the period. No matter if students get sketchy information from textbooks or TV, Dunn says, "the point is to make sense of it for ourselves."*

blackboard with names from Hammurabi to Nixon; if we could identify them all, then we supposedly knew something about the forces that shaped history."

In the '60s and '70s, "it became very fashionable to focus on questions," adds Con Darcy, professor of history at WMC. Texts of the period badgered student readers with "topics for discussion" as a way of engaging student interest: "What do you think an average merchant would have thought about the Declaration? A wealthy landowner? An artisan?" More recent texts, Darcy believes, divide history into specialized parcels at the expense of necessary information: "You look at a textbook and there's a paragraph given to Lincoln and a paragraph to Woodrow Wilson. These little units on 'The Women of the Second World War' are fine, but let's have that in addition to the basic story."

The minds of many older Americans are attics in whose nooks and crannies the artifacts of their national history are stored away: carpetbaggers, Teapot Dome, the Mayflower Compact, the XYZ Affair, Manifest Destiny. But to many contemporary students, it's all a jumble; their trunks have never been filled with history's treasures. At WMC, Nichols has only been teaching college for a few years, but notes that since her days as a graduate student the "lack-of-background" problem has been getting "incrementally worse and worse. You assume they know about intellectual currents, and they don't."

The approach emphasizing "life skills" at the expense of presenting history as part of an engaging narrative has come under special criticism from the chair of the National Endowment for the Humanities. Lynne V. Cheney, in the 1987 report *American Memory*, wrote about how in the teacher's guide to a popular textbook series, "Scores of skills to be taught are set forth: everything from drawing conclusions and predicting outcomes to filling in forms and compiling recipes." Yet, she emphasizes, "The cultural content of learning, on the other hand, is given only brief mention."

*Political turmoil and famine in Africa have drawn students to Con Darcy's class at WMC, where he tries to counter "Hollywood images of Tarzan or King Solomon's mines" with the rich heritage of African traditions and achievements. Right: Fleeing tear gas at a 1980 protest in Soweto, South Africa.*

*Students "have no idea that [China's] Cultural Revolution was coincidental with events in the United States and France in '68," adds Dunn at WPI. Left: Parisian barricades, June 1968.*

Focusing on recent history can be valuable in capturing the attention of students who in high school were turned off to history in general. Those who have no strong feelings about the Civil War may at least gain a sense of the importance of the war in Vietnam. Villanova's Dorley, for example, says students sign up for his popular Vietnam course because "their parents were there, or their parents are still talking about it. The war is still a very big issue because of its impact on domestic and foreign policy."

Teachers of recent history welcome the opportunity to fill in the knowledge gaps of their students, even though the effort is time-consuming. When Nichols talks to her Western Maryland class about changes in the Communist Party since 1917, she runs back and forth between blackboards, one of which has a diagram of the system in 1917, the other the current one. "You have to constantly tie them together," she says. But she admits, "it would be much easier if the basic history knowledge were there. In my Latin American class, we have to go back and talk about Incas and Aztecs before we can talk about terrorists in Peru."

Lack of background among today's high-school students is an equally serious problem for teachers throughout the humanities. Assistant Professor of English Kent Ljungquist offers a survey course in

## Reconstruction (1865–77): "The scandal of the system grew insufferable"

POLITICAL RECONSTRUCTION was carried out according to the plan of Congress. . . . Ostensibly the negro was master of the States; but his utter ignorance, incapacity, and credulity made him the dupe and tool of white adventurers from the North, nicknamed Carpet-baggers, who, in alliance with some apostate Southern whites, nicknamed Scallywags, got the Southern governments in to their hands. . . . At last the scandal of the system grew insufferable, military protection was withdrawn from the carpet-bagging governments, which fell, and the whites were enabled to reinstate themselves in power. They did not fail practically to disfranchise the negro. . . . So it is still. The negro at the South enjoys, as a rule, personal and industrial rights which the war won for him, but is excluded from political power. From social fusion and equality he is, if possible, further than ever, since concubinage has become rare, and there is an end of the kindly relations which sometimes subsisted between master and slave . . .

*The United States, An Outline of Political History*, by Goldwin Smith (1893).

## Desegregation: "So drastic a social revolution"

THE MOST MOMENTOUS action on a domestic problem was taken not by Congress or the President but by the judiciary. The Supreme Court ruled unanimously, on May 17, 1954, that the long-established "separate but equal" school facilities granted to Negroes violated the 14th Amendment. The Court fortunately indicated that so drastic a social revolution as desegregation would have to be worked out gradually. Dixieland hotheads violently resented this invasion of states' rights, but most Southerners showed a disposition to grapple with the problem slowly and sanely.

The historic decision of the Supreme Court was widely hailed as the greatest victory for the Negro since Emancipation. An intermingling of the races had already occurred with unexpected success in the armed services. Now destined for the schools, it would lift from the Negroes the psychological blight of being set apart as creatures inferior. The United States could henceforth hold its head up more proudly as the Land of the Free, and give the lie to Communist agitators who insisted that America was committed to holding the Negro perpetually in the ditch.

*The American Pageant*, by Thomas Bailey (1956).

American fiction at WPI. In it, he tries to "teach novels almost as case studies of the way in which certain political developments were transformed into fictional terms. Ten or 15 years ago, you might not have had to do that because you might have taken it for granted that the students had a reservoir of historical knowledge to call upon."

Ljungquist has found that the most popular works remain those that, like J.D. Salinger's *Catcher in the Rye*, stress timeless themes of individual experience and growing up. He has had less luck with novels like *Going After Cacciato* (in which Tim O'Brien works fantastic, fictional variations on the Vietnam War) or even those that assume familiarity with the mood or culture of an earlier decade. "Especially with so many writers of the '60s and '70s, popular culture becomes part of their fiction," Ljungquist says. "In Updike novels, people watch TV; he'll be writing about a person observing a particular historical event, and if the students don't know what that event is, then obviously there's a difficulty getting across what Updike's up to."

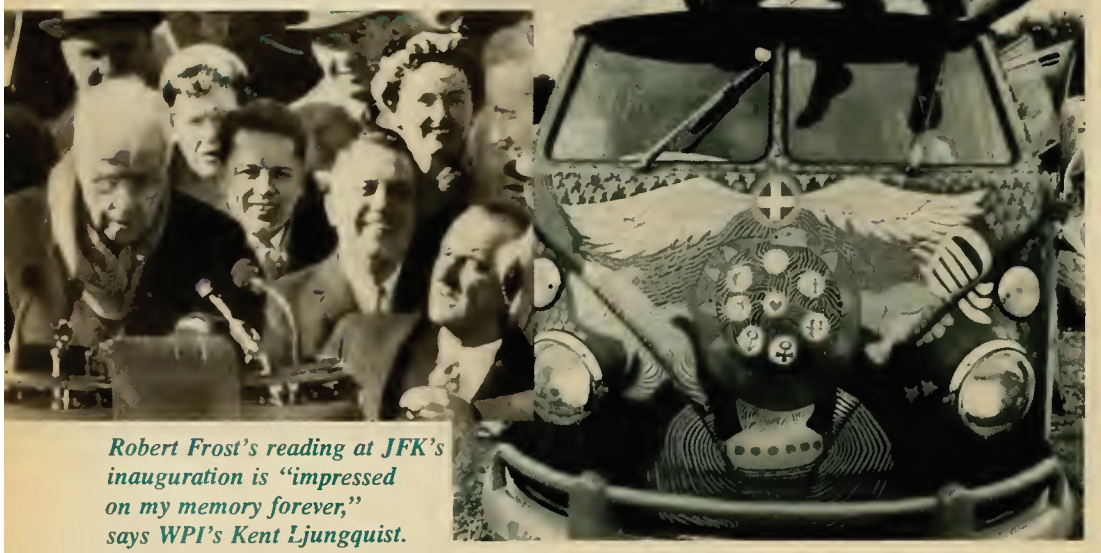
Teaching fiction does provide a chance, however, to raise political and moral ideas that students might otherwise resist. "If you teach an essay that has a polemical point to it, the student won't accept it. But if you teach a novel that has pretty much the same point or theme behind it, then suddenly they approach the subject with a greater degree of flexibility," Ljungquist says.

Park Goist, professor of history at Case Western Reserve University, teaches a class on social values in recent American drama. He believes that drama, even more than fiction, provides a level of engagement that helps students overcome their prejudices. "It's specifically American material," he says, "but it raises eternal moral questions."

Some courses turn up again and again in catalogs, either because they respond to areas of current national interest (Latin America, Africa, the Middle East) or because they are of perennial concern (the Cold War, U.S.-Soviet relations, racial and religious issues). Often, the most current topics are found in the political science department, since the discipline relies in part on analyzing systems rather than on making historical judgments. "In comparative politics, we have models of Communist systems or European systems," says WMC's Nichols. She teaches about Great Britain under Margaret Thatcher, for example, because Thatcherism "has been around almost 10 years, is a definite movement, and has radically altered the system."

The problem for historians is in deciding what trends or events from the infinitude of a particular year or decade are the significant ones. Many people can remember from their own textbooks what now seem like ludicrous oversights or predictions; only hindsight is able to select the little streams that become rivers. A 1966 text, *Contemporary America*, emphasized the economy, labor conflict, the Cold War, and civil rights as the major themes of the '60s. Vietnam receives a brief mention under the heading of "brush fires" around the

*Woodstock typifies a student view of the '60s as the era of hippies and drugs. Yet, says Dunn, "the only thing that comes through from the '60s in good shape is the music. There are still people out there who like the Doors and Dylan and Arlo Guthrie."*



*Robert Frost's reading at JFK's inauguration is "impressed on my memory forever," says WPI's Kent Ljungquist.*

## Take out a blank sheet of notebook paper . . .

How many of the following names, quotes, and events look familiar? There are five terms from each of the last four decades of American history. Extra credit: How close can you get to the actual year each event happened? Answers on page VII.

1. the Great Society
2. Apollo-Soyuz
3. "We're eyeball to eyeball . . ."
4. the safety net
5. SCLC
6. Gramm-Rudman
7. Gulf of Tonkin
8. 444 days
9. the great silent majority
10. Proposition 13
11. U-2
12. SALT II
13. PATCO
14. "I have here in my hand 57 cases . . ."
15. the Warren Report
16. 38th parallel
17. "There you go again."
18. Little Rock Central High School
19. CREEP
20. Bikini Atoll

world, and the chapter ends rather optimistically with a description of President Johnson's "New Society" programs. But within a few years, black urban neighborhoods had erupted into violence, Vietnam had become a full-fledged war, and Johnson's reforms has been upstaged by even more radical social and political movements. By 1977, the text *The National Experience* devotes an entire chapter to the 1960s as "Years of Revolt," stressing themes of alienation and social conflict and tracing the history of America's gradual entanglement in Southeast Asia.

Even within the '70s, events are beginning to sort themselves into piles of either the anecdotal or the significant. President Carter's pardoning of Vietnam War draft dodgers, a major event of the time, is now largely forgotten, while his failure to secure the release of U.S. hostages in Iran—a political disaster that may have influenced the 1980 election—is now viewed more as a failure of personality than of policy. What Christianna Nichols' political science students are learning about Carter are the sweeping effects of his human rights policy, which contributed to the fall of several Latin American dictatorships.

Since views of events change so quickly, how can historians presume to teach about those not yet sorted out? The problem is probably no worse than in the discipline of history as a whole. Yet someone who 40 years ago studied U.S. history—learning of presidents, politics, and wars—would find today's survey courses astonishingly different, encompassing decades of progress in teaching social history through such topics as slave culture, the women's suffrage movement, the effects of immigration, or the history of the family.

But teachers of contemporary history don't claim to be handing down the definitive view of the events they cover. While highly praised textbooks already exist on topics like the Vietnam War, courses on contemporary history rely on a tremendous variety of source materials, among them, newspaper articles, first-person accounts, tapes, and oral narratives. WMC's Con Darcy introduces his class to contemporary African culture through African-produced films. Morrell Heald, professor of American studies and history at CWRU, brought to his class a graduate who is a Vietnam vet and a counselor of fellow veterans, and another speaker who heads a Cleveland Vietnamese organization. F&M English Professor Anthony Ugolnik has students interview and profile Vietnam vets and takes the class on a field trip to the Vietnam Memorial in Washington, D.C. WPI's Dunn gives his students readings from the diaries of American soldiers who intervened in the Russian revolution in 1918.

Such materials introduce an intensity and interest far beyond the reach of textbooks and, with it, a problem: point of view. "I think it's essential that the students learn to analyze critically any book or article, whether it's on the left or the right," says WPI's Dunn. "I run into a problem in that the best textbooks in Russian history, and some of the best on Cuba, are written by émigrés who have a far-right opinion. Then, some of the best stuff on Iran is written by American critics on the left. I don't teach my students that any of these is the definitive interpretation."

Wildly divergent points of view can be disquieting to students raised on committee-approved textbooks. "So many come to college after reading these Dairy Queen homogenized products," says Darcy. "Some of them are going to react very strongly."

"I use the diary of a person who lived in Cuba during the Castro years," says Villanova's Gustafson. "One day I said that I liked a lot of what

### The 1960s: "Cults appeared among the young"

MOST BORN AFTER 1940 spent their childhood under relatively comfortable circumstances. . . . Life in the child-centered suburb was undemanding and defined the important goals in terms of good performance in the schools. . . . The prospect of the inadequate and unworthy challenges of the life ahead was distasteful to boys and girls starved for affection, who felt themselves lone wolves remote from everyone else. . . .

Childhood in the slums, and particularly in the Negro ghettos, lacked the ease and comfort of the suburbs and often lacked also the guidance of close family life and the discipline of the father. An upbringing like that of Malcolm X in such an environment quickly generated hostility to society, and the furious aggressions of adolescence found few legitimate channels of expression. . . .

From time to time cults appeared among the young, centering upon some symbol that indicated repudiation of authority—James Dean in the movies, Mickey Spillane in the pulps, or the Beatles on records—saying no to the solemn nonsense of the rulers of the world. Eccentric styles of behavior or dress flouted convention so widely in the 1960s that they themselves became conventional, and the uniform of the Beatnik was everywhere recognizable.

*The History of the United States* (textbook),
by Oscar Handlin (1968).

was discussed in the book but didn't like this or that. Many of the students had a shocked expression that a professor would be so silly as to disagree with a book he had assigned."

Professors also run into two very different types of prejudices that students bring with them to the classroom. The first—preformed political opinions—is often welcomed. "People come to my class with a rather hardened and enthusiastic position that is not particularly well-informed," says Gustafson of his course on Latin American politics. "That's an advantage of teaching the type of course I teach. For whatever reason—because they despise American policies or they despise the Sandinistas—they come motivated."

Teachers sometimes even wish for more dissension than they get. "I was a little puzzled by their attitudes initially," says Heald of the students in his Vietnam course. "What brought them to the class was that they had been hearing about the war for years and didn't really know much about it. They didn't see it as a controversial subject. With one or two exceptions, there were not strong views expressed; none at all on the pro-war side. What they showed was quiet curiosity."

*Villanova's Albert Dorley cautions that "history has parallels, but it doesn't repeat itself." Right: near Saigon, 1967.*

*Criticized for his handling of the economy and the Iran hostage crisis, President Carter is cited in Christianna Nichols' WMC political science class for his diplomacy in Latin America. Left: Carter with Brazilian President Ernesto Geisel in 1978.*

The second kind of prejudice students harbor is more dangerous: a perspective of history as a constantly improving, organized sequence of events in which the United States is always a force for good. "I think they have a very linear view, and see anything that deviates from that as being caused by drugs or hippies or weirdos or revolutionaries," says Dunn. "Their main line of thought is that things are getting better, and if they're not, it's because people don't act in the proper way.

" I see it more in the international arena: Students might be thinking, 'If people in Africa would work hard and think rationally like us, everything would be better.' "

F&M's Lou Athey adds that this attitude is not just true of history: "Our students also assume a kind of inevitability of technological progress. When you transfer that construct to social issues, there is a belief that clearly everything will be solved in time. We live in the modern age, with the assumption that this age is better than any other time."

History teachers—especially those who concentrate on the past few decades—see such complacency as one of their main targets. Their hopes for success may depend on what many report as an ambivalence among students toward social change, epitomized by current student attitudes about the 1960s. While their parents are caught up in the nostalgia of TV programs like "The Wonder Years," students are wrestling with two very different views of that decade: one, that it was a hippie-dominated era of drugs and dropping out; the other, that it was a time of great excitement and involvement, one they might have enjoyed experiencing. Often the student who passes up political activism to study hard and get into business school is the same one who rummages in her parents' basement for Dylan records and tie-dyed shirts.

Lou Athey has taught an oral history course in which he focuses on a different 10-to-15-year period each semester. When his class studied the '60s, he says, "there

## The Vietnam War: "Prolonged propaganda wears out the credit of governments"

THE UNITED STATES WAS ABLE to wage a war halfway around the globe. But officially it could not tell its own people the truth. As the war dragged on, the Saigon government became more and more dictatorial. . . .

So the statement that we were "defending democracy" in Vietnam became even more hollow. Yet American officials continued to repeat that plainly untrue statement. Prolonged propaganda eventually wears out the credit of governments with their own people. And the armed forces, too, once considered guardians of honor, fell into the habit of untruthfulness. Time and again, officials would announce that the government now controlled most of the countryside and that there was a "light at the end of the tunnel."

. . . . It was small wonder that the average soldier, the "grunt" at the bottom of the heap, became demoralized. He was fighting a war against an invisible enemy, was surrounded by what seemed to him ungrateful "natives," and was criticized by many war protesters at home. He was led by generals who often seemed interested only in image making, not in protecting him. By the thousands, therefore, soldiers in Vietnam took drugs, dodged regulations, and disobeyed their officers. The war was beginning to destroy the American army by 1968.

*Pathways to the Present:*
*A New History of the United States* (textbook),
by Bernard A. Weisberger (1976).

were students who wanted to discount the hippie experience as having been a minimal factor" in the social change the decade produced. He sees the reaction as part of an "absolute and utter rejection of critiques of existing social structures." When he assigned a class *Looking Backward, 2000-1887*, Edward Bellamy's 1888 novel describing a future socialist utopia, he says "half the class was furious at it. One paper attacked it and used language not proper to a paper." Yet at the same time, he has had students express great interest not only in the '60s but in the Civil War. "It's the intensity of involvement and conflict between the two nations, the very high level of commitment, that interests them," he says. "I think many would like to have lived then."

Particularly for instructors educated in the '60s, the interest shown by students in current history provides an opportunity to challenge, if not change, students' complacency. "As long as students, and people in general, don't explore the last 20 years, they tend to take the pronouncements of authority as fact. Rarely does a leader deliberately mislead," WPI's Dunn believes, "but if people haven't critically examined these events or cultural trends, then there's no basis for them to question what they hear. Then what do democracy and freedom of the press mean?"

Of his teaching, Dunn says, "There's some evidence that there is an impact. The way I look at it is that I have one shot at it; that's what I came here for. If I can see a visible change, a sensitivity and a willingness to entertain possibilities—that's the best I can do."

*Julia Ridgely is assistant editor of the Alumni Magazine Consortium.*

## Answers

There are no grades for this test, just some excuses: How well you did probably has less to do with how hard you studied in high school than when you were born or how you were taught history.

1. President Johnson's term for a package of social and welfare programs, including civil rights and aid to the poor and elderly. (1964)

2. Docking of American and Soviet spacecraft in the first international manned spaceflight. (1975)

3. ". . . and I think the other fellow just blinked." Comment made by Secretary of State Dean Rusk during the Cuban missile crisis. (1962)

4. Reagan administration term for programs that would save the "truly needy" from budget cuts. (1981)

5. The Southern Christian Leadership Conference, the civil rights groups founded by the Rev. Martin Luther King, Jr. (1956)

6. Congressional act to force federal budget reduction, later struck down in part by the Supreme Court. (1985)

7. Gulf where North Vietnamese torpedo boats were said to have attacked American warships. The resulting resolution by Congress granted the president whatever power necessary to "maintain peace." (1964)

8. Length of time 52 American hostages were held in the embassy in Tehran by Iranian revolutionaries demanding the return of the Shah. (1980–81)

9. Middle-of-the-road Americans whom President Nixon claimed had elected him and continued to support him. (1971)

10. California property tax referendum considered an opening volley in the tax-cutting movement. (1978)

11. American spy plane shot down over Russia. Pilot Francis Gary Powers was later exchanged for a Soviet spy. (1960)

12. Strategic Arms Limitation Talks at which President Carter and Soviet Premier Brezhnev agreed to a limit on ICBMs. The U.S. Senate refused to ratify the treaty after the Soviet Union invaded Afghanistan. (1979)

13. Professional Air Traffic Controllers Organization. The entire membership was fired when President Reagan enforced a law against unionization by federal employees. (1981)

14. Sen. Joseph McCarthy's claim in a speech at Wheeling, W.Va., that he had evidence of 57 "known Communists" in the government, the first time he had emphasized such a claim publicly. (1950)

15. The report of the President's Commission on the Assassination of President Kennedy, concluding that Lee Harvey Oswald had acted alone. (1964)

16. Border between North and South Korea. After North Korea invaded across the line, President Truman ordered in U.S. troops, the beginning of U.S. involvement in the Korean War. (1950)

17. Remark made by presidential candidate Ronald Reagan in the campaign debate with President Carter. Reagan believed his opponent had just misrepresented his views on national health insurance. (1980)

18. Arkansas high school where President Eisenhower sent federal troops to enforce integration over the objection of Gov. Orval Faubus, who had called out the state's National Guardsmen. (1957)

19. The Committee to Re-Elect the President, President Nixon's campaign organization later accused of being behind the Watergate burglary. (1972)

20. Pacific island destroyed during the first hydrogen bomb test. (1956)

Answering machines, VCRs, and processors of food and words are designed in part to save time. But how do we spend all those seconds we saved?

# HOME SLEEK HOME

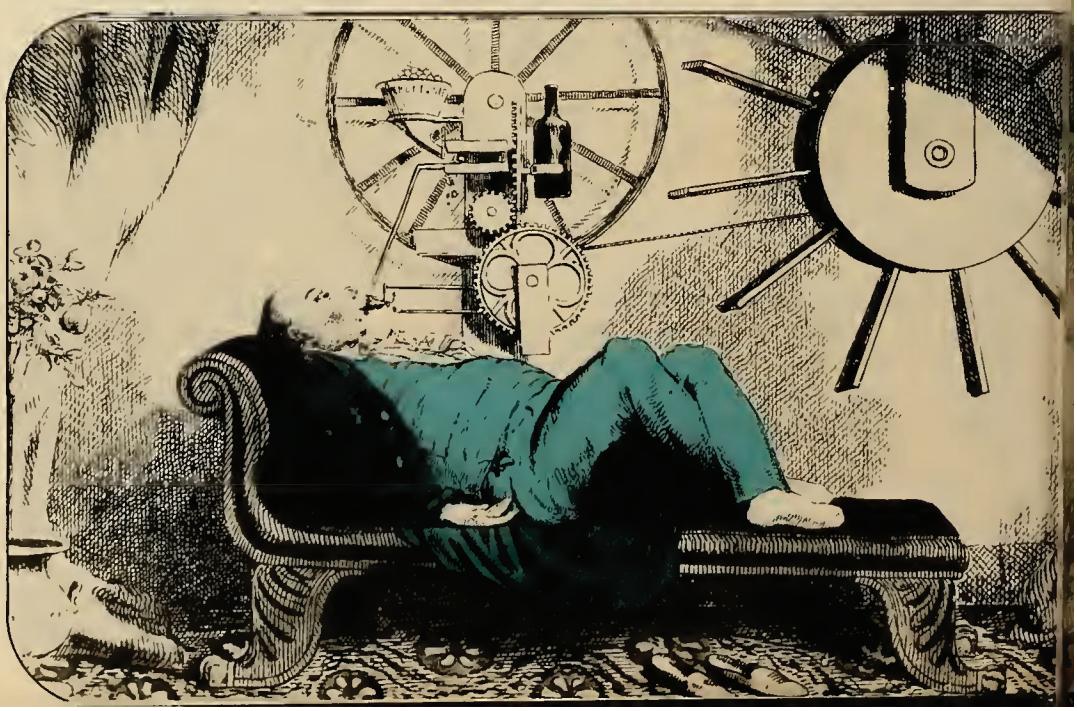
BY MARY RUTH YOE

Back in the summer of '72, when only three in a hundred American homes boasted a microwave oven, a friend extolled the marvels of his new culinary appliance. "I cook dinner in 10 minutes—a baked potato, too," he crowed, "then I sit back with my remote controls and watch my TVs."

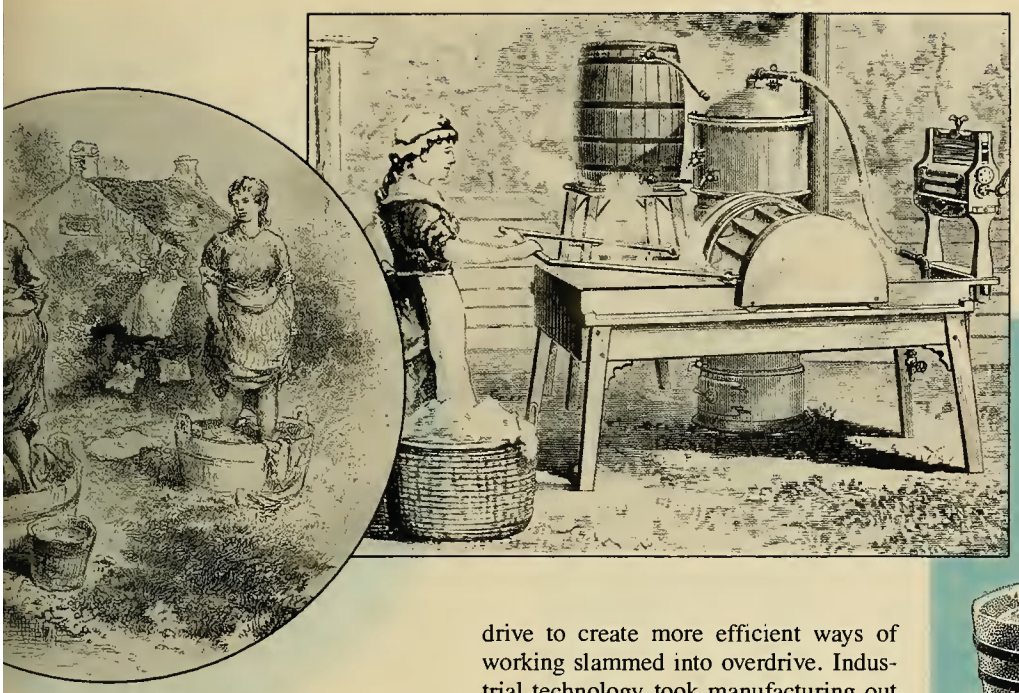
"TVs?" I asked. He had three in his living room, one for each of the major networks. During commercials, he sampled other channels: "I hate to waste my time."

The man was—just slightly—ahead of his time. Today, two in three American homes have microwaves. And televisions equipped with split-screen capabilities end what one catalog calls "the frustration of single-channel viewing." Ours is a nation dedicated to the proposition of saving both time and our own energy, at work and at home. It's only human: "To save labor in work and in the many other activities of daily living has been the supreme aim and proud achievement of modern civilization," wrote Stanford University economist Tibor Scitovsky in *The Joyless Economy*. "The saving of effort," he went on to note, "usually goes hand in hand with the saving of time."

In a certain sense, you can't save even a second. In the annual phenomenon known as daylight-saving time, an hour snatched away from the public each spring is returned, without interest, six months later. But it's more nearly day-



**The modern age is hardly the first to worship efficiency. In this 1880s scheme, the urge to expand the day, reduce work, and slip in more leisure time is taken to an extreme: The device offers relief from summer's heat by simultaneously fanning the body, cracking nuts, and serving wine.**



**The chore of laundry, originally hand-and-foot powered, was made easier by machines and then was taken out of the home altogether—for those who could afford it.**


light-withholding time. Every day, no matter what your time zone, everyone gets exactly the same number of hours to spend. Meanwhile, time marches on.

Which is why the 45 minutes you "save" by popping a potato into the microwave instead of an oven can't be added to your personal account at the First National Bank of Hours. It can't sit there, quietly earning additional minutes, or even seconds, until the happy day when you finally have the energy, but need to borrow the time, to embark on a long-planned project. In real life, the time you save doing one thing goes immediately into doing something else—or nothing else.

Timesavers have always been with us, although some have worked better than others. Start somewhere near the beginning of civilization, with roughly shaped bits of flint—the multipurpose gadgets of the Stone Age. Then fast forward thousands of years to the city of Pompeii. In its post-Vesuvius ruins, archaeologists uncovered housewares, including vegetable strainers and shallow pans for frying. Except for their handcrafted bronze construction, they would be at home in a contemporary kitchen.

Zoom ahead again, this time to the Industrial Revolution, when the human drive to create more efficient ways of working slammed into overdrive. Industrial technology took manufacturing out of the home and into the factory, separating production from "housework." (The word itself didn't appear until the 19th century.)

Suddenly the mechanics of daily living—tasks that had required essentially the same amounts of time and effort for centuries—were transformed. By the first years of the 20th century, most urban homes in the United States had tap water. Indoor plumbing was gaining ground, along with electricity and central heating. Unpredictable stoves fueled by wood or coal gave way to gas models; electric ranges would be next. Telephones, vacuum cleaners, electric irons, and rudimentary washing machines had appeared. Refrigerators were about to become less expensive and more reliable.

Inventions didn't always make common household tasks easier. According to a study published in 1917, almost all women living in households "earning enough for decency" had help with their laundry, either sending it out or bringing a laundress in. But what had been a two-woman job became relegated to one. While the advent of the automatic washing machine did take the back-breaking labor out of doing laundry, it also meant families could have more clothes, washed more often.

In an industrially driven society, each new household invention, from irons to bagel slicers, added to the already strong climate of expectation that time can—and should—be saved.

Americans bought that message, and in increasing numbers, they also purchased the items, from major appliances to minor gadgets. A few examples: In 1952, less than 4 percent of American homes had clothes dryers; by 1984, 61 percent did. In 1952, 3 percent had dishwashers; in 1984, 38 percent. During the 20 years ending in 1975, the percentage of homes with vacuum cleaners went from 59 to 97 percent. More people were buying smaller appliances—blenders, food processors, automatic coffee makers, electric can openers. The consuming continues, fueled by promises of "new, improved" variations.

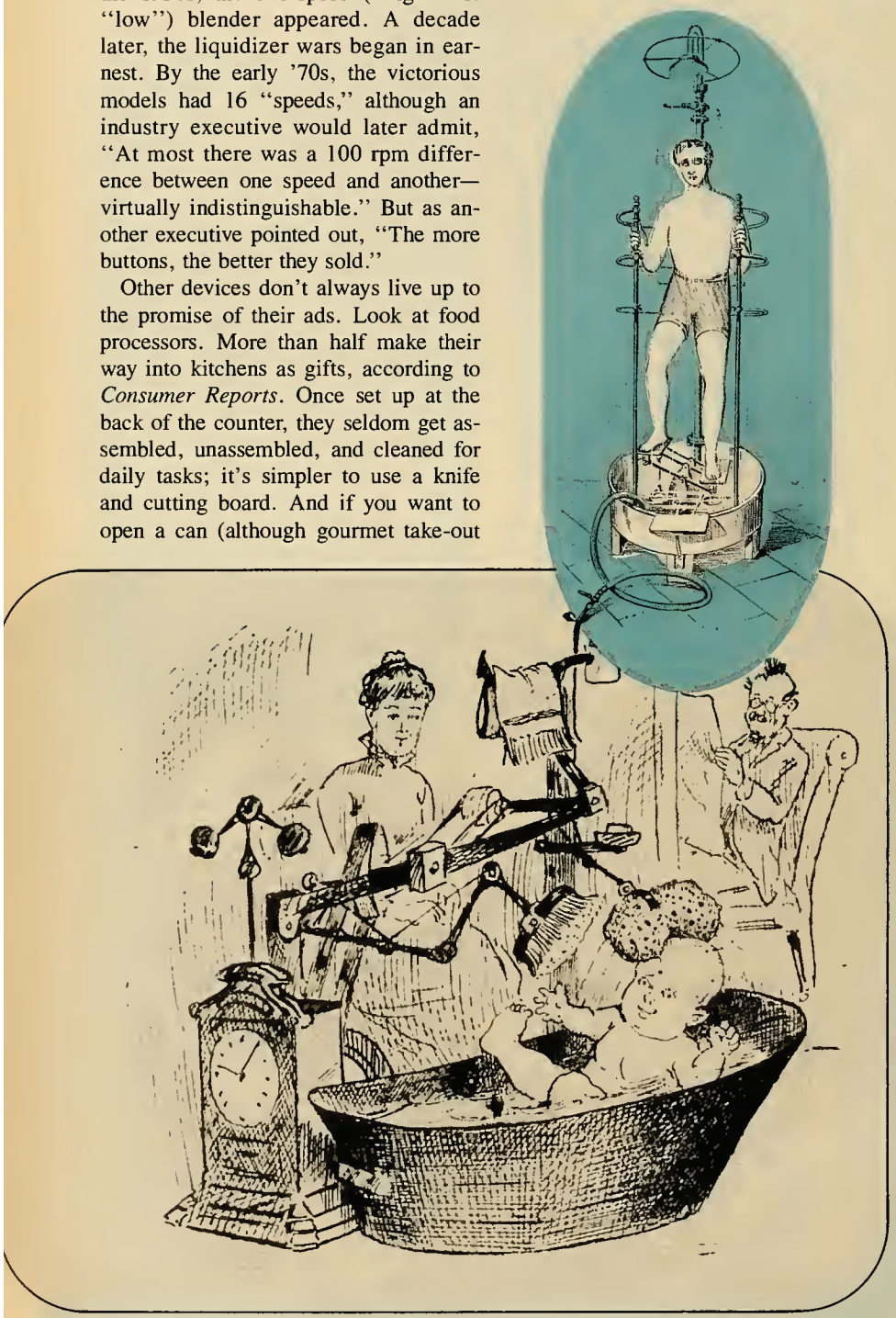
Some of the improvements are more gimmicky than genuine—shaving off the odd second here and there rather than doing away with a truly onerous task. Or they perform superfluous jobs. An electric ice-cream maker churns out a gourmet treat in minutes, but when you buy

Baskin-Robbins, you don't have to clean the machine—which, unlike your bowl and spoon, probably can't be popped in the dishwasher.

Then there's the multi-speed electric blender. When the first model reached the market in the 1920s, it had just one speed ("on" as opposed to "off"). In the 1950s, the two-speed ("high" vs. "low") blender appeared. A decade later, the liquidizer wars began in earnest. By the early '70s, the victorious models had 16 "speeds," although an industry executive would later admit, "At most there was a 100 rpm difference between one speed and another—virtually indistinguishable." But as another executive pointed out, "The more buttons, the better they sold."

Other devices don't always live up to the promise of their ads. Look at food processors. More than half make their way into kitchens as gifts, according to *Consumer Reports*. Once set up at the back of the counter, they seldom get assembled, unassembled, and cleaned for daily tasks; it's simpler to use a knife and cutting board. And if you want to open a can (although gourmet take-out and frozen/microwavable dishes are more in vogue), a manual can opener remains essentially as efficient as an electric one.

Do more machines mean less time spent on the daily work of living? A mid-1975 study showed that



**A self-powered pump shower let you exercise while bathing. But necessity may not have been the mother of invention for this baby bather.**

mothers who work outside the home have the fewest leisure hours of any segment of the population. That should come as no surprise to anyone who falls into this category. Although they may own more timesavers, today's women aren't the housekeepers their stay-at-home mothers were. The devices simply help them tend to the basics—feeding and clothing their families—while working full-time jobs.

Executives and other professionals who routinely put in 50-plus hours on the job, working schedules that rival those of pre-union sweatshops, also want to get lots of things done—and quickly—at home. To those whose large salaries are a constant reminder that time is money, timesavers become a symbol of status, a declaration that you have more money than time. Witness the class of efficiency-minded devices devoted to having fun, or otherwise doing what presumably you want to do.

Baking bread is a good example. Not too long ago, store-bought bread was viewed as a marvel ("Wonder" Bread was aptly named). Today, baking bread has become a luxury: for many people, the lengthy process is as enjoyable as the end product. But what if you have other things to do? Enter a device which, in the words of a Williams-Sonoma catalog, "not only mixes and kneads bread dough, but also lets it rise for just the right length of time—and then bakes the loaf! All you have to do is measure the ingredients into the non-stick container, put the yeast in the dispenser in the lid, and switch it on. Four hours later, you remove a fragrant loaf. . . ." (Your first homemade loaf will cost you—not including the flour and yeast—approximately $300.)

Exercise is another good example. A machine simulating the aerobic workout of cross-country skiing is geared to people who don't have the time to go "gliding across a snow-covered hillside." Instead, an hour a week is all it takes. Among the promised—if somewhat dubious—benefits: "You'll find you can work longer, with less fatigue."

For certain consumers, time is worth so much that they keep working even when they're at home, aided by a new class of gizmos, many of which wouldn't have been necessary even 20 years ago.

In 1987, when *TIME* magazine sent new subscribers a booklet on time management, it listed five devices that "might make an enormous difference to your productivity." Those five—VCR,

## Great gizmos: They're chic. They gleam. They even talk and tell time.

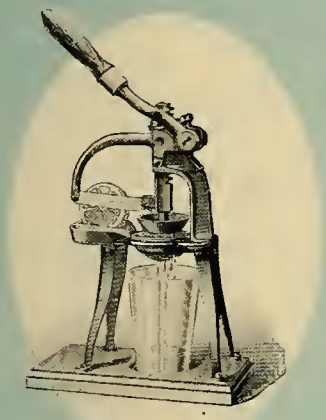
Why are some gadgets best-sellers, while others quietly expire long before their patents run out? To judge by those mail-order catalogs geared to buyers with no time for stores, auxiliary features mean as much as efficiency.

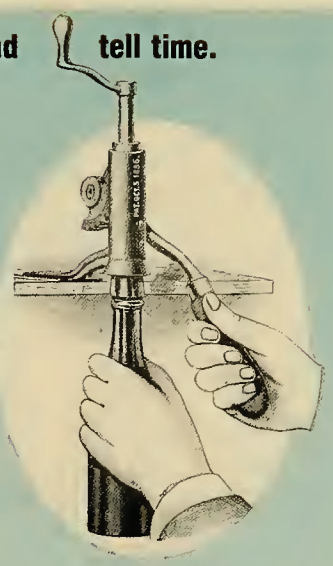
First and foremost, the perfect gadget mustn't get in the way. Appliances from radios to coffee makers to cordless mixers no longer vie for space on a crowded countertop; instead, they hang above it. If this trend of upward mobility continues, the perfect gadget will soon have to be redesigned for use far from the madding crowd, back on the countertop.

The ideal gadget has several, simultaneous uses. Some contemporary appliances make a certain sybaritic sense: a machine that makes drip coffee, espresso, and steamed milk for cappuccino comes in handy when entertaining; another coffee maker pauses after the first cup so the caffeine addict needn't wait until the whole pot is brewed. Then there's the under-the-cabinet, electric can opener lit by its own electric light—presumably to make it easier to check the contents of the can for incipient botulism.

Whatever else it does, the perfect gadget gives users the time of day—in digital readout. That feature isn't a frill, because the gadget does its task automatically, according to pre-programming or reacting to your instructions from across the room, over the phone, or via another machine. No more pressing an index finger against an electronic touch control. Rather than responding by word-prompt display, the ideal gadget speaks. A new home automation system, for example, delivers its lines in the proper tones of a British butler.

**The Ajax Lemon-Squeezer**





**The Hercules Cork-Puller**

Last but not least, there's the matter of appearances. Right now, sleek efficiency is in. The more frivolous the gadget, the more serious the look. Finishes are matte black, smooth white, or gleaming chrome. Streamlined curves are evidence that even a motorized, under-the-counter spice rack is a working machine (it even goes in both directions, the ad points out). It is, of course, the D-cell-powered heir to the Industrial Revolution (batteries not included).

personal computer, telephone answering machine, speaker phone, and speed-dialing—are all instruments of communication and information that are now increasingly creeping into the home.

Three of those five tackle telephone-related problems. Answering machines promise the "convenience" of ignoring interruptions from the outside world while satisfying your curiosity about who is calling. Speaker phones keep your hands free for working at other tasks. Speed-dialing takes touch-tone dialing one step further: by pushing a button you dial your most frequently called numbers. It makes the rotary dial a digital dinosaur.

Leisure is seen as something that can always be done faster. The *TIME* booklet bills the VCR as a three-in-one time-saver: It lets you make recordings that skip past the six minutes of commercials in every half-hour of TV, it gives you a storehouse of tapes to play when there's nothing on the tube, and it ends your having to stand in line at movie theaters (not a word, however, about those long lines at video rental stores).

The fifth item? A personal computer, and *TIME* warns it shouldn't just be used for playing games or balancing your checkbook. However, the types of tasks the computer does best—budgeting, data storage, mathematics, graphics, and writing—are usually related to work, not home.

One thing *TIME* didn't mention was a home-automation system. You can already buy low-cost remote controllers to connect to lights and appliances throughout the house. More sophisticated and expensive home-automation systems build up networks of such controllers. Sensors monitor the home, and the system responds, for example, turning on the sprinkler when the lawn's moisture level drops. While these systems are basically add-ons, next year will see the construction of Smart Houses, whose basic wiring allows for pre-programming and voice and remote control of household devices. In a sense, your home becomes a timesaving machine.

Today, "making life easier" can be translated as "making work easier." The two phrases are often, if unconsciously, synonymous. There's an irony involved. Our dedication to saving time and energy is so great that we sometimes find it hard to spend the time and energy we've saved. After all, judging by the high cost of our own labor, what we've accumulated is so valuable it seems sinful to spend it on anything except more work—or more devices to save time and energy.

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zoo

# Zoos, tunes

## A DICTIONARY OF CAMPUS SLANG

Like a tide, new words and new meanings come rolling in: dweeb, chill, power snooze. They move from campus to campus, changing subtly. Then, about the time they show up in TV commercials, they're gone, into limbo with "the bee's knees" and "feelin' groovy."

Each generation evolves its own lexicon of "slanguage." It's hard for a student, let alone for a parent or an alumni magazine, to keep up with the way students speak. Yet we've tried, with the kind help of students from Franklin and Marshall College, Johns Hopkins University, Villanova University, Western Maryland College, Western Reserve College, and Worcester Polytechnic Institute. These words are theirs.

As you read, notice how student slang reflects the particular world it comes from. The Eskimos have dozens of words for snow; college students have multiple ways to talk about courses, drinking, partying, sex, doing well or badly, and social status. Some of these words are new while others are familiar, but all listed here are current. They are a way to talk about things students need to talk about. And often what they talk about doesn't reflect activity so much as anxiety.

—EH

air mail

**Abuse!** (exclamatory): The appropriate response when someone rags or harshes you.

**-age** (added to the end of any noun for comic effect): tunage (music), crammage (studying for a test), spillage (in a bar, usually beer), theftage (taking a five-finger discount).

**airhead** (n.): One who is dumb, ditzy, dorky, a bimbo, a dingbat. Most often used of females.

**air mail,** to get (vb. phrase): To have no mail in the mailbox, only air.

**all-nighter,** to pull an (vb. phrase): To stay up all night studying or writing a paper. The traditional way, especially for freshmen: "I pulled three all-nighters this week."

**awes** (adj., rhymes with hoss): Wonderful, terrific. Condensed from awesome, a passé word now used mostly as a joke.

**beat** (adj.): Bad, boring. Of a party, no one was there. Of a course, extremely hard.

**beauteous** (adj.): Generically good, used of an event, a scope, a time.

**big-time** (adj.): Important, impressive, on a grand scale. "I did big-time scoping." Or, "Was it a rough test?" "Big-time." See also: **major,** in a big way.

**blizzard,** to get a (vb. phrase): At Worcester Polytechnic Institute, to fail, derived from the fact that failing grades are not recorded. Therefore, if you fail all courses, your grade sheet will be blank, white as snow.

**blow off** (vb., transitive): To cut or bag a class, to reject a person, or to take things easy. "I blew off my eight o'clock" or "She blew me off." Noun and adjective forms also exist: A blow-off course is an easy ace. A blow-off is one who cuts classes all the time and generally makes no effort.

# nd gweeps

Words collected and defined by Elise Hancock
Illustrations by Shaul Tsemach

## all-nighter

**box** (n.): A source of tunes, a radio/tape player. Formerly, boom box.

**brain-dead** (adj.): Tired, worn-out, beat. Also, brain-damaged, out of it, burned, burned out, wiped, zonked, zoned, zoned out.

**cake** (n.): A blow-off course, an easy ace. The word has been around a while.

**chill** (vb.): To calm down, chill out, relax, cool down. Usually said as a command to one who is overwrought: "Chill!" Similarly, "Take a pill!" "Take a chill pill!" "Cool your jets!" "Bring it down a thousand!"

**clue** (n.): A sense of what's going on, both socially and academically. "Get a clue!"—said to someone who has just done something incredibly stupid.

**clueless** (adj.): Pathetic, inept, gripless.

**cold** (adj.): Harsh, nasty, unpleasant, below-the-belt. "That was cold"—what you might say if someone ragging on you gets out of control.

**Cool beans!** (exclamatory): Good, terrific, always used as a response.

**crank** (vb.): To study, to do well, to work like a well-oiled machine. "She cranked on that test." Sometimes with "out": "I've got to crank out some major work."

**crash and burn** (vb.): To do badly.

**CUP** (n.): A member of the Convention of Ugly People.

**diseased** (adj.): Socially untouchable, absolutely not fitting in with the crowd.

**ditz** (n.): A dumb girl. Also, bimbo.

**do** (vb.): An all-purpose verb; one can "do" almost anything—do books, do dinner, do Vivarin.

**do okay** (vb.): To do well. It is considered improper to brag outside one's intimate circle. So if some acquaintance asks how you did on a test and you aced it, you say, "I did okay."

**do shots** (vb.): To toss down hard liquor by the shot glass. As a ritual, to celebrate getting legal.

**double-geek** (n.): A double-E (electrical engineering) major.

**Dr. Staff** (proper n.): A Renaissance marvel, obviously the most energetic professor on campus, Staff is listed by the catalog as teaching dozens of courses each year. At Villanova, who you say will teach a course if you don't know.

**dump** (vb.): To reject, stone, shoot down, or give the boot to someone with whom you've been going out. Stage one of dumping is signaled by the statement, "We're still going out, but we decided we should see other people."

**dweeb** (n.): A socially unacceptable weirdo, super-clueless, lower than a geek, a person who has *no* redeeming social value.

**factor** (n.): Used in a turn of phrase that adds emphasis, usually of something disgusting: "The grease factor is definitely there." To have a boot factor of 10 would mean you have an overwhelming need to throw up.

**fresh** (adj.): Good-looking, used of a woman.

**freshman 15:** The 15 pounds that almost any first-year student gains. On some campuses, the freshman 10.

**fried** (adj.): Crushed, totaled, wiped out, obliterated. A common condition after swilling or taking a test: your brain got fried.

**friend** (n.): Said in a certain tone of voice, replaces "boyfriend" or "girlfriend." One can also sardonically say, "mah *wo*man," "mah bimbo," "mah man," "mah chick." "Main squeeze" and "significant other" enjoyed a brief vogue and are still heard. Actually, there is no satisfactory way to refer to one's significant other. Most usual is to use the person's name. If anyone asks, you say, "We're going out."

**geek** (n.): A lamo, a person who is socially unacceptable in an earnest, perspiring sort of way. Often an engineering or science major, possessing a watch that beeps. One who overdoes: video geek, EE geek, computer geek. Derives


from carnival slang for a person who bites the head off live chickens. To geek out is to study.

**Get a grip!** (exclamatory): Get a clue! Pay attention!

**girl** (n.): Sometimes an acceptable term for a college-age female; sometimes a dire insult. "Woman" is always acceptable.

**god/goddess** (n.): One who is extremely attractive. With modifiers: an expert on the subject, one who breaks the bell-shaped curve: chem god, sex god, study

# Between the lines of the catalog

**Air 'n' Sunshine:** Arts and Sciences, the liberal arts. Also, Arts 'n' Crafts.

**Baby Bio:** Biology for those who aren't pre-meds.

**Big Chem:** A serious chemistry course (as opposed to Baby Chem), normally taken by pre-meds and majors.

**Bill on Film:** Shakespeare in the Movies (Villanova).

**Bowling for Diplomas:** A bowling course taken to fulfill the gym requirement (Worcester Polytechnic Institute).

**CMPS** (pronounced Chomps): Computer Science (Western Reserve College).

**DiffEQ:** Differential Equations, pronounced Diff-E-Q.

**Football Physics:** An easy physics course—*very* easy.

**Grunge Lab:** An engineering lab that teaches materials selection and sand-casting, welding, machine shop, and other activities that make you filthy and grungy (WPI).

**Kiddy Chem:** A chemistry course long on concepts, short on math. Intended for non-majors.

**Kiddy Lit:** Children's Literature.

**Orgasmic:** Organic chemistry. On some campuses, Orgo, O-chem.

**Rocks for Jocks:** Geology, generally conceded to be the most passable science for persons with, um, no mathematical bent.

**Sadistics:** Statistics.

**Underwater Basket Weaving:** Any course with a guaranteed A.

**Volts for Dolts:** Electrical engineering for dummies.

god. "If the professor doesn't know, the chem god will."

**going out** (vb. phrase): Definitely a couple, not seeing other people, yet not committed.

**golden** (adj.): Supreme, classic, used of a glorious, definitive moment: "It was golden. I was hysterical."

**goober** (n.): A loser, a geek.

**Good call!** (exclamatory): Good thinking! You're right! Derives from sports.

**graffiti party** (n.): A party to which everyone wears a white T-shirt and carries a felt-tip pen, the better to inscribe you with.

**grip** (n.): A hold, a clue, some inkling of what's going on. When a person is out of control, you say, "Get a grip!"

**guido** (n.): A guy with open collar, lots of chest hair, gold chains glinting, strong grease factor. Often found in a bar.

**guy** (n.): A male of college age, a young man. In the plural, used of groups and can include females.

**gweep** (n.): A computer geek, a concave-chested person, almost always male, whose computer is his closest friend. Pronounced with a hard G, the word derives from the sound made when finger hits keyboard. To gweep out is to spend a lot of time at the computer. The word is possibly unique to Worcester Polytechnic Institute.

**hating it, hating life** (vb. phrase): Said with a certain emphatic drawl (HAAAAT-ing it), expresses the state of mind of one who has 13 weeks of work to learn in one night.


fried

gweep

**hang,** or (more rarely) **hang out** (vb.): To exist, not doing anything in particular, to be with your friends: "We're just hangin'." Sometimes, to have a hangover. Synonyms: veg or veg out.

**Happens!** (exclamatory): A response, said with a certain twist in the voice, meaning: Oh well, it's to be expected.

**harsh** (adj.): Very bad, tough, or hard; worse than beat. A harsh booze would be, for example, tequila.

**Hey!** (exclamatory): An all-purpose greeting, said without so much as breaking stride. No answer is required. Similarly, "What's up!" "Yo!" "How ya doin'?" "Hey, dude!" The response, if any and also without breaking stride, would be: "Still alive!" "Surviving!" or "Stressing!"

**history** (n.): Past, gone, out of the picture, often used of people. After breaking up, one might say, "He/she's history."

**hit on** (vb.): To approach a member of the opposite sex, to attempt a pick-up.

**home** (n.): Where you live, in a dorm room or apartment.

**home-home** (n.): Where you come from, a place you visit that parents and siblings may think is your home.

**hook** or **hook up** (vb.): To connect with something desirable, usually booze or a member of the opposite sex. One might say to the bartender, "Hook me up with some suds." Used as a noun, hook-up implies sex.

**hot** (adj.): Very good-looking, used of either sex. A hot mug is an attractive face.

**in a big way** (an all-purpose intensifying phrase): Very much whatever it is: sweet in a big way, spillage in a big way.

**intense** (adj.): The utmost of whatever-it-isness, whether good or bad. An intense concert blew you away. An intense course is extremely hard.

**jam** (vb.): To go smoothly, dancingly, jazzily: "I was jamming on that exam." Sometimes used as a synonym for tunes, music.

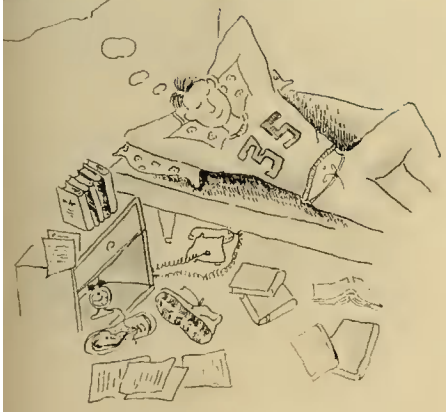
**Just say no** (slogan): Offered as mock advice in any situation where people are about to do something they know they should not.

**lame** (adj.): Not up to expectation, boring, weak, lacking in substance: a lame class, excuse, professor, or party. The variant noun "lamo" would be used only of a person, or as an exclamation.

**leech** (n.): One who can't hear no, won't leave you alone, attempts to hit on you despite your icy stares.

**legal** (adj.): To be of drinking age, 21. To "get legal" is to turn 21.

## home



**library,** at the (adv. phrase): Where you say your roommate is when his or her parents call. Similarly, "at church."

**license to swill** (n.): An ID card that alleges its carrier is over age 21.

**lose it** (vb.): To be gripless, lose control.

**major** (adj.): Very important, big-time, on a grand scale: a major party, a major geek. Or, "I have to crank out some major work." Conversely, minor equals unimportant.

**mall chick** (n.): A certain type of high-school girl most often seen at a shopping center, wearing tight pants, plastic jewelry, artificial-looking hair, eyelashes out to there. Also, mall bunny.

**married** (adj.): Committed, going together, inseparably coupled, though not literally married. People call such a couple "Mr. and Mrs."

**mode,** in the —— (adv. phrase): Designates how you're occupied. Examples: in the study mode, in the party mode, in the sleep mode.

**my brain hurts:** A statement of fact, for whatever reason:. You had a test; you have a hangover. Derived from Monty Python's Professor Gumby.

**N.A.C.** (exclamatory): Not a Clue! The proper comment when someone is droning on.

**nasty** (adj.): Ugly, gross, wrong, foul, below-the-belt.

**No doubt!** (exclamatory): Said with emphasis on both words, a response of enthusiastic agreement. "That's really true!" "I couldn't agree more!" "Totally!"

**nuke** (vb.): To destroy utterly ("I nuked that test") or to put in the microwave.

**orgasmic** (adj.): Intense, wonderful, climactic. Often used of concerts or chocolate.

**over-rated list,** the (n.): The people you don't like head this list. They have won the over-rated tournament.

**packed** (adj.): Well-built, used of a man.

**P.C.** (adj.): Politically correct. At one campus, that could mean vegetarian, anti-Contra, feminist, pre-Peace Corps.

**P.D.A.** (n.): Public Display of Affection. The proper response is, "Get a room!"

**photon box** (n.): An empty mail box; only light is in it. Similarly, air mail.

**pound** (vb.) **beer:** To lift 16-ounce arm curls, to drink beer in the chugging mode.

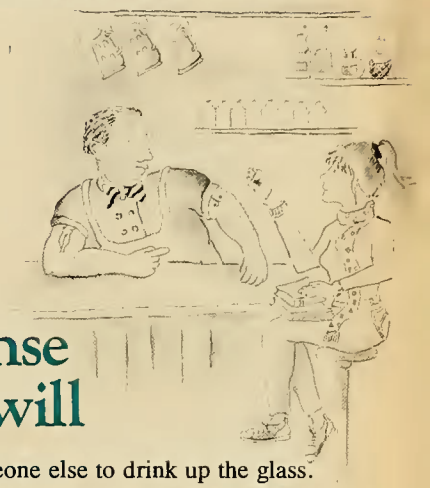
**power snooze** or **nap** (n.): 15 seconds to 15 minutes of reviving slumber, as in the middle of an all-nighter.

**pre-wealth** (adj.): Pre-law, pre-med, pre-other lucrative profession.

**primal scream** (n.): Heartfelt scream emitted during exam week as a form of study break. On some campuses, a group activity for specific times or places, usually midnight. At other schools, may be indulged as each individual feels the need.

**psyched** (adj.): Worked up, elated, excited, very happy. Often used of readiness for athletic performance.

**Quarters** (proper n.): A drinking game in which players bounce quarters off the table into a shot glass. Rules vary. Sometimes if you're successful, you may



## license to swill

pick someone else to drink up the glass. Other times, if you fail, which is easy, you have to drink.

**radical** (adj.): Enviable, wonderful, both terrific *and* novel, roughly equivalent to the antique expression "far-out." More common on some campuses: rad.

**rag on** (transitive vb.): To tease, rip, or cut someone down.

**RAM overload** (n.): To forget something. From computerese, overload of the Random Access Memory.

**rank** (adj.): Disgusting, stomach-turning.

**real food** (n. phrase): Restaurant food, home-home food—any food that is not from a cafeteria.

**rents** (n., plural): Parents.

**run,** to make a ——— (vb. phrase): To run an errand: to make a pizza run, beer run, doughnut run.

**SAGA** (proper n.): A food service corporation that supplies many college cafeterias. At some campuses, said to stand for Soviet Attempt to Gag America.

**scary** (adj.): Extremely ugly, weird, or otherwise undesirable, to such a degree it is outside nature. Weird people have a high scare bear factor.

**scoff** (vb.): To bum, or to steal in a benign sort of way, as from the dining hall or from someone who really might not mind, for instance, a banana from one's roommate.


## make a run

**scope** (vb.): To check out the scene, looking for someone hot. Once the person is found, he or she might be called a scope. At Worcester Polytechnic Institute, scope is the first of the four S's, which proceed to scam (finding the hot one), scoop (making the hook-up), and scromp (the ensuing activities).

**see** (vb., transitive): Comparable to the archaic term "to date," meaning to see someone, to go out with someone. Example: "They're seeing each other," said of a couple who've been out more than once, but the relationship is casual. One might be seeing several people.

**See ya!** (exclamatory): What you say in parting. Also: "Bye," "Peace," "Be good," "Let's blow," "Catch you later," "I'll get back" (black slang), "I'm outta here," "I gotta boogie," "I'm history," or "Later, dude!"

**skank** (n.): Someone with an unattractive personality. Also, dirtball, scumbag, slime, sleeze, scab, or dink.

**slam** (vb.): Brutally to reject, to shoot down, to spike or ace another human being.

**slime** (n.): One who is lowlife; a mattress-back, a slimeball, a sleazebag, a trollop, a slam piece, a gross and cheesy person. A very young piece of slime might be called a sleaze puppy.

**So I shot 'im!** (exclamatory): A phrase designed to draw attention, used when you're telling a long story and no one is listening. Similarly, "So *he* was dead."

**stick it in the queue** (exclamatory): Add something to a pile, as putting your coat on a mound of coats; from computerese.

**stressing** (adj.): To be under stress, schizzing, losing it; a common condition during exams.

**stud muffin** (n.): A very good-looking guy. Also, stud cake. Adj.: studly. As a joke, a good-looking woman might be called a stud-ette.

**super-senior** (n.): Someone who failed to graduate and is still hanging around, pathetically taking a few last courses. Also, to be on the five-year plan, the six-year plan, the seven-year plan.

**sweet** (adj.): Sexually attractive, hot, fresh. Used only of females.

**swill** (vb.): To consume, to drink an alcoholic beverage. Also to pound, slam, chug, hammer, tip back, catch a load, catch a buzz, or hook up with a buzz. A swilldog is a lush.

**tacky tourist party** (n.): A party at which one wears a lame shirt and carries a huge camera, guidebooks, etc.

**team Xerox** (vb.): To copy a set of homework problems, usually from the year before, for a group.

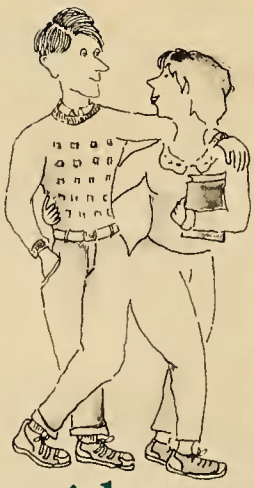
**ticket meal** (n.): In the dining hall, a meal that requires a special ticket because it is supposed to be especially good, but which turns out to be only mystery meat, or maybe Pucks 'n' Crayfish (turf 'n' surf).

**tight with** (adj.): Intimate with, close to, either to a friend or to a lover. On some campuses, a very connected couple is "tight at the hip" or "joined at the hip."

**toasted** (adj.): Buzzed, somewhat drunk.

**tool** (vb.): To do well, to crank.

**tool** (n.): An insentient thing masquerading in human form, a jerk, a fool.



## tight with

**total** (adj.): Very, really, utterly; an all-purpose intensifier.

**Totally!** (exclamatory): "I agree!" "Even more so than what you said!" Example: "Wow, that was a really good tune!" "Totally!"

**trashed** (adj.): Extremely drunk. Also, loaded, wasted, hammered, wrecked, bombed, slammed, outta hand, gone.

**tunes** (n., pl.): Music of any sort, or the source of music. As in, "Put some tunes on" (put on a record) or "Grab some tunes" (bring the radio). The tune master controls the tunes.

**twit** (n.): An airhead of either sex, a dork.

**veg** (vb.): To do nothing, think nothing, just hang; vegetate. Veg out is used less frequently.

**Vivarin** (proper n.): Caffeine pills, now preferred to the classic No-Doz.

**wanked out** (adj.): Exhausted, very tired.

**wastoid** (n.): A drunken burnout.

**way** (adv.): Very, as in way funny, way harsh. Similarly (said with emphasis), *too* cool, *too* funny.

**whipped** (adj.): Of a guy, "married," never seen without his woman. Implication is that she nags him and runs his life.

**wired** (adj.): On your fifth wind—excited, nervous, overwrought, stretched, and exultant. Too much Vivarin would do it.

**wonk** (n.): A computer geek.

**Yo!** (exclamatory): A greeting.

**za** (n.): Pizza.

**zel** (n.): Pretzels.

**zog** (vb.): To drink beer in the chugging mode.

**zoning** (vb., present participle): Same as antique expression "spaced out": to be a human vegetable, to hang, to major in couch potato.

**zoo** (n.): Registration or any other confused, crowded situation.

*Elise Hancock met with some 80 students in gathering "slanguage" for this article. Former editor of the* Johns Hopkins Magazine, *she is now university editor at Hopkins.*

# 74 to 1

## With the Odds Against Them, WPI's First Women Undergraduates Paved the Way for Those Who Followed

*Sixteen years ago, a lone woman, Lesley Small Zorabedian, walked across the stage in Harrington Auditorium and into WPI history, becoming the first woman to receive an undergraduate degree from the college. The following year, a small group of women made that same walk, earning their B.S. degrees with the rest of the Class of 1973. The frustrations and successes of those pioneering women changed WPI forever.*

By EVELYN HERWITZ

There were no big anti-war rallies, no major civil rights demonstrations, no sit-ins or classroom take-overs. But at WPI in 1968, a social revolution of a different sort was just beginning—a change in century-old traditions that would alter the face of campus life.

It was a time when WPI's students were required to attend R.O.T.C. classes Saturday mornings, when weekend parietal hours had just been established, when the campus was headed by a three-star general. And it was a time for evaluating the way things had been done since the Institute's founding in 1865.

The curriculum and grading systems weren't the only topics scrutinized during that introspective period; there was the more sensitive question of who should attend WPI in the first place.

For more than 100 years, undergraduate enrollment had been limited to men, a situation that suited some faculty and students just fine. Two women had earned master's degrees at WPI—the first in 1957—and two more would earn graduate degrees before the 1960s were over. But the voices of those who felt women also had a right to an undergraduate education in the engineering and science disciplines were becoming more insistent. In 1968, they prevailed.

At a Board of Trustees meeting on February 10 of that year, the decision was made to admit women undergraduates to WPI. The news hit campus on Valentine's Day in the form of a brief page-one article in *The Tech News*. Headlined "Board Approves Plan for Coeds," the article quoted President Harry Storke:

" 'We have been receiving an increasing number of serious inquiries from scholastically qualified young women who could benefit from the quality of education Worcester Tech provides . . . With a much higher percentage of women preparing for courses in engineering or science, it was inevitable that this college would open its doors to the ladies . . .

" 'Worcester Tech's founder, John Boynton, recognized that the school would have women students someday when the trustees felt the time was appropriate. That time is now.' "

While President Storke put the best public face on the decision, the Board's approval had not been achieved without some serious debate and internal protest. Dean of Undergraduate Studies William Grogan recalls some of the arguments he heard as a young, active faculty member who in the late 1960s chaired the curriculum committee.

"It had been talked about for a long time," he says. "Some senior faculty members felt that engineering was not an appropriate field for women—that it was OK for women to study math or physics, but that engineering was a man's world.

"But most of the discussion centered on costs and how to handle the change. There were endless discussions about housing and use of the gym, locker rooms and pool."

Though not privy to the executive board discussions that led to the final decision to accept women, Grogan attributes the move to two major factors:

"First, it was a time for new and liberal thinking. We were really questioning everything we were doing. It was a natural extension of that process to ques-

tion the attitudes of the college toward women students.

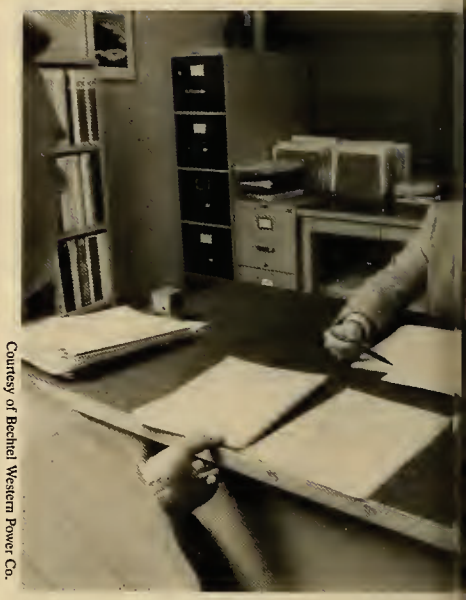
"There was also thought about long-range economics—engineering school applications were not strong anywhere nationally, part of a general reaction against technology. Those trends certainly encouraged whatever other thinking supported opening the college to women."

The decision to admit undergraduate women came too late in the academic year to make possible an aggressive recruitment effort for the fall. As a result, only two women entered WPI as freshmen in September: Lesley Small, a graduate of David Prouty High School in Spencer, Mass., and Jayne Rossetti, of Hopedale (Mass.) Junior/Senior High School. Both were class valedictorians.

Their names, faces and accomplishments were known to WPI men well before their arrival. A picture of the two women appeared on the front page of the May 8 edition of *The Tech News*. The previous week, the student paper had introduced their names and achievements, adding, "The girls stated that they are a little scared and nervous about entering a school which was previously all-male. But Miss Small did state that she has been in all-male classes in high school so that it's really nothing new."

But the reality of being one of only two women undergrads turned out to be a whole new experience for Lesley "Lee" Small Zorabedian ('72 MA), who now has four children and lives in Reading, Mass.

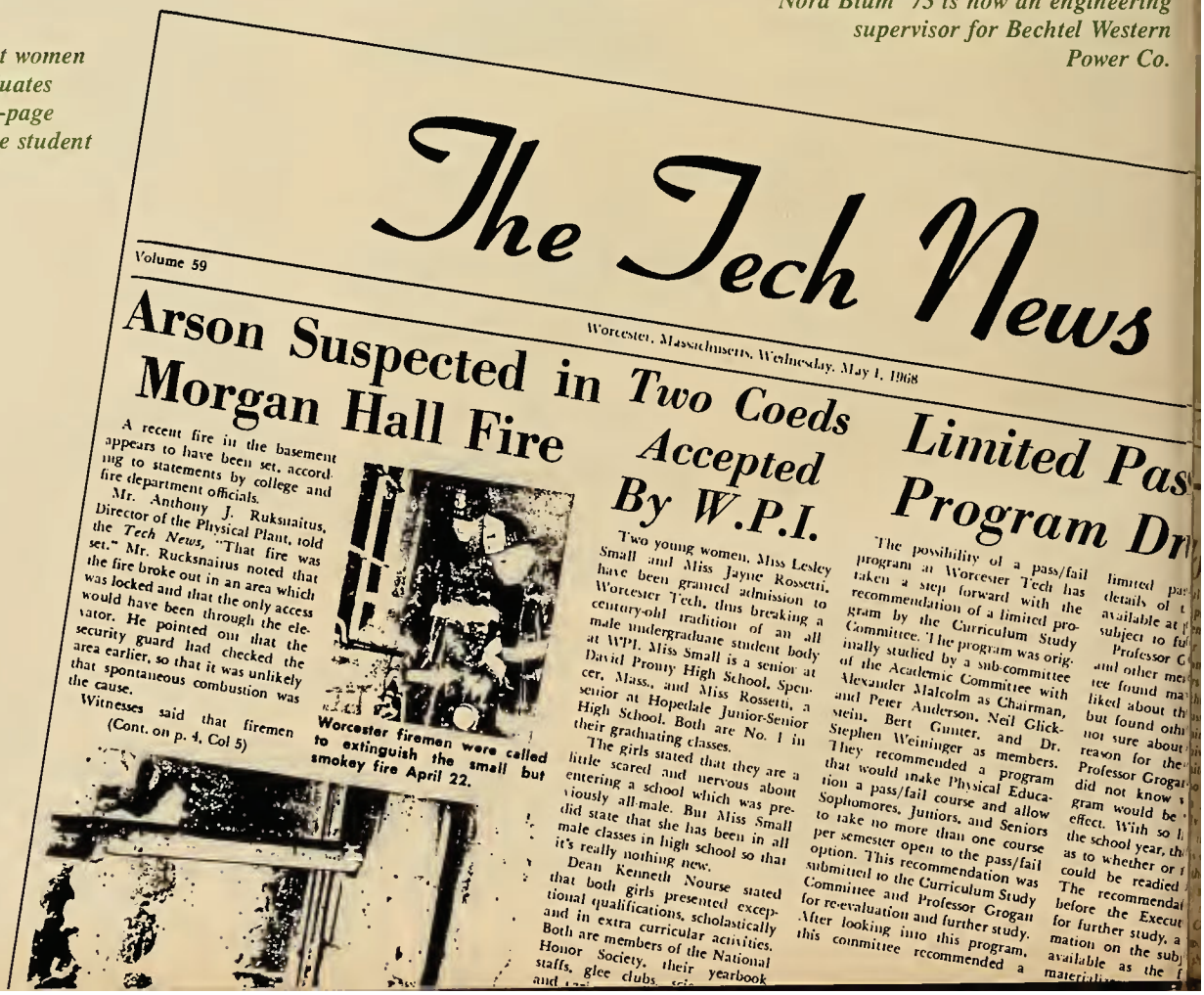
Since there were no residence halls



Courtesy of Bechtel Western Power Co.

*Nora Blum '73 is now an engineering supervisor for Bechtel Western Power Co.*

*WPI's first women undergraduates were front-page news in the student paper.*



The Tech News

Volume 59

Worcester, Massachusetts, Wednesday, May 1, 1968

Arson Suspected in Morgan Hall Fire

A recent fire in the basement appears to have been set, according to statements by college and fire department officials.

Mr. Anthony J. Ruksnaitus, Director of the Physical Plant, told the *Tech News*, "That fire was set." Mr. Rucksnaitus noted that the fire broke out in an area which was locked and that the only access would have been through the elevator. He pointed out that the security guard had checked the area earlier, so that it was unlikely that spontaneous combustion was the cause.

Witnesses said that firemen

(Cont. on p. 4, Col 5)

Worcester firemen were called to extinguish the small but smokey fire April 22.

Two Coeds Accepted By W.P.I.

Two young women, Miss Lesley Small and Miss Jayne Rossetti, have been granted admission to Worcester Tech, thus breaking a century-old tradition of an all male undergraduate student body at WPI. Miss Small is a senior at David Prouty High School, Spencer, Mass., and Miss Rossetti, a senior at Hopedale Junior-Senior High School. Both are No. 1 in their graduating classes.

The girls stated that they are a little scared and nervous about entering a school which was previously all-male. But Miss Small did state that she has been in all male classes in high school so that it's really nothing new.

Dean Kenneth Nourse stated that both girls presented exceptional qualifications, scholastically and in extra curricular activities. Both are members of the National Honor Society, their yearbook staffs, glee clubs, sci...

Limited Pass... Program Dr...

The possibility of a pass/fail program at Worcester Tech has taken a step forward with the recommendation of a limited program by the Curriculum Study Committee. The program was originally studied by a sub-committee of the Academic Committee with Alexander Malcolm as Chairman, and Peter Anderson, Neil Glickstein, Bert Gunter, and Dr. Stephen Weininger as members. They recommended a program that would make Physical Education a pass/fail course and allow Sophomores, Juniors, and Seniors to take no more than one course per semester open to the pass/fail option. This recommendation was submitted to the Curriculum Study Committee and Professor Grogan for re-evaluation and further study. After looking into this program, this committee recommended a limited pas... details of t... available at ... subject to fu... Professor G... and other me... tee found ma... liked about th... but found oth... not sure about ... reason for the ... Professor Grogan ... did not know ... gram would be ... effect. With so l... the school year, th... as to whether or ... could be readied ... The recommenda... before the Execut... for further study, a ... mation on the subj... available as the ...

"I didn't want special treatment. I just wanted to be treated as one of the students."

equipped to handle the two newcomers, both women lived off-campus and commuted their freshman year. "I felt very lonely," says Zorabedian of that first year. "I went to class and came home. I really didn't have a place to go. The library was my home base."

"On a day-to-day basis, I was in sections of 20 or 25 men, and that wasn't so bad. But I was shy, and I didn't want special treatment. I just wanted to be treated as one of the students."

That shyness kept Zorabedian from venturing onto the quadrangle by the men's dorms well into her second semester. "I didn't want to be seen."

By her sophomore year, however, she had begun to join in campus activities. At a dorm committee meeting the previous spring concerning the needs of incoming freshman women, she met classmate Jack Zorabedian, whom she later married.

And then there were the 24 women who came to WPI in the fall of 1969. With their arrival, the ratio of men to women teetered at a lopsided 74 to 1. But for Zorabedian, who was now able to live on-campus, even small numbers were a welcome change: "It sure was nice to have female company," she says.

Housing accommodations consisted of half the first floor in Sanford-Riley Hall. Triples and a few doubles, plus a resident advisor's suite, were set off from the rest of the dorm by a pair of fire doors at either end of the hallway.

With the women came many changes to the formerly all-male environment: urinals were changed into planters, shower curtains added privacy to gang showers, full-length mirrors and curtains graced dorm walls and windows.

And there were changes in residence hall rules as well. For example, restricted visiting hours for women in male dorms soon went by the boards.

But the most profound changes—those that affected the basic social structure of the campus and classroom—took longer and were much more difficult to achieve.

Janet Woodcock

*One of just two women accepted in 1968, Lesley Small Zorabedian '72 felt conspicuous on campus; the situation improved the following fall when WPI admitted 24 more women.*

"They finally discovered we were not walking computers, but real people."

Janet Woodcock

*Mary Zoeller Murray '73 recently joined Phoenix Technologies, Ltd., as director of marketing programs.*

"That first term was crazy," remembers Janet Merrill Mambrino ('73 MA), who now runs a computer consulting firm with her husband in Old Saybrook, Conn. "I remember people taking pictures of us as we walked across campus because we were such an oddity," she says.

"The guys felt we must be eggheads—slide rule on the belt and all that. Women weren't supposed to be into science, so they figured we must have been either very brilliant or very strange."

"The majority of boys did not like us girls—we were invading their turf," agrees classmate Deborah (LaPlante) Goodwin ('73 MA), a math tutor in Greenville, S.C. "We would go into the cafeteria en masse and no one would sit by us. Then we tried to sit individually, and still no one would sit by us."

Those memories are shared by mathematics Professor John van Alstyne, then dean of academic advising and still friend to many of WPI's first women graduates. "When the women first came in, they had a terrible time," says van Alstyne. "The men resented them based on fear. The women were very bright, and they had to be highly motivated to withstand the guff they took.

"They were more conscientious regarding assignments, so the men had to work harder to keep up, and they didn't like to look stupid in front of the women.

"In addition, most of the male students came from families where women stayed home while the men earned a living. These women were stepping out of traditional cultural roles, and the men didn't understand. The women were on center stage from day one."

That uninvited notoriety proved to be a personal challenge for each of the new freshmen, complicating the normal stresses of a first year at college.

"You got a lot of attention—sometimes it was good and sometimes negative," recalls Nora A. Blum ('73 CE), now an engineering supervisor with Bechtel Western Power Co. in Norwalk,

Calif. "It could make you feel important or be overbearing. Sometimes you had the feeling that everyone was watching; it made you wonder if you were some kind of freak."

In addition to contending with male students' fears and prejudices, the women also had to confront the occasional male professor who would make life that much more difficult.

"I remember walking into my chemistry class the first day," says Janet Merrill Mambrino. "The teacher said he didn't feel women belonged in an engineering school, and if I wanted more than an F, I'd have to really prove myself."

Fortunately, such instances were the exception rather than the rule. And by mid-year, tensions with the male students were easing as well.

"The turning point for me came at the end of our first semester," says Mary Zoeller Murray ('73 CH), who recently moved back East from California to take a position in technical marketing with Phoenix Technologies, Ltd., in Norwood, Mass.

"A group of gentlemen at the other end of the hall gave a Christmas party for us. It was a very nice gesture. I felt like we had comrades—friends."

Gradually, as, in Deborah Goodwin's words, "they finally discovered we were not walking computers, but real people," the WPI men began asking their new acquaintances out on dates. That, too, was a major departure from campus tradition, which favored women from Becker Junior College and local nursing schools.

But dating also singled out the women in yet another way. "By their sophomore year, the women were being asked out by seniors," says van Alstyne. "But whenever a senior would ask one of the women for a date, everyone else on campus would know about it, because there were so few of them. So it was like the men had staked out a claim, and others would be afraid to ask them out."

Nonetheless, some couples inevitably formed, and several of the women, including Lee Small, Deborah LaPlante and Elizabeth C. Poulin, eventually married WPI men—John Zorabedian Jr. ('72 CM), Stephen Goodwin ('73 EE) and Frank Steiner ('71 ME) respectively.

As more women were admitted to the college, the novelty of coeducation began to wear off, and campus life settled into new social patterns. Those in the Class of '73 continued to distinguish themselves academically, and a few started to venture away from the hard sciences they had favored since high school and into the male bastion of engineering disciplines.

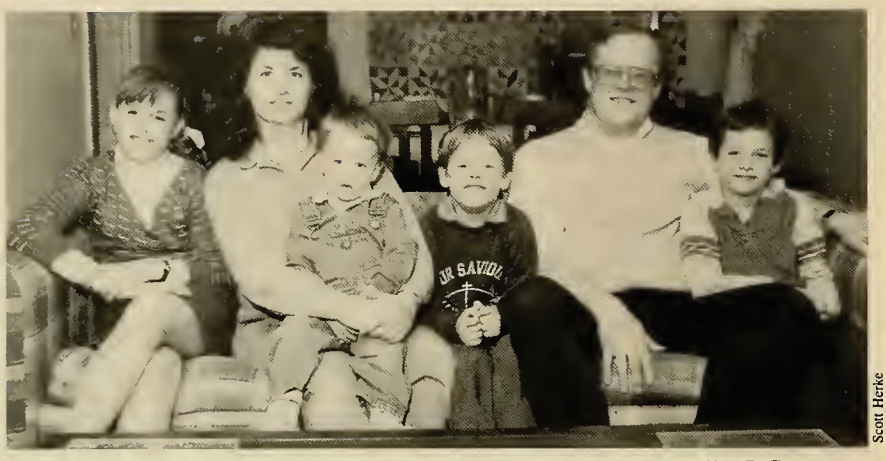
They also became involved in extracurricular activities. In the absence of sororities, some, like Diane Gramer and Janet Merrill, pledged as fraternity "brothers" to Alpha Epsilon Pi. Lee Small became the first woman president of Tau Beta Pi, the engineering honor

Christina Herzegu

*Elaine Kowalewski Tepper (MS '71) was WPI's first woman resident advisor.*

Courtesy of Hamilton Standard

*Dean Gramer Drew '73 is now a senior design engineer for Hamilton Standard in Suffield, Ct.*



Scott Herke

*Deborah and Stephen Goodwin '73 with their children in Greenville. S.C.*

society, while Nora Blum became the first woman to edit the *Tech News*. Others helped to form some women's athletic teams in crew, fencing and basketball, and many became cheerleaders.

"In picking the initial students, [Dean of Admissions] Ken Nourse tried to select strong candidates, because he knew they would face a lot of problems," says van Alstyne. "He picked women who had a good chance of succeeding, and most of them lived up to his expectations."

For many of the women, van Alstyne was an important key to their success, as well as newly appointed Assistant Dean of Students Bernie Brown. " 'Van A' was like a father to us all," says Beth Poulin ('73 MA, '78 M.S.ME), now a research engineer with Foster-Miller Inc. in Waltham, Mass. "He'd often call us into his office—he kind of knew when things were going wrong. And Dean Brown was very good to us."

Now vice president for student affairs, Brown gives special credit to one other individual who helped ease the coeds' transition—WPI's first woman resident advisor, Elaine S. Kowalewski. A first-year graduate student in mathematics, Kowalewski was a "main resource" for Brown at a time when no counseling center existed and there were no other professional women on campus.

Nicknamed "Ma Riley" after their home in Sanford-Riley Hall, Elaine Kowalewski Tepper ('71 M.S.MA), now a programmer analyst with AT&T in White Plains, N.Y., has warm memories of her years as resident advisor: "I tried to keep my door open—I was really very fond of the women. Even though I was four years older, we all had a common bond."

That kind of support, a lot of hard work and a willingness to take risks, enabled most of the group to finish their four years at WPI among the top students of their class. Twenty of the original 24 completed their studies and received degrees, following the example of Lee Small, who had become the first woman undergraduate to graduate from WPI the previous year. (Jayne Rossetti dropped out for personal reasons midway through her WPI career.)

And then the real challenge began.

"In college everybody treated me as an equal," says Diane Gramer Drew ('73 HTE), a senior design engineer at Hamilton Standard in Suffield, Conn. "In the working world, I found things much more different—more prejudiced.

"I'm still dealing with it. It's hard being a woman engineer. All the managers are men, and most of the engineers are men. A woman has to work harder to prove she can do something."

Her experiences were shared by Nora Blum in her first engineering position with a Boston firm: "In a new situation, people who didn't know you would assume you were Joe's secretary. Sometimes it was almost funny and sometimes you could get really upset.

"My reaction was to keep my anger inside. I'd pound my desk in private and think, damn it, I'm going to show them. Then I'd do a very competent job. With experience I became more confident and others became more accepting."

For many of the women, their early years at WPI helped them to bolster their self-esteem as they met challenges later in life. "If there's one thing I learned from that time, it's that there's nothing you can't do if you really want it," says Zorabedian. "It's a belief I hope to instill in my own children."

It's also a belief that a number of the alumnae have shared with WPI's current women undergraduates during campus visits. The group they address today—accounting for 17 percent of the student body—enjoys a number of benefits they lived without: coed athletic facilities, three sororities, more women staff and faculty members and the acceptance that comes with nearly two decades of experience with women students.

Administrators like Bill Grogan look forward to the day when women will account for at least a fourth of undergraduate enrollments. And Bernie Brown thinks that, despite how far the college has come with coeducation, there is still room for improvement.

But getting this far, he adds, could never have been accomplished without the help of those first two dozen who sensitized WPI to women's issues and needs.

"It was such a special group," says Brown. "They fought the early battles for those who came after."

*Evelyn Herwitz, a free-lance writer living in Worcester, is a frequent contributor to the* Journal.

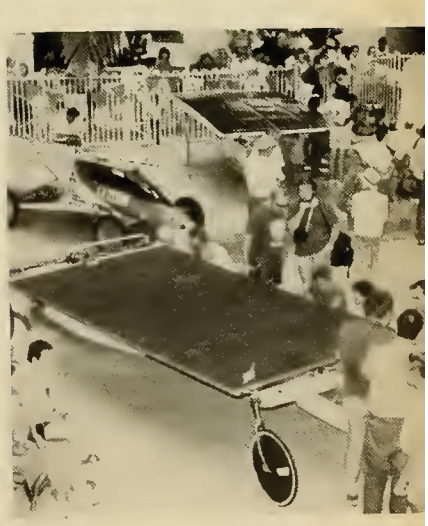
# A Personal Adventure

## Across the Australian Outback with the World's First Transcontinental Solar Car Race

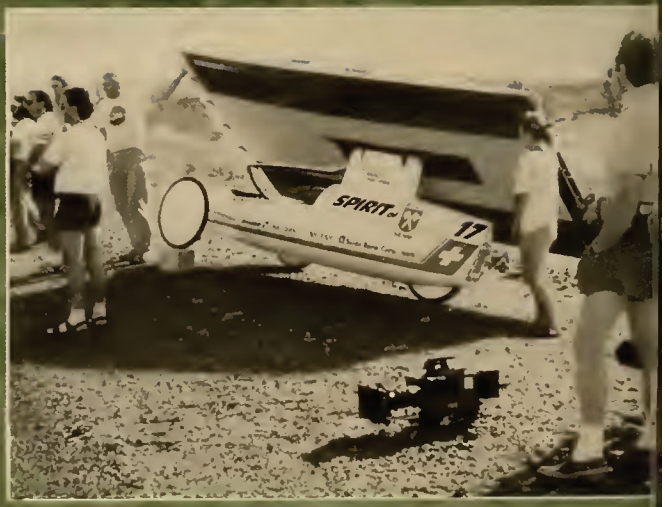
By Edward N. Clarke

Photos by Ed Clarke and General Motors

*Left: GM's* Sunraycer *at the finish line with the World Solar Challenge cup. Below: the challengers were on display in Darwin before the race.*




I flew to Sydney, Australia, in late October 1987 and thence to Brisbane, where I boarded a bus for the 2,500 mile, 2½-day trip northwest to Darwin. By the time my travels in this continent would end, I would cover 6,000 miles of lovely, wild land; see strange, exotic and dangerous animals; sleep in the open under the endless Australian sky and slog through four inches of rain in a desert outpost that had not seen a storm in 13 years—all to get a chance to witness the World Solar Challenge, the first ever transcontinental solar car race. What an odyssey it was!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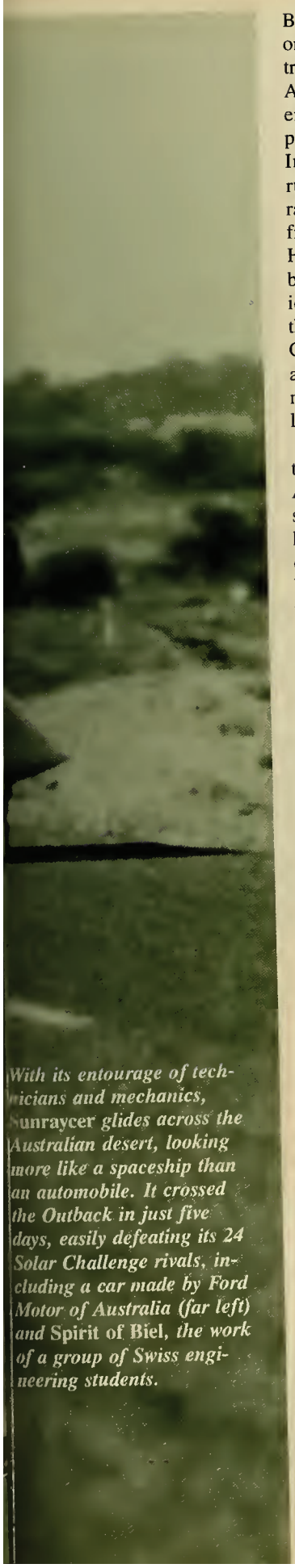


*With its entourage of technicians and mechanics, Sunraycer glides across the Australian desert, looking more like a spaceship than an automobile. It crossed the Outback in just five days, easily defeating its 24 Solar Challenge rivals, including a car made by Ford Motor of Australia (far left) and* Spirit of Biel, *the work of a group of Swiss engineering students.*

BEGINNING IN DARWIN, on the northern coast of Australia, the course crossed the Australian Outback before ending in Adelaide, 2,000 punishing miles south on the Indian Ocean. Had it been run in North America, the race would have stretched from Calgary, Alberta, to Houston, and would still have been a human and technological milestone. But crossing the Outback made the Solar Challenge both grueling and, at times, dangerous—and the most exciting adventure of my life.

In all, 24 vehicles started the race on a warm spring (in Australia) day. When the last stragglers crossed the finish line some 30 days later, 14 cars had reached Adelaide. When all was said and done, the General Motors (GM) *Sunraycer*, powered completely by solar cells, or photovoltaics, and batteries charged only by the sun had raced the distance in a little over five days, averaging 42 miles per hour and defeating the second-place Ford entry by a good two days.

Since returning to the States, it has been hard to contain my enthusiasm for what I was a part of. People frequently ask me how I became involved. It was in early 1987 that I learned of the Challenge race and its vision of demonstrating that automobiles could run continuously with no source of energy other than the sun. This was history in the making in my field of technology, and I wanted to be a part of it.

GM announced its plans to participate in the Solar Challenge in the spring of 1987, with just seven months left until race time (most of the other competitors had already been at work on their entries for more than a year). I contacted Robert Stempel '55, who had just become president of GM, and told him of my interest. Bob put me in touch with the manager of GM's solar car program and its public relations director. I was fortunate enough to be invited to the unveiling of the *Sunraycer* in Detroit that September, an event that made news nationwide.

GM invited me to travel across the Outback with the safari that would accompany *Sunraycer*. But as exciting as that offer was, I soon found myself facing the kind of dilemma we all dream of, for the opportunity had arisen for me to travel in the safari of race organizer and modern adventurer Hans Tholstrup. Here was a chance to follow not one but a number of the 24 national teams throughout the race.

Accompanying Tholstrup was a chance I couldn't pass up, though I am grateful to GM for enabling me to become involved with the Solar Challenge in the first place. I had come to know a number of the GM team members, whom I now count as friends, but I wanted an even broader experience.

AUSTRALIA IS A VAST NATION the size of the continental United States. Most of the country's 17 million people, however, live in the southeast and on the east coast. This is where the British dumped convicts in the late 18th and early 19th centuries, and many Aussies are still conscious of their felonious forebears.

Most of the continent is tropical or arid, with the hottest region lying in the center. It was through this hot, dry land that the race passed, rolling along the famed Stuart Highway. Giant termite mounds—some up to 15 feet high—ubiquitous insects, kangaroos, dingoes, goanna lizards and large poisonous spiders were the order of the day—and night.

The Solar Challenge passed through two Australian states—starting in Darwin in the tropical Northern Territory, passing through the desert-like Outback of South Australia and ending in Adelaide, near beautiful rolling hills of wheat fields, vineyards and sheep farms.

As the weather turned colder back home, summer was approaching in Australia. In fact, temperatures may have reached 114 degrees while we were in Darwin, a city of about equal latitude as Lima, Peru. For once, I'd been able to extend the Indian Summer we so cherish in New England.

The 24 solar racers that arrived for the start of the race originated in Denmark, Japan, Pakistan, Switzerland, West Germany and Australia, in addition to the GM *Sunraycer* from the U.S. Three Australian high schools competed, as well as colleges and universities.

The best college solar cars came from the engineering college in Biel, Switzerland, and the Darwin and Chisholm institutes of technology, both in Australia. *Spirit of Biel*, the Swiss car, which had backing from Mercedes Benz, finished third. The Australian university entries came in fifth and sixth, respectively. Farther down in the pack were cars built by students at MIT and Crowder College in Missouri.

Time trials in Darwin on the day before the start of the race determined the starting positions, much as they do at the Indianapolis 500. *Sunraycer* won the pole position with a speed of 70 miles per hour. The Hawaiian *Mana La* ("power of the sun") got the other front-row slot.

Each entry was also required to demonstrate stability against the air turbulence created by passing road trains—truck tractors pulling three large trailers in tandem. Up to 130 feet long, with 72 wheels, these monsters travel

100 miles per hour carrying 120-ton payloads! In addition to *Sunraycer*, *Mana La*, the Ford Motor of Australia car and the Swiss car performed well in these trials.

On November 1, the Challenge got under way—fortunately under bright blue skies and intense sunshine. By the end of the first day's racing, *Sunraycer* had opened up a 68-mile lead on its closest competitor, the Swiss team, and was 73 miles ahead of the Ford. *Mana La*, meanwhile, had made some strategic errors, and before racing ended at 5 p.m., its batteries died, leaving it 87 miles behind GM.

Day 2 dawned cloudy—a threatening surprise for most of the cars, for race rules prohibited charging batteries with any source other than the sun. By that evening, *Sunraycer*'s lead was up to 150 miles. And, by the end of the third day, *Mana La* had dropped out for good, though it was not the first to quit.

By the time *Sunraycer* rolled across the finish line, it had opened up a gap of 600 miles between itself and the Australian Ford car, the second-place finisher, and more than 1,000 miles between itself and the last of the 14 entries that completed the Challenge within the 10-day official limit of the race (two cars would take a month to get to Adelaide).

After the GM and Ford entries came the *Spirit of Biel*. The Swiss car would probably have done better had it not collided in central Australia's Alice Springs with a conventional automobile that had entered an intersection at precisely the wrong time. Ironically, it was the driver of the Swiss car who wound up getting a ticket.

In a display of automotive wizardry, the Swiss had their car repaired and back on the road in less than six hours. But, by then, they had lost second place to Ford for good.

I had the privilege of spending two fascinating nights with the Swiss team—the night after the collision and the night before their final day of racing. It was on this second night that they made the emotional decision to reach the finish line before the end of the next day, even if it meant racing beyond 5 p.m. and thus accumulating penalty points for being on the road at that hour.

Somewhat to our surprise, the three Japanese entries performed relatively poorly. In fact, all three were still in the Outback as I was leaving Australia. But the Japanese had ample opportunity to study *Sunraycer* and, perhaps, will make use of what they saw.

DURING THE RACE, solar car drivers slept in tents, vans, trucks, station wagons—wherever they could find a restful spot—when they finished their turns at the wheel. While in the tropical part of the Outback, I slept on the desert in a sleeping bag, making certain that my exposed little "bedroom" was free of the 2-inch poisonous spiders that were everywhere—at least they weren't around when I first lay down to sleep. I guess I assumed that kangaroos were too timid to come near and that goanna lizards would simply stay away.

For the physical exercise that is an invaluable part of my daily ritual, each morning before the cars got under way at 8 a.m. I ran three or four miles in the Outback. I suspect this has to be some sort of record, for it even drew the attention of television crews covering the Solar Challenge.

Of the six GM drivers, three were from the United States, including Molly Brennan, an engineer from the New Concepts Division of GM. A graduate of Michigan State University, where she studied computer engineering and the humanities, she was also a Rhodes Scholar. During the race, Molly drove three segments, including one over a rough section of road under construction and another on a stretch newly resurfaced with asphalt and pebbles. Both surfaces caused tire failures, but the crack GM race team had the tires replaced in under two minutes. These were the only mechanical problems *Sunraycer* suffered in the whole length of the Solar Challenge, a testament to the quality of the design and engineering that went into it.

*Driver Molly Brennan and a GM crew member*

MY OVERRIDING IMPRESSION of the Australian Outback was of a vast, desolate land with precious few people, stretching from tropical in the north to barren in the south. Traveling down the Stuart Highway, I was in awe as I realized that this wilderness extended uninterrupted to the east or west for more

## WPI's Stempel Launches a Bit of Engineering History

While the General Motors *Sunraycer* is the product of several GM divisions and the experience and talent of dozens of engineers and technicians, it began with the vision of one man and the bold decision of another. It was Howard G. Wilson, vice president of the General Motors Program of the Hughes Aircraft Company, who first suggested that GM enter the Solar Challenge.

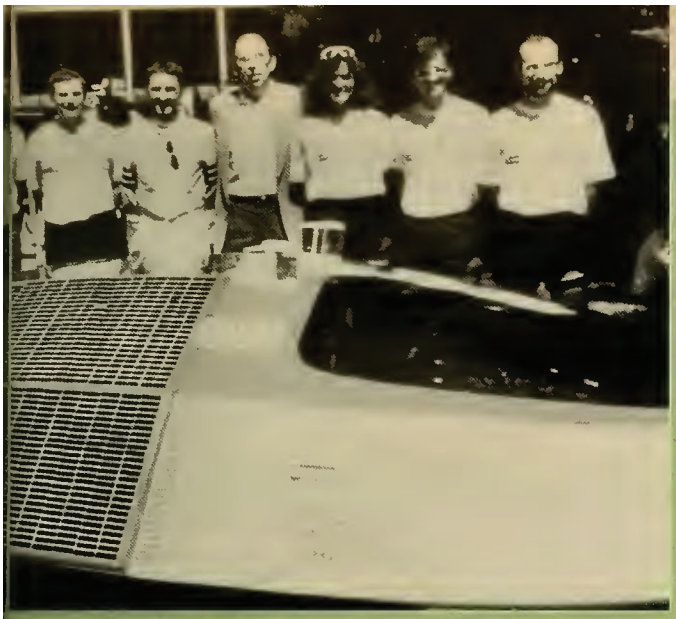
Wilson's suggestion fell on the receptive ears of Robert C. Stempel '55, who assumed the presidency of GM one day before delivering the 1987 WPI Commencement Address.

It was Stempel who made the key decision to produce *Sunraycer*—to commit the resources of GM to a crash program to design not just a solar-powered car, but a new concept in automotive technology. The result is as beautiful as it is brilliant.

Packed into the *Sunraycer* is some of the world's most advanced technology: lightweight materials, low-friction moving parts, high-efficiency solar cells, advanced motor and power electronics, advanced aerodynamics, experimental batteries, and regenerative braking, a technique that enables the drive motor to generate energy and feed it back to the batteries when the driver takes his or her foot off the accelerator.

The car has the planar dimensions of a family station wagon, but weighs only 360 pounds—just under 550 pounds with driver. Its chassis weighs in at a scant 15 pounds, and the entire shell is less than 100 pounds! The body is made of a sandwich of Kevlar and Nomex. The car's bicycle-type tires are 17 inches high and made of Kevlar as well. Inside, the driver sits neatly suspended in a comfortable sling seat.

*Sunraycer*'s drive motor is one of the most efficient power



*bert Stempel '55 (center) with the drivers and crew of*
*raycer. Stempel's decision launched the* **Sunraycer** *project.*

plants ever produced. Dubbed "Magnequench" to describe its powerful permanent magnets, the motor produces a steady two horsepower with a capacity for 10 horsepower bursts. It weighs less than 10 pounds.

The car's photovoltaic array is made of 7,200 gallium arsenide solar cells, made by GM's subsidiary, Hughes Aircraft Company, and other manufacturers. The solar cells used by the other challengers were made of less expensive, but also less efficient, silicon. GM also used a different approach to mounting the cells, gluing them directly onto the streamlined, teardrop-shaped body of the car to reduce drag. Most competitors used a bulky overhead panel, tending to make these cars look as if they were hauling their arrays rather than integrating them into the car's aerodynamics.

The peak output from *Sunraycer*'s eight square meters of solar cells is 1,500 watts. That's the power consumed by an ordinary countertop toaster. But 1,500 watts can drive *Sunraycer* at 45 miles per hour—trickle charging the batteries at the same time—and up to 70 miles per hour if augmented by the solar-charged batteries. In photovoltaics, the name of the game is efficiency. *Sunraycer*'s silver-zinc batteries, also produced by Hughes Aircraft, are one-fifth the weight of lead-acid batteries used in most cars.

AeroVironment, Inc., of Monrovia, Calif., created the sleek, low-drag design of *Sunraycer*. The company has had plenty of experience in the design of lightweight vehicles. Its founder, Paul MacCready, designed the *Solar Challenger*, the first aircraft to cross the English Channel powered entirely by the sun.

MacCready was awarded an honorary doctor of engineering degree from WPI in 1980. His degree citation stated, in part, that his aerodynamic designs "have lifted our spirits, fired our imaginations and expanded our horizons. He has given us all a new sense of the possibilities of our bodies and of our technology."

Though GM had a clear advantage with its technology, the company left little to chance. Racing experts were brought in to carefully study the Stuart Highway and devise tactics for the race. One of those tactics, which had the driver use extra power for the first 15 minutes of the competition, helped give *Sunraycer* a lead it never relinquished.

During the race, technicians in an air-conditioned trailer followed the solar car and monitored its energy consumption and production, the weather and road conditions, wind speed and other key factors. They used a computer to help the drivers get the maximum performance from the motor and make the best use of the battery charge.

Despite the success of *Sunraycer*, GM says it has no plans to mass-market solar-powered cars. I had asked that question openly and publicly—with GM chairman Roger Smith present—back in Detroit after the unveiling of *Sunraycer*. Later that day, a number of GM design engineers thanked me for raising the question. Apparently, some at the nation's largest auto maker would like to produce a solar-powered commuter car. —EC

than a thousand miles.

On one of our safari's first nights in the Outback, we camped at Barrow Creek. This place is on every map, even though it is nothing more than a gas station. We were welcomed to this outpost with a downpour that left four inches of rain and even deeper red mud. Should it have surprised us when the family who operates the gas station told us it had not rained there in 13 years?

During the night, they had taken their two pet kangaroos indoors for fear that the storm would frighten the animals. It may have been the storm or my unexpected arrival at the house that caused one of these fascinating animals to hop through an open door into my arms. So there I was, holding this excited kangaroo, hoping its master would come to my aid.

The Stuart Highway is strewn with the carcasses of kangaroos and other animals killed by the monstrous road trains, which, having no chance of slowing down as they cruise at 100 miles per hour (there are no speed limits in this part of Australia), simply plow aside any animal unfortunate enough to get in their way. The cabs are fitted with "roo bars"—gratings of two-inch-diameter steel pipes—that enable them to hit animals as large as cattle and water buffalo without being damaged. Both are numerous in the Outback; the road carnage made that clear.

Road trains closing in on our safari at a relative speed of 150 miles per hour took their half of the highway out of three-quarters of the road. The Stuart Highway is two lanes wide in most places, so you don't play the road game of chicken—or kangaroo—unless you are prepared to end up alongside the unfortunate animals themselves.

The weather during the Solar Challenge was unusually cloudy and wet for a late Australian spring. It's impressive to see solar cars rolling in the sunshine—sleek, quiet and smokeless. It's even more impressive to watch them cruising under clouds—not too fast, of course, unless they are drawing upon the solar-charge of their batteries.

Because this much-needed precipitation coincided with the race, Australia's farmers are probably praying for the return of these strange vehicles again next year. Actually, the next Challenge race is not scheduled until 1990.

I CANNOT FINISH relating to you my impressions of the Australian Odyssey without telling you about Hans Tholstrup, the Solar Challenge organizer. It is now universally recognized that this single

event has created the greatest degree of public awareness of solar photovoltaics in the 30-year history of the technology. In Tholstrup you will find a nonengineer, nonscientist who has shown us a vision of the future of engineering and science.

Tholstrup was raised in a wealthy Danish family with roots in cheese and wine-making. By his own admission, Hans did not fit into the scheme of what he might call passive education. Instead, he has created his own brand of education, lifelong learning through what most of us would call high adventure. Once, he piloted a speedboat solo from Denmark across the Atlantic to Maine, stopping only to refuel in Iceland and Newfoundland. He holds the record for circling the globe in the smallest aircraft ever to achieve that feat—after taking a total of 10 days of flying lessons from six of the best pilots in the U.S. He has sailed around the Australian continent in a small boat and, about two years ago, he became the first to drive a solar car across Australia from west to east.

Currently, Tholstrup is planning a solo trek to the South Pole using a "solar dogsled." He says he will be ready to go in January 1989, during a month when the sun never sets in Antarctica. The vehicle will be totally solar powered. He will carry kerosene only to melt snow for drinking water and cooking.

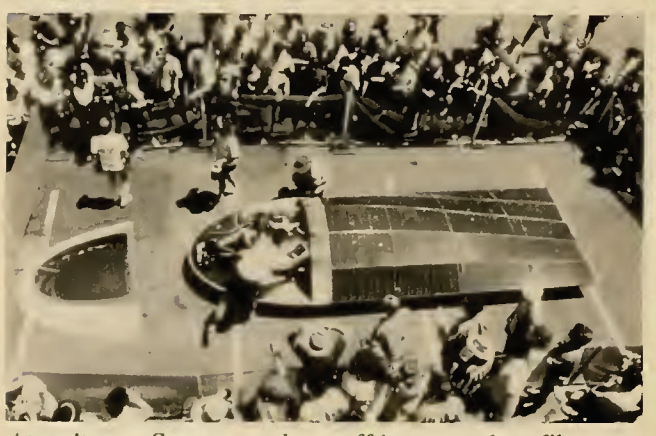
At one point during the race, Hans and I traveled together in his sports car at a speed that reflects his lifestyle while we searched for two of the Australian cars approaching Adelaide. During our ride, he told me that he became an Australian citizen about 10 years ago, in part to fight what he considers to be rising socialism there.

Tholstrup's view of life is that if it's not exciting, perhaps it's not worth living at all. He argues that day-to-day life is not ordinary if you try to create positive change in that life.

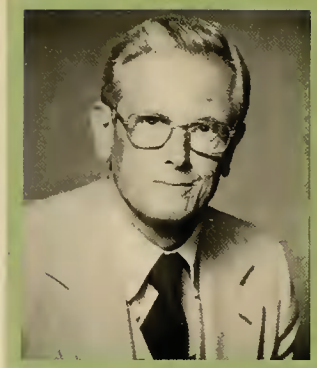
In response to Hans Tholstrup's vision and initiative, GM has been able to create a solar car using the most advanced technology in all elements of vehicle design and to create what is a major contribution to humankind.

Somewhere in the Outback, Tholstrup compared GM's achievement to that of the Wright brothers. "It's simply as important as that," he said. "GM has done for energy efficiency what John Kennedy did for the space program. It's a little awesome."

*Edward Clarke is director of the WPI Center for Solar Electrification and professor of engineering science.*



*At a pit stop,* Sunraycer *shows off its unusual profile to a crowd of spectators.*



## Ed Clarke: Still Blazing New Trails

As solar cells draw their power from the sun, Ed Clarke seems to get his energy from the power of new ideas and the exploration of uncharted territory.

In 1950, after receiving an undergraduate degree in engineering from Brown University, two master's in applied physics from Harvard and a Ph.D. in physics from Brown, Clarke joined Sylvania Electric Products, Inc., as a member of the technical staff working on semiconductors.

Back then, semiconductor science, the foundation of modern electronics, was a new field, and Clarke was one of its founders. He became a group head for research at Sperry Rand Corporation's semiconductor division, and in 1959 helped found the National Semiconductor Corporation, where he served as vice president until 1965.

Along the way, Clarke's work stayed on the leading edge of this rapidly advancing field of electronics. He led in the creation of transistors that helped make possible the first test launching of the Minuteman I missile as well as electronic devices incorporated in the F-104 fighter aircraft.

He led the team that produced the world's first mass-produced integrated circuit. ICs, also called microchips, made possible everything from digital watches to personal computers. His work earned him three patents, including one for a basic method used by the entire semiconductor industry for manufacturing transistors and integrated circuits.

Clarke joined WPI in 1965. As director of research and associate dean of graduate studies, he helped start a program of scholarship and graduate studies that continues to grow today. It was as research dean that he caught the solar bug.

In 1975, in the wake of the first national energy crisis, he worked to interest WPI faculty in solar energy research. When it became clear that the federal government intended to establish a national Solar Energy Research Institute, he lent his efforts to the drive to bring the lab to Massachusetts.

When he began to think about stepping down as dean, Clarke saw a chance to devote himself full time to students and solar power, which he believes can impact society as significantly as the semiconductor did.

As founder and director of the Center for Solar Electrification, he directs student projects in solar photovoltaics. Under his guidance, WPI undergraduates have carried solar arrays and the wonders of solar energy to the far corners of the world, from the Penobscot Indians in Maine to remote mountain huts along the Appalachian Trail.

Clarke reports that interest among WPI students in his solar car adventure has run high. In response, he has created nine new projects related to solar cars and worldwide solar car competitions. —Michael Dorsey

# COMMUNIQUÉ

## Do We Need Leadership in Higher Education?

By Dr. Jon C. Strauss

Leadership. It's a concept that's being talked about a lot nowadays in business and government. It's natural to wonder whether leadership is also something we in higher education should be thinking more about.

With the inertia of the tenure system, the lack of authority in collegial governance and the many disparate performance measures imposed on colleges and universities, we must question the role, form and effectiveness of leadership in the college and university environment.

John W. Gardner, founder of Common Cause, says leadership is "the empowerment of others." By empowering, leaders reinforce worth, develop competence, foster community and, most important, assure enjoyment.

However, leadership has its risks. The popular image has a charismatic leader on a white charger out in front of his troops. But the troops aren't always happy when they recognize that only the leader gets a change in scenery. Clearly, part of a leader's role is gaining acceptance among the troops for the rewards of their success.

Three specific leadership challenges for colleges and universities, Gardner notes, are fostering leadership, encouraging educational breadth and developing intuitive understanding of the culture.

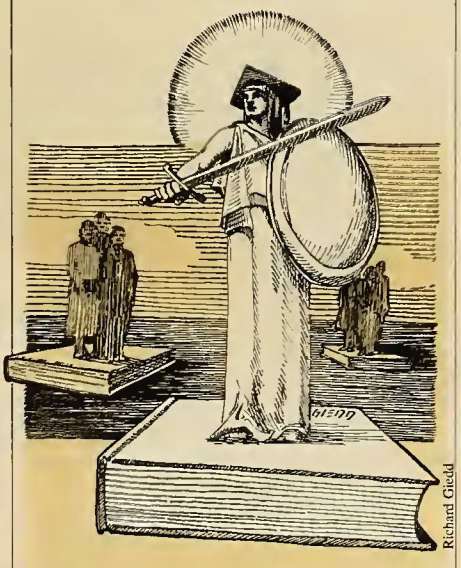
At WPI, we have met these challenges successfully in our undergraduate program. Through the Humanities Sufficiency and the Interactive Qualifying Project, the WPI Plan develops breadth of interest and a fundamental grounding in American culture. And the project system, with its team organization, builds leadership skills.

One of my greatest pleasures as president of WPI is listening to the rave reviews our students receive from corporate recruiters, employers and graduate school deans. They laud our graduates for their problem-solving and communication skills, but they are especially complimentary of their ability to lead and of their confidence. These observations are reinforced by the remarkable career success of our graduates.

The WPI Alumni Association has profited from and has played a major role in developing the outstanding leadership skills of its officers and its Council and Fund Board members. Service as trustee also provides ample opportunity for leadership development for the benefit of WPI. And WPI has benefited significantly from the leadership of its past presidents, deans and officers.

However, it is in the faculty of WPI where I see the greatest past success and the greatest future promise for leadership. Two decades ago, the faculty demonstrated remarkable innovation and dedication in developing and implementing the Plan. They met all the challenges of leadership except one. Although the Plan has had a significant influence on educational thinking, it has not been imitated.

Warren Bennis, former president of the University of Cincinnati and a scholar of leadership, said that "managers do things right, leaders do the right things." The Plan was the "right thing" for students, though it proved so costly in faculty effort that no other institution has found it possible to adopt.



Richard Giedd

While the Plan has been one of our most successful demonstrations of faculty leadership, it is also the cause of our greatest leadership challenge. Partly because of the time demands of the Plan and partly because of the rewards of its perfection, some of our faculty drifted out of the mainstream of scholarship and research during the 1970s. Fortunately, in the early 1980s, other faculty members recognized that the Plan could only be sustained by active faculty scholarship and spoke out for a greater emphasis on scholarship and research.

Their demands led to the hiring in 1984 of Richard H. Gallagher, provost and vice president for academic affairs, and myself in 1985. We have been actively engaged since then in helping faculty members realize their ambitious plans for improving scholarship while retaining and enhancing the Plan. A number of quantitative indicators demonstrate significant initial success.

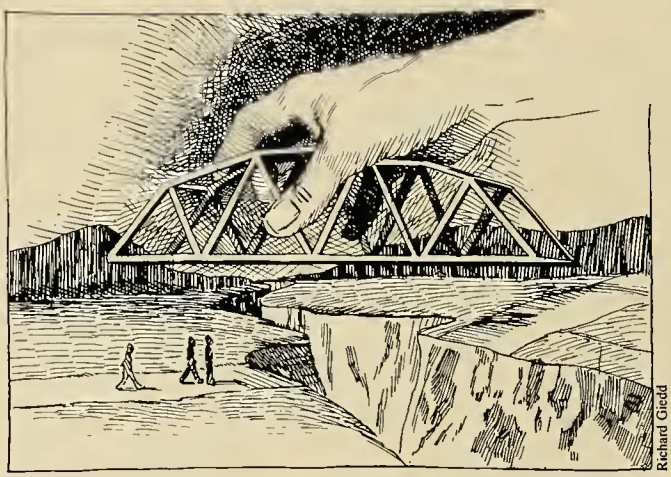
Well, this brings us full circle. I began by asking whether leadership makes a difference in higher education. The answer has to be a resounding yes!

As most members of the WPI family know, we are now engaged in the task of raising $52.5 million over the five-year period ending on Founders Day, November 11, 1990—the 125th anniversary of the founding of WPI. The *Campaign for Excellence* will provide the resources needed to reinforce the inherent quality of the Plan and build excellence in scholarship and research. We all stand to gain from this endeavor and, consequently, we all will be called upon to play a leadership role. I know we can count on you.

*Jon Strauss is president of WPI.*

# Worcester's Minority Students See Their Hopes Rise on WPI's COMET

By Denise R. Rodino


Richard Giedd

Across the country, institutions like WPI are searching for ways to attack the nation's critical shortage of minority engineers and scientists. WPI's 100 minority students make up just under 4 percent of the undergraduate student body, a figure all agree is unsatisfactory.

In the fall of 1985, a group of WPI faculty members began to ask how the school members could attract more minority students. Their conclusion echoes the results of national surveys: Most minority students do not get the training or encouragement they need to pursue careers in technology and science. There is simply no pool of minority students for WPI to draw on.

Nationwide, the solution would seem to lie not in better college admissions recruiting, but in attacking the problem at its source by preparing minority students to attend college.

This realization gave birth to Career Opportunities Merging Education and Technology (COMET). Working with the Worcester public schools and a Worcester-based organization called ALPA (the Latin-American Progress Association), WPI faculty designed a program to help educate junior and senior high school students and motivate them toward college enrollment and, ultimately, careers in science and engineering.

In 1986, a $30,000 grant from GTE Corporation's Focus program brought the plan into reality, and two subsequent grants from the Massachusetts Board of Regents, totaling $145,000, have helped broaden and refine it.

Today, more that 20 WPI students—undergraduate and graduate—work with 60 Worcester high school students and 60 students from the Burncoat Middle School. COMET Director Bruce Young-Candelaria began using WPI students when it became apparent that what younger students need most is individual attention, not lectures, field trips, or even remedial classes.

In the high schools, WPI students work after school two days a week as tutors. During two-hour sessions, they help students with homework, teach basic concepts and work on their charges' English skills. They also serve as role models and friends.

"We seek to create both an academic and a social atmosphere," Young-Candelaria notes, "where students and tutors can exchange impressions about high school and college life and talk about career opportunities."

In the middle school, COMET is a teaching rather than a tutoring program. WPI students use classroom time and innovative demonstrations to give students individualized instruction in computer science. One project, for example, involves building a Heathkit robot that will become the school's mascot. As they help with the assembly, students get a rare glimpse into the workings of a robot and its computer brain.

At the high school level, both tutors and students are paid for their efforts, a practice Young-Candelaria staunchly defends.

"These students can drop out of high school today and make $5 to $6 an hour doing menial labor at any of the warehouses down the street," he notes. "Of course, most of them will still be in the same job 10 years from now, but high school students don't often think that far ahead."

By paying students for their attendance, Young-Candelaria says, "we're telling them their time is valuable and nothing is of more value than an education."

Like a job, the program makes demands on students. They must demonstrate motivation to their teachers and guidance counselors before they are accepted into the program. Once enrolled, they are paid by the hour and fired for poor attendance, or if their motivation or work ethic falters.

The program's success is judged by increases in such standard measurements as grades and test scores. Both tutors and students say it seems to be working.

What's next? Young-Candelaria would like to see a summer camp develop from COMET. WPI Professor Susan Vernon-Gerstenfeld, who began working with COMET this year, hopes to involve IQP students in research relevant to the program.

With two years of "graduates," it is now possible to begin tracking the success of the students. This information will help in planning the future of the program and ensuring that COMET will not only continue to benefit tutors and their students, but also that WPI will continue to contribute to meeting a national challenge.

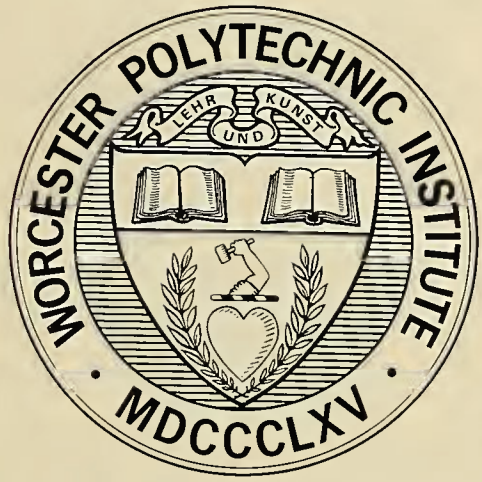
*Denise Rodino is director of foundation relations at WPI.*

# MEMORY BANK

## WPI Marks the First Century of Alonzo Kimball's Seal

By Roger N. Perry Jr. '45

*"We never have been able to learn why the school has not adopted a seal. We were once shown the 'thing' on the back of the catalog and assured that it was a seal."*
*The W.T.I.*, a monthly WPI student publication, February 1887




With those words, a group of student editors threw down the gauntlet to the WPI community, seeking to set right what they saw as a longstanding wrong. Though the college was 22 years old, it had yet to adopt an official college seal.

Change was in the air in 1887. The college had only recently changed its name from Worcester County Free Institute of Industrial Science to Worcester Polytechnic Institute. (While the school was known informally as Worcester Technical Institute for several years—a name adopted by the student publication quoted above—this name was never officially approved.)

Many students responded to *The W.T.I.*'s challenge by submitting proposals for a seal. But it was Professor Alonzo S. Kimball, the popular head of physics and electrical engineering, who developed the seal which was adopted by the Board of Trustees in 1888, 100 years ago this year.

Kimball's seal included several key elements, most notably two open books, an arm and hammer, a heart, and a banner with the German motto *Lehr Und Kunst* (Learning and Skilled Arts). In *Seventy Years of the Worcester Polytechnic Institute*, Herbert F. Taylor '12 described the symbolism of these items:

> The heart is from the seal of the City of Worcester, the Heart of the Commonwealth. The German motto was selected to indicate the combination of academic learning, also symbolized by the books, and practical arts, symbolized by the arm and hammer. The latter device was adopted at the opening of the Institute in 1868. The use of a German legend was probably due to the vogue of that language in the '80s.

For an official date, Kimball chose 1868, the year the Institute opened. The stained glass window on the west end of Boynton Hall was based on this design and includes this date. In later versions of the seal the date was changed to 1865, the date of the Institute's founding.

Kimball's seal has undergone other changes over the years. Several typefaces have been used and the seal has appeared with "fluting" around its edge, representing the pattern left when a seal is pressed into sealing wax. And in the early 1960s, the German motto on the seal printed on some sweatshirts sold in the WPI Bookstore had degenerated into nonsense.

When the college prepared to celebrate its centennial in 1965, it was decided to establish an official version of the seal, which, while not copyrighted, is a trademark of the Institute.

With the help of an artist, a standard seal emerged. Actually, three standards were decided upon, varying only in the amount of detail. The larger the intended size of the printed seal, the more detail it contains.

While it was the lack of a school seal that most vexed WPI students in the 1880s, they also lamented the absence of school colors. After watching a football game in 1886, a student wrote a letter to the editor of *The W.T.I.* He noted that members of the opposing team all wore uniforms of the same color. At WPI, he said, it was traditional for each class to choose its own colors, causing confusion for football fans.

While details of the adoption of school colors are vague, a choice was made. Long fabled in college songs as crimson and gray, the accepted colors are actually maroon and gray.

As the seal was being formalized in the 1960s, standards were also set for the colors. Preserved in the Alumni Office were two pieces of antique ribbon considered to represent the original choices. These were matched with standard color samples used by printers.

It seems clear that Professor Kimball never intended for the seal itself to be reproduced in color. Still, attempts have been made over the years to design a full-color version. The Boynton Hall stained glass window and the carved wooden seal in Harrington Auditorium are two examples. Though they differ significantly in color, both are considered official.

It's been 100 years since WPI embraced Professor Kimball's seal. Most aspects of college life have changed since then, but this seal has remained a standard that still boldly proclaims WPI's guiding principles.

*Roger Perry is director of campaign communications at WPI.*

# FINAL WORD

## After two years in the mountains of Nepal, Dan Laprade '85 ponders culture shock, values and human obsolescence

By Amy Zuckerman Overvold

It is a long way from the mountains of Nepal to the high-pressure, high-tech corporate world of America.

Just ask Dan Laprade '85. He returned this winter from a two-year stint designing and building water systems with the Peace Corps in the highest nation on earth and is still reeling from culture shock.

"I haven't touched a computer in two years," he sighs, neatly delineating the problems engineers can face making the transition from work in the Third World to employment in an industrial society. While the work he did in Nepal was useful and fulfilling, he says it was also a far cry from the technologically advanced jobs he set his sights on when he returned.

Laprade's two years in Nepal were a real push-and-pull for a young man "looking for a challenge." He worried frequently about slipping behind technologically, but the needs of the Nepalese—and the rewards of making a contribution—would pull him back. In fact, they almost kept him there.

Laprade was in the middle of inspecting water projects when his tour ended. Wanting to see his work through to completion, he thought about signing up for another two years. Peace Corps veterans urged him to reconsider, explaining that there would always be more work to be done no matter how long he stayed.

And Laprade began to wonder what he would say to an employer if he hadn't touched a computer for four years. "What if I am obsolete at the age of 28?" he would ask himself. He decided it was time to come home.

Despite his worries, Laprade says he wouldn't have traded away his years in Nepal.

"When I graduated from WPI," he says, "I could have gone the hectic, corporate avenue. I could have, but I thought Nepal would be a challenge."

It was, though not in the ways Laprade had expected. He said life in Nepal is slow and seems inefficient to an outsider. Yet this environment forced him to be creative and constructive and to take the initiative.

**"When I graduated from WPI, I could have gone the hectic, corporate avenue. But I thought Nepal would be a challenge."**

Most of his WPI education proved far too advanced for the simple water systems he designed or inspected in outlying villages. But he found value in doing something that "wasn't a textbook thing."

He also learned something about hard, manual labor in the mountains of Nepal. Laprade was assigned the task of bringing water to a remote village near Yasuk, where the inhabitants had previously spent three hours a day fetching water.

In the absence of trailers, workers carried piping on their backs through miles of rugged terrain. To keep the pipes below the frost line, Laprade's crew dug 30-inch trenches in ground often the consistency of concrete without the benefit of jackhammers or backhoes.

The work wasn't as arduous as it sounds, Laprade says, nor was it the hardest part of his time in the Peace Corps. Far more trying, he says, was adjusting to "taking things as they come" and making decisions he did not feel qualified to make.

And Laprade says he got used to the food and to sleeping in huts, but he never quite got over his homesickness. "People draw you back," he says. "There isn't much social life in Nepal. You always desire to see your family and friends again."

As remote as his Nepalese village was, it wasn't too isolated for one of Laprade's WPI classmates to visit him, as Geoffrey Strange did in 1986 during a tour of Asia (for more, see *TheWire*, spring 1987).

As his time in the Himalayas wore on, Laprade says he "dreamed of settling down and getting established [in the United States]. I thought of getting a nice job and making money. Of being comfortable."

Since he has been back, he has thought of working with international organizations or corporations. International development work was also an option, he says, adding that recruiters have told him "the ball is in your court." "The Peace Corps experience," Laprade says, "gives me something above a new graduate."

For all his concerns about becoming obsolete, Laprade says joining the Peace Corps "was the best thing I could do. I got a chance to step away from my culture and put things in perspective."

And, he says he can better appreciate why the United States is a major power. Although he dislikes the hectic pace of corporate America, he can see "that's why we are the country we are" and why the laid-back attitude in countries like Nepal only serves to perpetuate Third World poverty and suffering.

If he could, Laprade says he would combine the best of both worlds—coupling the serenity of the Himalayas with American drive. For now, though, he will be happy just to have a job.

*Amy Zuckerman Overvold is a free-lance writer living in Worcester.*

***Above: Dan Laprade '85 lectures to schoolchildren in the Nepalese village where he lived for two years as a Peace Corps volunteer. Below: villagers untie pipe to be used in the water systems Laprade designed and helped build.***

# EXCELLENCE IS... Merl Norcross,

## Veteran Track and Field and Cross Country Coach

Men's track and field teams coached by Merl Norcross have enjoyed 20 consecutive winning seasons, two of those undefeated.

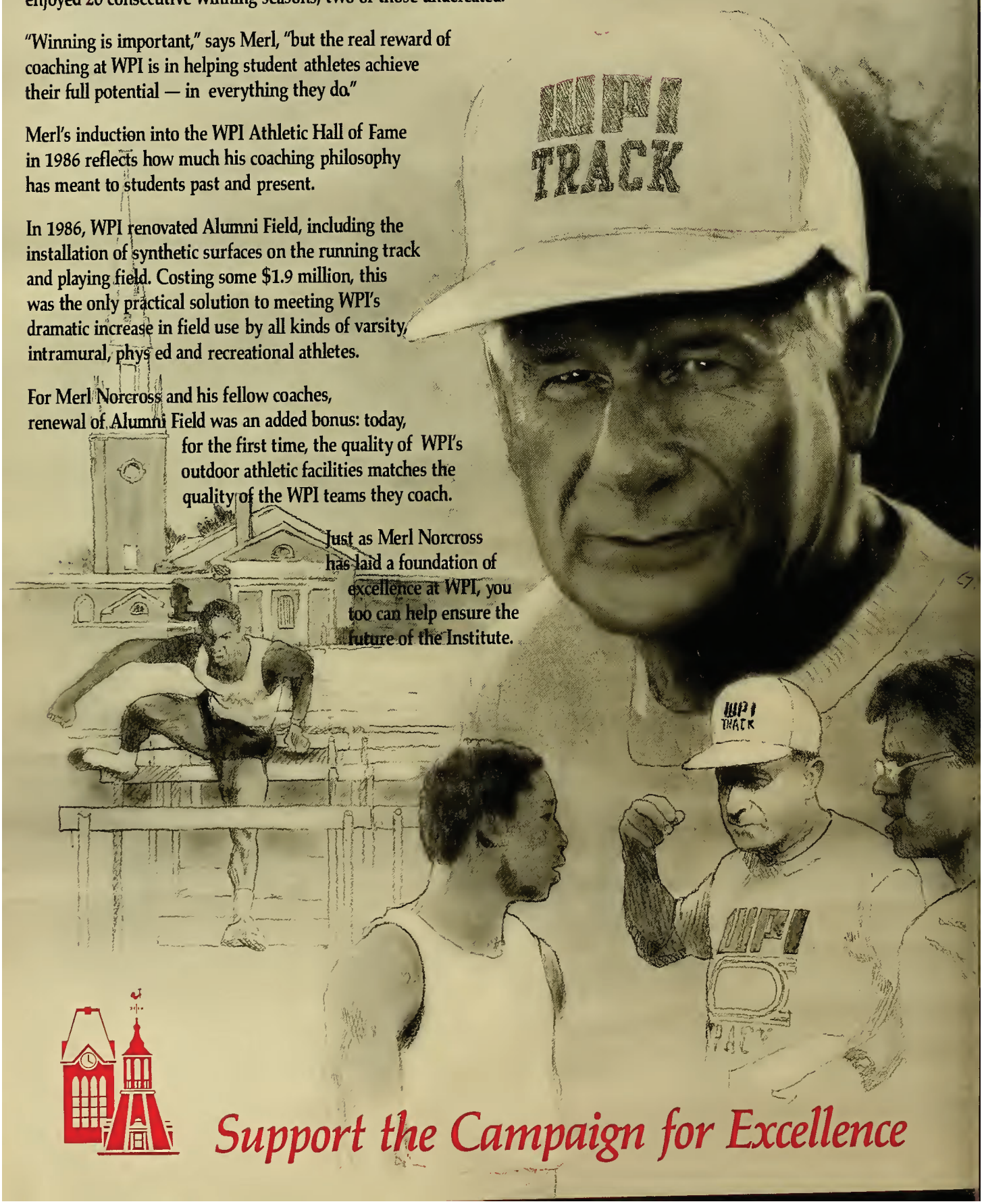
"Winning is important," says Merl, "but the real reward of coaching at WPI is in helping student athletes achieve their full potential — in everything they do."

Merl's induction into the WPI Athletic Hall of Fame in 1986 reflects how much his coaching philosophy has meant to students past and present.

In 1986, WPI renovated Alumni Field, including the installation of synthetic surfaces on the running track and playing field. Costing some $1.9 million, this was the only practical solution to meeting WPI's dramatic increase in field use by all kinds of varsity, intramural, phys ed and recreational athletes.

For Merl Norcross and his fellow coaches, renewal of Alumni Field was an added bonus: today, for the first time, the quality of WPI's outdoor athletic facilities matches the quality of the WPI teams they coach.

Just as Merl Norcross has laid a foundation of excellence at WPI, you too can help ensure the future of the Institute.

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